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BSP's Peoples and Forests Program is designed to: 1) develop participatory methods for applying geomatics technologies for mapping and land-use planning in order to improve community-based natural resource management 2) assist community groups and NGOs to apply these methods more widely 3) clarify and strengthen the legal status of indigenous rights to ancestral lands 4) assess the spatial overlap between indigenous peoples and forests and 5) link these findings to the national policy level through workshops, publication of case studies, and other forms of outreach.

BSP's Peoples and Forests Program **Discussion Papers** are circulated to encourage discussion and comment among interested parties. The findings, interpretations, and conclusions expressed in this paper are entirely those of the author and should not be attributed in any manner to the US Agency for International Development (USAID), the Biodiversity Support Program (BSP), World Wildlife Fund (WWF), World Resources Institute (WRI), or The Nature Conservancy (TNC). BSP does not guarantee the accuracy of the data included in this publication.

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FOREWORD

Indigenous communities and conservation organizations are increasingly turning to mapping and

geomatics technologies for implementing their strategies to strengthen tenurial security over resources and improve natural resource management. The Peoples and Forests Program of the Biodiversity Support Program (BSP) aims to foster communication between groups concerned with these issues and methodologies. To meet this goal, the Peoples and Forests Program publishes the Discussion Paper Series and supports study tours and workshops to bring together community groups, NGOs, government agencies and other interested parties from Indonesia, the Philippines, the Americas and other regions of the world to share their experiences and build informal networks for future communication.

The Peoples and Forests Discussion Paper Series was created to disseminate analyses of issues, methods, and policies related to tenure, community-based natural resources management, and mapping. It is hoped that these analyses will be reproduced and shared widely by all interested parties.

In this paper, Peter Poole summarizes the results of a global search for community-based projects that have used maps for natural resource management and/or land claims. His search was primarily done through personal contacts since most reports on community-based work are distributed very locally and do not appear in most libraries nor standard databases. Because his personal contacts are primarily in Canada and Latin America, more activities in those areas are included in this survey the fact that fewer projects are listed for Africa, Asia, and Australia should not be considered indicative of fewer mapping activities being conducted on those continents.

To encourage information networking, contact numbers have been provided so readers can contact people directly involved with particular projects in order to learn more of their experiences.

We hope this survey proves useful to others who are considering mapping as a strategy and are wondering about the potential pitfalls to avoid, or who are trying to evaluate the technical options. We ask that users of this survey contact us at BSP so that we may add new information about experiences and lessons learned from these or other projects and can update the survey in the future.

To discuss this survey, or to request more information about the Peoples and Forests Program, please contact Janis Alcorn, Director, Peoples and Forests Program, Biodiversity Support Program, j World Wildlife Fund, 1250 24th Street NW, Washington, DC 20037 USA. Tel: 1-202-861-8313, Fax: 1-202-861-8324, Internet: alcorn+r%wwfus@mcimail.com.

SUMMARY

Until recently, advances in mapping technologies (geomatics) have been limited to satellite sensing systems and costly Geographic Information Systems (GIs). But these are now becoming cheaper, more user-friendly and more versatile. It is widely accepted that such technology has extensive potential for environmental monitoring and management. The purpose of this report is to examine the ways in which indigenous communities are using maps and advanced mapping technologies for local purposes and in their transactions with external agencies, and to assess the extent to which these local uses are consistent with the Biodiversity Convention. The underlying question addressed here is: how well can these technologies work in community-based applications and what are the implications for biodiversity conservation?

This report is based upon a desk study of 63 projects worldwide. The projects were selected according to two criteria: 1) they represent a local application of mapping and 2) they are locally initiated or managed. Cases include those using advanced technology and others using Participatory Rural Appraisal (PRA) methods to draw ephemeral maps in the sand. The essential source of information, however, has

remained the same: local knowledge.

People-land ratios varied widely: between 10,000 hectares per person in the Amazon and entire communities with a few hundred hectares in Southeast Asia. In the former, mapping tends to be used as a methodology for managing such large areas in the latter, mapping tends to be used as an instrument for local communication to discuss environmental issues and resolve land conflicts.

Informal maps meet local needs, while technical maps tend to be used in transactions with external agencies. Global Positioning System (GPs) technology is being used to geocode local data in order to bridge the gap between these two kinds of maps. Once local information is geocoded, it can be exchanged with similarly geocoded data in the global environmental data bases and satellite sensing systems which are evolving to address environmental problems worldwide.

Local mapping applications fall into five categories. These correspond to the efforts of indigenous and land-based communities to regain or exercise control of their lands. Generally one application precipitates another in the following sequence:

Recognition of land rights

Demarcation of traditional territories

Protection of demarcated lands

Gathering and guarding traditional knowledge and

Management of traditional lands and resources.

Traditional cartography is being increasingly supplemented by contemporary information science. Local mapping, however, remains a significant and effective instrument, and several projects have been able to achieve their goals without reliance on external technology.

The survey identified five levels of technical activity: 1) sketch maps 2) geocoding with GPs 3) applying imagery from external sources 4) generating own imagery and 5) GIs The first three are more locally sustainable, while the last two generally need continued external support and advice. With proper support and training, off-the-shelf mapping technology can be effective in amplifying local capabilities to manage large areas.

Global Positioning System technology, in the form of cheap, handheld units, has been successfully used to produce maps geocoded to an accuracy of 30-50m. Differential GPs increases accuracy to 3-5m, but at some extra cost. GPs technology offers the best return on training and financial investment. It can be grafted to local knowledge gathering, transforms informal maps into cartographic forms familiar to external agencies, and radically reduces the potential costs of land demarcation.

Satellite imagery has proven useful in some areas, but the ground resolution (10-30m), the cost, and the scarcity of good imagery in cloudy areas have tended to limit its utility for local applications. Stock aerial photography has proven useful in smaller areas, and several projects found that photos at a scale of 1:5,000 are helpful resources for PRA projects. Some groups also expressed an interest in acquiring their own local imagery. Advances in GPs/video coupled with light aircraft promise to make this a sustainable local technology in the near future.

Some groups are using GIs but risk loading themselves with more hardware or software than they need. Most of the local applications encountered in the survey require entry-level mapping packages rather than high-end analytical GIs, which appear more suited to the needs of associations rather than single villages. GIs are useful at two levels: (1) as computer-based mapping programs capable of producing maps from locally acquired geocoded data and (2) as advanced, analytical systems more appropriate for community umbrella or support associations.

The range of activities reported here corresponds closely to the priorities for biogeographical mapping under the Biodiversity Convention. To that extent, they could qualify as implementation of the Biodiversity Convention.

Many groups with interests in mapping expressed a need for information: how to decide which technology to select, how to avoid being misled by vendors, how to make the most of technology they already possess, and how to increase local mapping capacities. The potential benefits of these technologies for locally based conservation of biodiversity would be well served through establishing a program which:

Addresses current priorities in mapping land occupancy and demarcation, with a focus on the use of GPs

Explores the use of aerial GPs/video/photo systems for monitoring boundaries,

mapping biodiversity and recording long-term ecological changes and

Mobilizes new, low-cost computer-based map systems as local databases for long- term environmental monitoring.

In conclusion, the survey revealed a potential for local mapping to reach five objectives:

Conserve and reinforce local/traditional knowledge

Amplify community capacities to manage and protect lands

Raise and mobilize local awareness of environmental issues

Increase local capacities to deal with external agencies and

Enable local and global groups to play reciprocal roles in global programs for biodiversity conservation.

Some groups have expressed concern that the mapping process enables outsiders to control information previously controlled by communities. The process by which traditional knowledge is gathered and applied remains the critical element that determines success, regardless of the degree of sophistication of the mapping technology.

PART I. ANALYSIS

1.0 INTRODUCTION

1.1 Objective

The objective of this report is to document the ways in which indigenous communities are using maps and advanced mapping technologies - both for local purposes and in their transactions with external agencies. Of special interest is the extent to which these local applications are consistent with the goals of the Biodiversity Convention.

The survey included 63 mapping projects carried out by indigenous communities or their associations. They range from ephemeral maps drawn in sand, to the use of advanced computer-based image analysis systems. The projects meet a variety of purposes and applications but, whatever the level of technical sophistication, locally gathered traditional knowledge is conserved as the basic source of information.

For those interested in the potential for biodiversity conservation through community-based mapping, the projects included in this report provide glimpses of the promise of mapping for amplifying the existing capacities of communities to protect and manage the resources upon which they depend.

1.2 Criteria for Survey

> Two criteria were established for selection of projects included in this review:

(1) the project must involve some aspect of mapping, ranging from sketch mapping and aerial imaging to advanced GIs, and

(2) the project must be a community-based initiative or, if introduced by outsiders, must be under local management.

Because of the use of these selection criteria, this report excludes information on the use of mapping technology by anthropologists and geographers for research purposes including mapping and classifying of traditional forms of land use (e.g. Behrens and Severs, 1991). Although useful as indicators of technical potential, such accounts do not reveal how this technology works when mediated through local perceptions of landscape and imperatives on how land should be managed.

1.3 Characteristics of Projects Surveyed

The projects examined vary widely with respect to population and land coverage. In some cases, small and scattered indigenous communities are using mapping to collectively manage quite large territories. In situations with higher population densities and different land-use pressures, mapping is being used as a communications medium for villagers to resolve local land conflicts and to deliberate over planning scenarios.

In the Amazon, for example, 470 Mengraknoti Kayapo\ (proj. 5) have recently demarcated their 4.4 million ha territory, representing almost 10,000 ha per person, and 145 Paran< (proj. 6) are planning the reoccupation of 400,000 ha of their traditional lands, i.e. 2,750 ha per person. In such cases, the value of mapping rests on its potential to amplify the traditional capability of land-based people to care for their lands. Above all, it enables the communities to find out and monitor what other interest groups, often with conflicting agendas, are doing on the lands of the community, and to take action.

This contrasts with the role that mapping has come to play in PRA exercises. The most simple forms, ephemeral sketch maps and aerial photographs, have become elements in a repertoire of techniques for raising awareness and mobilizing local human resources, that is a medium for communication between

villagers and others. This use of mapping reveals differences between classes, gender and age groups. It also becomes part of a process of resolving and accommodating these differences through cooperation.

Communities can orchestrate geomatic technologies to 1) meet their needs to demarcate lands and communicate to external groups and 2) harmonize local interests and motivate them toward cooperation in environmental care.

2.0 PURPOSES OF MAPPING

Informal maps are often intended for local use, while technical maps are usually required for transactions with external agencies. In both cases, however, maps are based upon traditional ecological and cultural knowledge and practice.

The power of maps (which represent packets of environmental data) has been used to good effect by indigenous peoples, as they realize the negotiating potential which is inherent in the deployment of more supportive data when dealing with external agencies. Specific expressions have been coined for this strategy, such as "counter-mapping", i.e. using maps to defend traditional territory, or reclaiming historical places by renaming them in the vernacular language. As Butler (1994) has noted, "formal or written use plans are often developed in response to a perceived external threat."

Another form of external linkage can be achieved by geocoding locally gathered environmental data by means of GPs technology. Once geocoded, such data can then be exchanged or compared with geocoded data stored in environmental databases. This would enable local groups to draw upon global data sets for their own purposes and, at the same time, to contribute local data to the global environmental community. The potential for reciprocal data trade, however, has yet to be realized in a systematic manner.

The projects examined in this review can be classified into six categories of objectives or purposes for mapping. To some extent, the first five categories (Sections 2.1-2.5) described below represent a natural progression. A given land-use situation, and the type of mapping employed in that situation, tends to lead toward the next in the series. This pattern is particularly evident within the Americas, though it is somewhat less notable elsewhere. Throughout this progression, the traditional knowledge that is essential to the first stage is gradually expanded and consolidated through exposure to different applications.

2.1 Gaining Recognition of Land Rights

Indigenous peoples have repeatedly emphasized that they cannot assume responsibilities for their traditional lands until their rights and ownership are recognized and legally defensible. In many cases, the vehicle for negotiating this recognition has been a Land Use and Occupancy Study, a methodology which seems to have been pioneered by the Inuit in Canada in the early 1970s (proj. 20,21) and subsequently employed with many variations throughout the Americas.

Since then, there have been several advances. Dependence upon external expertise has gradually diminished. Wildlife and environmental management regimes, which previously tended to emerge after a settlement had been reached, now are often included in the negotiating package. In British Columbia, where land claim negotiations with First Nations are only now beginning, land use and occupancy data are being integrated in GIs GPs is being used to geocode accounts by elders of traditional practices and culturally significant sites. While land occupancy studies have utilized the entire range of mapping technologies, there is still a need for large-scale high resolution photography for detecting traditional

sites.

2.2 Demarcation of Traditional Territories

Land-claim settlements may confirm boundaries on paper without providing for their demarcation on the ground. This can be a costly proposition and provides a tempting excuse for government agencies to procrastinate. However, GPs promises to be cheaper and faster than conventional surveying methods, and operational skills can readily be acquired. GPs applications will expand once techniques for working under forest canopy have been improved.

Some authorities seem prepared to accept boundaries marked by GPs, but others have insisted on problematic elements, such as installation of boundary markers of specified dimensions. For example, the largest item in the US $600,000 budget for the Mengraknoti demarcation (proj. 5) was the use of helicopters to transport the cement used to make boundary markers.

The Ye'kuana demarcation in Venezuela (proj. 11) represents a very different approach. First, the demarcation will be completed on the ground by teams from the communities. Then, they will make a technical map with the assistance of the Assembly of First Nations (Canada) for presentation to the National Congress.

There is a clear need for a detailed evaluation of demarcation methods and much to be gained by sharing information on planning and execution. For example, it is difficult to compare costs of various methodologies without information on the length of, visibility of and terrain types traversed by boundary lines. Rivers make for fast work, while forested mountains slow the process down. Systematic information on this would permit realistic comparisons between various methods, as well as more reliable estimates of the costs and logistics of individual demarcation projects.

2.3 Protection of Demarcated Lands

Demarcation does not assure protection unless it is supported by some form of subsequent boundary monitoring. The projects reviewed in this report do not include any systematic examples of boundary monitoring. Satellite imagery has been considered for the Amazon, but constraints include expense, low resolution and problems with cloud cover. A group in Sao Paulo is proposing to use an ultralight aircraft for video patrolling (proj. 7). Video cameras coupled to GPs promise an alternative to satellite imagery. This is an area which calls for field exploration.

2.4 Gathering and Guarding Traditional Knowledge

The combination of GPs and of cassette and video recorders has made it possible for local researchers to visit special sites in the company of elders and to generate a geocoded database of traditional knowledge. Some groups, for example the Shuswap Nation Tribal Council (proj. 24), are storing this data in a GIs and protect it with controlled-access software.

2.5 Management of Traditional Lands and Resources

In addition to the straightforward management of forest, fish and wildlife populations, management of traditional lands and resources includes projects to restore degraded lands and to assess and monitor the environmental impacts of industrial development projects.

Tribal resource groups such as the Yakima and Navajo are using GIs as an integrated database for reservations and neighboring lands. The Zuni Nation (proj. 28) uses GIs for the Zuni Conservation Project which aims to restore their lands and traditional agricultural practices. High resolution geocoded aerial photography has an application in monitoring in fine detail progress in forest recuperation in selected sites.

By combining the resources of 23 Cree communities, Manitoba Keewatinowi Okimakanak has developed a GIs database which covers a third of the province of Manitoba (proj. 23). Seasonal patterns of traditional practice and wildlife movements can be readily retrieved. This system has proven effective in responding to proposals for industrial resource development.

2.6 Community Awareness, Mobilization, and Conflict Resolution

Most of the cases described in this report derive from attempts by indigenous peoples to regain control of their traditional territories. However, there is another area of activity, known as Participatory Rural Appraisal (PRA) or Rapid Rural Appraisal (RRA), which also uses maps.

PRA is comprised of a set of methodologies which are used by external groups to stimulate communities to reflect upon their situation, to openly discuss interactions between their environment and local institutions, and to collectively assume responsibility for allocating and managing local lands. In this context, maps are used to animate discussions, to show the disposition of lands between families and clans, and to illustrate the interaction between environmental variables and local land-use decisions.

These maps reveal as much about the peoples' minds and attitudes as about their lands. In Bangladesh, Gupta (1989) has pursued what he calls "reality mapping" by providing pens and paper to villagers and asking them to map the features they felt were important to their survival. The maps varied between women and men, between rich and poor: for example, the poor drew only their neighbors, while the rich drew the whole community.

Ecological mapping based upon farmers' comments illustrates biological interactions as well as the influence of caste and gender upon agricultural decisions. Gupta also found that it illuminated the connections between risk, poverty and environment. Conventional maps are supposed to be and assumed to be objective. These maps, however, are intended to be subjective, expressing the things a person or group feels are essential to them -- they are "message maps."

RRA (a set of methods used for rapid appraisal by external agents) has also revealed how maps and three-dimensional models can be instrumental in addressing local land-use conflicts. In this context, maps can help to level the playing field by exposing an issue for public comment and measurement.

3.0 MAPPING METHODOLOGIES

3.1 The Scope and Local Potential of Geomatics

Geomatics is a new branch of digital information technology for acquiring, analyzing, and manipulating earth images. In recent years, traditional mapping methodologies have been modified by advances in information technologies for the recording, storage, manipulation and analysis of geographical imagery. Three technologies -- remote sensing, global positioning systems, and computer-based image manipulation and analysis -- are steadily becoming cheaper and more user-friendly and, in these respects, are thereby becoming more accessible to remote communities. Geomatic technologies are now being used

locally for applications that were once assumed to be the reserve of research institutions and centralized agencies. One encouraging conclusion suggested by this survey is that the use of advanced technologies does not displace simpler local mapping methods, nor do they seem to distort the essential source of information: the geographical knowledge of local people.

For example, at the local level simple video and digital cameras can mimic the spectral windows used by imaging satellites. GPs positioning now enables local, highly detailed images to be directly compared to satellite images, which cover larger areas but in far less detail. This suggests a dual utility for local mapping and geomatic applications: not only can they serve local needs in biodiversity conservation, but they can also be used to extend, amplify and verify the information gathered by global monitoring systems. There is the potential for mutually beneficial exchange of global and local environmental data.

At the local level, geomatic technology has the potential to amplify the capability of groups with limited resources to map and monitor large areas of land. If the pattern set by negotiations between indigenous peoples and governments continues, as many as 210 million ha in the Amazon will revert to indigenous control, one third of the total area. Altogether, as much as 13% of the Americas could revert to some form of indigenous control, almost double the area committed to protected areas. However, indigenous communities face formidable resource constraints in attempting to protect parks and reserves. The emerging local applications of geomatic technologies convey useful messages to the global conservation community -- how to do much with little.

3.2 Basic Mapping: PRA, Sketch Maps, and Cartography

The survey revealed three levels of basic mapping methodologies: 1) Participatory Rural Appraisal (PRA) 2) sketch mapping of local land use and occupancy and 3) topographic maps for external purposes.

Maps produced for PRA are intended as communication tools for use while the appraisal is in progress. They tend to be ephemeral, ranging from outlines in the sand to the use of colored materials to make maps on the ground. Their simplicity and flexibility make them ideal vehicles for discourse within and between local groups (proj. 2,7).

Methods for sketch-mapping the areas of traditional practices and knowledge commence with conversations between technicians and practitioners, including the elders, and the women and men active in medicine, gardening, hunting, fishing and gathering. Several projects in Central America (proj. 13,14,15,16) have evolved a methodology whereby local residents are trained as surveyors, responsible for gathering and mapping this information. In Canada, the Dene Cultural Institute has produced a guide for such field workers from its experience in the Dene environmental and medicine projects.

The method refined in Central America takes this information a step further by cartographically combining sketch maps with existing topographic maps in order to produce technical maps acceptable for transactions with external agencies. This has led to recognition of the maps as evidence that the land is being used. In turn, this enhances claims to ownership by local communities.

In Southeast Asia, the Endangered Peoples Project (proj. 36) has been conducting workshops to train communities and their associations in basic compass and chain methods to draw accurate local maps onto existing topographic maps. The area of such maps tends to be limited to villages and those surrounding lands which are subject to continual use.

3.3 Geocoding with the Global Positioning System (GPs)

Geocoding, or georeferencing, is the identification of any bit of information by its geographic coordinates. A GPs unit can geocode any bit of data whether the user is stationary or mobile. These GPs-generated data points can then be entered into a computerized mapping software or a GIs to produce maps.

The Global Positioning System is based on a network of 24 satellites originally designed to facilitate navigation by US Naval submarines. By receiving signals from three different satellites, the GPs receiver computes its triangulated position and displays it in the form of standard longitude and latitude coordinates. Reception of signals from four satellites permits a three-dimensional fix. GPs units can also be used to navigate between a set of waypoints entered by coordinates. GPs receivers are ostensibly accurate to about 30m. The military operators of the system, however, often scramble the signal and thereby limit civilian units to an accuracy of 100m. Civilian users can circumvent the problem of access to the higher-accuracy signals by choosing to employ a differential GPs

Differential GPs, a technique to improve the accuracy of GPs, requires two units: a base unit left at a site with verified coordinates, plus a mobile unit which is taken into the field. While the mobile unit is in use, the base unit monitors noise and signal variations in the GPs network. Special software is later used to correct the mobile unit's positional record. As a result, accuracies of 2m-3m can be achieved at a moderate additional cost, while precision of several centimeters can be achieved at far greater expense.

Reliable GPs units can be obtained for as little as $400, while systems for differential GPs can cost $10,000-$20,000. Alternatives for achieving differential GPs accuracies are being devised, and costs will likely decrease in the near future.

GPs can be coupled with photo and video cameras so that the coordinates are automatically recorded and retrievable on the imagery. This is a luxury for most ground work, but useful in the air. One new instrument combines a GPs with a notebook computer. In an on-screen, digitized aerial image, the user is shown as a moving point of light.

It should be noted that field operational problems and limitations to this approach persist. Forest canopies interfere with reception, thus a method is needed for raising the GPs antenna above the canopy. Also, battery life is brief at only 4-6 hours, or approximately one hour per AA cell.

3.4 Satellite Remote Sensing

Digital scanners on board orbiting satellites produce imagery which varies according to spatial coverage and resolution. The US Landsat system produces images in four spectral bands which cover 160km x 160km at a ground resolution of 80m. The French SPOT images produce scenes covering 36km x 36km. SPOT ground resolutions are 20m for multispectral (color) and 10m for panchromatic images. A Russian system uses conventional (optical) cameras on the satellite in lieu of digital sensors. The resulting images cannot be retrieved in real time, but are of higher resolution, apparently to 2-5m this imagery is now sporadically available. The Canadian Radarsat was scheduled to be launched in 1994 and promises imagery with resolutions in the 20-30m range. Although radar imagery is low in resolution and spectral information, it can penetrate cloud cover, an advantage over current satellite systems for example, in the Colombian Pacific forest, it has been virtually impossible until now to obtain satellite images free of cloud cover.

Satellite imagery has proven useful in areas where maps are non-existent or inaccurate. In Brazil, this

imagery has been accepted in law as evidence of illegal logging and settlement activity in indigenous lands. Images cost from $2,500-$5,500 each, although year-old imagery may be cheaper. For the Yuqui demarcation (proj. 2), SPOT images were obtained at an educational discount for $1,000 each.

3.5 Aerial Imaging

Aerial imaging usually refers to images taken from airplanes, although kites, balloons and dirigibles have all been used for the same purpose. For local mapping, four imagers have potential: photo, video, digital and radar (which is similar to satellite radar). Conventional aerial photography, which uses 230mm x 230mm stereoscopic mapping cameras, is very accurate although quite expensive. It is generally thought to be justifiable only when large areas are to be covered for topographic mapping.

Stock panchromatic aerial survey photography, 230mm x 230mm, has proven useful in local PRA exercises. This imagery usually has a scale between 1:20,000 and 1:60,000. This scale is adequate for mapping and terrain interpretation, but is considered to be too small for useful local discussions. Several studies have independently concluded that a scale of 1:5,000 is optimum as a stimulus for local discussions. At that scale villagers are able to easily recognize significant landscape features.

Over the last ten years or so, researchers have experimented with small camera formats, such as 70mm and 35mm, in some cases using four cameras, each filtered to gather data in a specific spectral band. This approach has potential for such applications as crop and forest disease detection, land-use sampling, urban and settlement studies, and wildlife census. The advantages of small format photography are low system cost, simple operation and processing, and a wide range of film and lens types. The one disadvantage is the limited ground area covered in each image in comparison with standard mapping cameras. Small format imagery is suitable for obtaining selective data to upgrade existing maps, but not for topographic mapping itself.

Aerial video is attracting interest for a similar range of local and specific applications. This method's advantage over photo surveying is that videotape is cheaper than film and carries no processing costs. The disadvantage is lower resolution. Video can obtain either a moving image, or, with special instruments, a video-still image can be frame-grabbed for individual attention. Some users have then digitized such stills for computer-based analysis. Some reports suggest that digital video is being used for aerial imaging. Usually, this is not strictly the case. Video images may be captured digitally, but then stored and displayed in analog form. In such cases, frame-grabbed images are then re-digitized, thereby losing resolution in the process. Moving video has been used for locating point sources of pollution and for coastal studies in fact, it can be used for many small-format photo applications which tolerate low resolution.

Direct digital aerial imagery can be obtained using one of the new digital frame cameras. These are still cameras, which resemble standard photo cameras, but use an array of digital receptors instead of film. At present, data storage capacities limit the utility of digital cameras in light aircraft. For example, one off-the-shelf system requires 1.3 megabytes of storage per image. However, once this problem is solved, this technology should be competitive with the video/frame-grabber combination.

When coupled with GPs, photo/video combinations in light aircraft have great promise for a wide range of mapping and monitoring missions. For monitoring environmental change, in combination with differential GPs navigation, flight lines or selected photo sample plots can be replicated to an accuracy of less than 5m. Where traditional lands are recognized on paper, but not demarcated on the ground, their margins can easily be monitored with GPs/video to produce image transects.

3.6 Computer-Based Image Analysis

The study found wide interest in GIs, but only a few groups have so far used this technology to its fullest extent. There are accounts of technological overkill vendors at a recent GIs conference in Vancouver estimated that 80% of the systems obtained by First Nations groups are not being properly utilized. Various reasons were cited for this -- lack of follow-up service, lack of initial training, and hidden and incremental costs. Many of the First Nations groups who are successfully applying the more sophisticated GIs have had to accept the cost of hiring full-time operators. Evidently, there are often mismatches between GIs capabilities and local capacities.

There is also evidence of a mismatch between GIs techniques and local applications. Some users do not need to compare and analyze a series of layered data sets, but require only accurate maps, or the capacity to enter incremental or sequential data onto existing maps. Computer-based mapping systems are available for such applications which do not incur the expense or require the operational skills that high-end GIs packages do.

4.0 MATCHING TECHNOLOGY, APPLICATIONS AND LOCAL CAPACITIES

The matrix in Figure 1 below illustrates some general linkages between the type of technology and the situation in which mapping is needed.

4.1 Levels of Technical Activity

In Section 2, a progression from initial occupancy studies to integrated long-term management was suggested. To a degree, this corresponds to the technical progression summarized in the five following categories of technical activity (Sections 4.2 - 4.6). These categories describe five phases with increasing levels of skill, technology and cost. The first three, which are relatively low-cost, appear to be within the current capacities of some individual communities, and require minimal training. The last two are more suitable either for associations of communities, or for groups faced with the task of managing large areas. They require greater investment in training and technology, and long-term access to technical support and service.

4.2 Gathering Local Knowledge for Sketch Maps or Cartographically Produced Maps

Local information-gathering is the essential first step for all levels, and in some cases is sufficient for immediate goals. The Ye'kuana communities (proj. 11) are demarcating their territories on this basis alone, and the ephemeral maps used in Participatory Rural Appraisal (PRA) have proven adequate for such local discussions. These maps may be transferred onto existing topographical maps. Several projects have refined methodologies for gathering and recording such information in a community context. The sequence of projects in Central America (proj. 13-16) can serve as a model in this regard. The external inputs required include introductory training and minimal materials. This combination of sketch maps and cartographically produced maps has the highest potential for local sustainability.

4.3 Geocoding with Global Positioning Systems (GPs)

In transactions with external agencies, local information has proved to be more effective when presented in a familiar cartographic form. After the initial stage of gathering local information on sketch maps is completed, GPs, topographic maps, and traditional land-survey technology (separately or combined) have

been used to make this transformation. GPs is showing considerable promise for demarcation when accuracies of 25-50m are acceptable. Also, GPs can be introduced at the local level fairly easily. Where accuracies of 2-3m are needed, differential GPs requires increased levels of skill and cost, but these are still low in terms of ultimate results. External inputs required include training and an investment of $1000-$20,000. Geocoding with GPs has high potential for local sustainability. External contacts are needed for GPs maintenance and repair.

4.4 Using External Image Sources

In this case imagery (aerial photos, satellite imagery) is used directly as a map. Aerial photography, particularly at a scale of 1:5,000, has proven useful in stimulating local discussion of land issues. Satellite images have been used for detecting habitat change but low resolution permits only very general distinctions. However, this resolution will reveal certain kinds of incursions across boundaries and some countries will accept satellite imagery in court. Although suitable for community-based applications, the cost of single images can be prohibitive for single communities. External inputs required include training, basic analysis and mapping equipment, and images costing $1,000 each or more. There is a high potential for local sustainability although it is dependent on external inputs. External contacts are needed for continual access to imagery.

4.5 Generation of Remote Imagery

Creating remote imagery can be done in two ways. Aircraft may be commissioned to obtain video or photo imagery, or local capacities to do so can be developed. The study identified only one case in which a group has generated its own capacity to acquire aerial data. Makivik Corp. (proj. 21) has operated a 70mm camera system in an Inuit-owned aircraft, though others are now considering the same approach. In Brazil, the Kayapo\ (proj. 5) obtained an aircraft for reconnaissance and were recently considering modifying it for aerial imaging. A group at Sao Paulo University may acquire an ultralight aircraft for patrolling the boundaries of indigenous lands (proj. 7). In Canada, First Nations Aviation is modifying aircraft to provide services to indigenous resource groups. External inputs required include training and an investment of $5,000-$150,000. Local generation of imagery is likely to be regionally rather than locally sustainable -- with one unit serving scattered communities unless very large areas are involved. External contacts are needed for technical back-up and upgrades.

4.6 Geographic Information Systems (GIs)

Available GIs systems range from relatively cheap and simple methods for image manipulation and map production to powerful analytical technologies. This study suggests that advanced GIs has settled into two niches. One niche is its use by associations rather than individual communities, e.g., Makivik Corp. in Quebec (proj. 21), MKO in Manitoba (proj. 23), and COICA in the Amazon (proj. 12), with the objective of supporting long-term environmental management on a regional basis. The other niche is one in which First Nations in the US has applied GIs in integrating layers of social, economic and environmental variables for long-term environmental management on reservations, as well as for transactions with numerous external agencies. At the simpler end of the GIs spectrum, emerging low-cost systems have potential for recording and mapping evidence of traditional land use, for occupancy mapping and for demarcation. Some of these applications are compatible with basic computer systems and software. External inputs required include training and an equipment investment of $5,000-$50,000. GIs is more likely to be regionally rather than locally sustainable, with a central unit serving scattered communities. External contacts are needed for technical support and upgrades.

5.0 CONCLUSIONS: COMMUNITIES, MAPPING, AND THE BIODIVERSITY CONVENTION

5.1 Anticipating Agenda Differences: Whose Maps? And for What Purposes?

Before presenting my recommendations, a few comments are provided on the political variables affecting biodiversity conservation when communities and indigenous peoples are involved.

The territories over which indigenous peoples are regaining various levels of control are often, in the Americas at least, extensive and of critical importance for biodiversity conservation. This brief inquiry has located a number of cases in which communities and their associations have declared their intention to recover, restore, and protect their lands and perpetuate their traditions of sustainable resource use. With slender resources, they are making impressive gains in these directions. Mapping and geomatics have contributed to this effort, and there is potential for expanding this role.

Agenda 21 and the Biodiversity Convention contain numerous statements recognizing the intrinsic value of traditional indigenous knowledge and practice, and assign special roles for land-based communities in biodiversity conservation. However, while urging that signatory governments consult with and involve indigenous peoples, both documents skirt the sensitive but unavoidable issue that has emerged from this survey: that the recognition of land rights is an essential precondition for indigenous peoples to assume such roles which are contingent upon secure tenure and access to resources. While understandable, given the political horse-trading that led up to the Biodiversity Convention, this omission has led some conservation organizations to assume readiness on the part of indigenous peoples to collaborate on biodiversity conservation. Where land rights have not been recognized, this assumption is dangerous and may precipitate unexpected tensions.

The recognition of indigenous territorial rights marks a threshold. After crossing beyond the threshold, communities and their associations can focus their energies upon protecting their lands and devising ways to perpetuate their traditions of sustainable resource use. At this point, indigenous peoples' objectives may come to resemble those of the Biodiversity Convention. In addition, there are other latent potentials for agenda conflict. Those indigenous groups which have endorsed the Convention have done so only with clear reservations about its position on the ownership and use, or abuse, of traditional knowledge for commercial or political gain.

Several of the surveyed projects reported tensions with external support groups over the ownership of maps created by the project. Others requested us not to jeopardize their mapping projects by reporting their existence. If even the compilation of this survey itself is to be compromised by such political sensitivities, then any recommendations on programs to support mapping must be tempered by similar cautions. The object of this survey is not to dissect this issue, but to bring it to attention as something that should be taken into account and dealt with clearly and openly, before commencing any program to generate local capacities in mapping and geomatics.

5.2 Implementation of the Biodiversity Convention

Scientific advisory groups are now discussing structures and methodologies for implementing the Biodiversity Convention. Their conclusions provide a guide for evaluating the results of this survey. The recent Open-Ended Intergovernmental Meeting of Scientific Experts on Biological Diversity (UNEP 1994) was charged with the "identification of innovative, efficient and state-of-the-art technologies (on)

the conservation and sustainable use of biological diversity.@ Six technologies were identified as "biogeographical mapping technologies@:

Habitat, vegetation and gene-variation mapping

Regional mapping technologies

Remote sensing for spatial heterogeneity and complexity

Geographic information systems

Aerial survey, patrol and photography and

Traditional knowledge of territories and habitats.

With the exception of gene-variation mapping, these technologies are utilized in various ways in the projects described in this survey. To that extent they could qualify as virtual implementation of the Biodiversity Convention. They also serve as valuable indicators of the kinds of biodiversity mapping and monitoring that can be accomplished when these technologies are applied in a community context.

The following section outlines a four-stage program which capitalizes upon the advances and innovations made by indigenous groups in community-based mapping. The program aims to further support such initiatives and to simultaneously establish a framework for implementing the numerous recommendations of the Biodiversity Convention and Agenda 21 for involving indigenous peoples and land-based communities.

5.3 Recommendations for a Program in Community-Based Mapping for Implementing the Biodiversity Convention and Agenda 21

This study has identified a wide spectrum of motivation and interest in community-based mapping. But current activity levels, for example in self-demarcation, are well below their potential. This is an information-intensive rather than capital-intensive activity, and the focus should be upon technical guidance and assistance.

The **objective** of the program would be to provide technical support for indigenous and land-based communities, associations and support NGOs to maximize the potential for localizing geomatic technologies for community-based biodiversity conservation. The program would be based on the principles that:

Local capacity-building should be the main focus,

Local capabilities already established should serve as a starting point for the program,

Focus should be limited to information and assistance,

Development of the program should be applications-driven, not technology-driven,

Applications and technology should match local capacities.

Program implementation would begin with **database development**, expanding the directory appended to this report and dividing the groups contained in it into four key categories:

Practitioners: Communities, their associations, and other local environmental management groups

Support groups: Local/national support groups and international NGOs interested in mobilizing support

Technical support: Institutions, experts, technology training programs and dedicated support programs and

Programs/Donors: Non-dedicated global programs which may offer support for local geomatic projects.

The second stage of implementation would include preparation of four **resource documents**:

A guide to current methods of demarcation, monitoring, and protection, including estimation of effort and costs for local demarcation projects

A Global Positioning System field guide on choosing access equipment and seeking advice, covering single unit and differential GPs

A guide to the acquisition of satellite and aerial imagery, and low cost methods of analysis, covering both stock imagery and methods for direct local imaging and

An introduction to Geographic Information Systems and guide to GIs software from low-cost mapping to advanced analytical systems.

The third stage would consist of a **workshop**, bringing together experienced practitioners and support groups to review drafts of the manuals and to decide upon a structure for the program.

The final stage of implementation would consist of **pilot and demonstration projects** and **local capacity-building** the specific content would be determined by the results of preparatory research and the workshop.

PART II. SURVEY: PROJECT DESCRIPTIONS

Projects have been presented under the region in which they were implemented. Under each entry, first find the country, then the first half of the title refers to the project name, and finally, following a slash (/), find the technology or application type. For example under Asia, number 37 is "Indonesia: Kayan Mentarang Reserve / GPs". The project title is "Kayan Mentarang Reserve" and the technology used is GPs

The information about donors and implementor organizations may be incomplete due to the difficulty of getting complete information. Over time, situations may have changed. Please contact the institution or individual listed under **Contact** for more complete and up-to-date information.

SOUTH AMERICA

Argentina: Wichi Land Occupancy / Basic Mapping

PROJECT STATUS:Completed.

LOCAL ORG: Asociacion\n Francisco Perez.

NATIONAL ORG:--

EXTERNAL ORG: Survival International.

DONOR AGENCY:--

CONTACT: John Palmer, Survival International, 6 Walton Manor Court, Oxford, England, OX1 6EL, UK. Tel: 44-865-52650.

REFERENCES:--

OBJECTIVE: Land occupancy mapping to obtain communal land title.

BACKGROUND: About 5,000 Wichi live in 35 villages in 240,000 ha of land which has deteriorated due to pasture development by about 1,000 colonists. In 1987, the provincial government invited Wichi and the colonists to "regularize" land occupancy under a provision that 20 years residence would qualify applicants to obtain title.

METHOD: A legal entity, Asociacion Francisco Perez, was created to apply for communal title to an undivided area. A team of local people and Survival International staff visited the Wichi communities and produced hand-drawn maps of their traditional lands, which also included over 1,000 Wichi place names. This was plotted on a military topographic map and cartographers produced a composite map at a scale of 1:75,000 and submitted to the government in 1991. Colonists have also applied for title to individual plots, a combined total of 500,000 ha, much of which overlaps with the Wichi claimed area.

RESULT: The Wichi map and application for title was then lost by the provincial government, which then changed. The incoming government set up a commission to evaluate the application within 90 days. This is now more than two years overdue.

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2. Bolivia: Yuqui Self-Demarcation / Aerial Imagery, GIs

PROJECT STATUS: Completed.

LOCAL ORG: Yuqui Consejo.

NATIONAL ORG:--

EXTERNAL ORG: University of Central Florida, Department of Anthropology, University of Florida Geoplan Center (Keith A. Jarvis).

DONOR AGENCY: --

CONTACT: Allyn MacLean Stearman, University of Central Florida, Department of Sociology and Anthropology, 4000 Central Florida Boulevard, P.O. Box 25000, Orlando, FL 32816-1360, USA. Tel: 407-823-2227 Fax: 407-823-5156.

REFERENCES: Jarvis 1993, Jarvis and Stearman 1995.

OBJECTIVE: To demarcate Yuqui territory and produce a geocoded map as a basis for further activities.

BACKGROUND: Yuqui land covers 115,000 ha in the Amazon basin, a lowland complex of meandering rivers, swamps, lakes and rainforest. The Bolivian Government had recognized Yuqui ownership of their territory on paper, but this had yet to be demarcated on the land. The process described here is the first of three phases of the Yuqui Ethnodevelopment Project. The next phases envisioned are: 1) monitoring and protecting the demarcated land, and 2) compiling a resource inventory.

METHODOLOGY: To introduce the project to the Yuqui, the confirmed boundaries were marked on a composite map formed from nine 1:50,000 hydrographic/topographic field maps derived by government agencies from 17 year-old aerial photographs. An aerial reconnaissance used a basic GPS unit to obtain rough fixes for key boundary points. Surface demarcation work combined river and land-based boundaries. The river party located basepoints and cleared a space around the largest trees. The trunks of these basepoint trees were painted with oil-based white paint and marked with survey tape and the name of the Yuqui Territory, azimuth, date and coordinates. Land-based boundaries proceeded from basepoints, using a survey compass to open up lines of sight for visual contact.

RESULT: The Yuqui project mobilized the entire spectrum of geomatic technology: satellite remote sensing, cartography, aerial photography, GPS and GIS. These laid a technical foundation for confirming tenure, future monitoring and protection and resource inventory and sustainable utilization. Its future utility will be dependent upon maintaining this technical support for the Yuqui Consejo. This project is worth monitoring to witness how the connection evolves. In the course of the project, the field crew collected data that was used to correct obsolete maps, particularly changes in watercourses.

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3. Brazil: Acre Community Agroforestry / GIS

PROJECT STATUS: Current.

LOCAL ORG: Pesquisa e Extensno em Sistemas Agroflorestais do Acre (PESACRE).

NATIONAL ORG: --

EXTERNAL ORG: University of Florida, Gainesville.

DONOR AGENCY: USAID.

CONTACT: Marianne Schmink, Center for Latin American Studies, University of Florida, Gainesville, FL, USA. Tel: 904-392-0375 Fax: 904-392-7682.

PESACRE, C.P. 277, 69.000 Rio Branco, Acre, Brazil. Tel/Fax: 55-68-2263017.

REFERENCES: Schmink 1994.

OBJECTIVE: To develop community-scale GIS and test its utility in land use planning.

BACKGROUND: For eight years, the University of Florida has engaged in cooperative programs of agroforestry research training and extension in the state of Acre, and since 1990 with PESACRE, a local NGO which has established a strong competence in these areas. The collaborating groups now propose a further stage -- an agroforestry field program focusing on three groups which represent a cross-section of small producers: rubber tappers, indigenous communities and agricultural colonists.

METHOD: GIS has been assigned a role as one element in a complex program. The stated objective is to be able to use this technology for land use planning at the community level. In 1994, two PESACRE researchers will receive GIS training at the University of Florida. Locally, PESACRE has begun to collect baseline data for this. The University has also received a request for GPS equipment.

RESULT: The geomatic elements of this long-term program are still in the exploratory stage. It will be interesting to see to what extent GIS skills and technology will be put to continual use at the level of individual communities, as opposed to the PESACRE coordinating level.

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4. Brazil: Jau National Park / Basic Mapping

PROJECT STATUS: Planned.

LOCAL ORG:--

NATIONAL ORG: IBAMA (Environmental Agency).

EXTERNAL ORG: World Wildlife Fund (WWF).

DONOR AGENCY:--

CONTACT: Carlos Miller, Director FVA, Manaus, Brazil. Tel: 55-92-642-1336 Fax: 55-92-236-3257.

John Butler, Fundo Mundial para a Natureza (WWF-Brazil), SHIS EQ 6/8-Conjuncto E 2^{o} andar, 71620-430 Brasilia, DF, Brazil. Tel: 061-248-2899 Fax: 061-248-7176.

REFERENCES: Butler 1994.

OBJECTIVE: To map critical resources and patterns of use.

BACKGROUND: A map of the resources used by the 1,000 residents of Jau National Park is proposed as part of a community-use plan for the park, which covers 2,272,000 ha of the watershed of the Rio Negro. Mapping and planning is modelled upon two other kinds of informal or formal inter-community agreements that have emerged in the Brazilian Amazon. One is the fishing agreements, which have evolved among fishing communities using common waters to protect their interests against commercial fisheries. The other is the Extractive Reserve Use Plan, required by the environmental agency IBAMA before recognizing use titles by the members of the Association of Residents for an Extractive Reserve. One such plan has been prepared for the Alto Jurua Extractive Reserve, but has yet to be approved by IBAMA. Categories in the Alto Jurua plan include the definition of common areas.

METHOD: IBAMA is now requesting associations or residents to compile Extractive Reserve Development Plans, which require maps of resource distribution and patterns of use. The Jau Park project will build upon this inter-community experience and aim for this kind of resource map as an integral element of the overall management plan for the park. They will map the distribution of the resources critical for survival, local tenure systems, location of species felt to be in decline, and the coverage of informal agreements that may already exist.

RESULT: To commence in late 1994.

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5. Brazil: Menkragnoti Kayapo Demarcation / GPS

PROJECT STATUS: Completed.

LOCAL ORG:--

NATIONAL ORG: FundaHno Mata Virgem (FMV).

EXTERNAL ORG: Rainforest Foundation International (RFI).

DONOR AGENCIES: Unspecified, from RFI and from sources in Norway, the U.S., the U.K., Italy, and Japan.

CONTACT: Larry Cox, RFI, 270 Lafayette Street, New York, NY 10012, USA. Tel: 212-431-9098 Fax: 212-431-9197.

REFERENCES: RFI 1992, Geonex 1992.

OBJECTIVE: To demarcate Mekragnoti territory.

BACKGROUND: RFI (1992) details the conventions for demarcation in Brazil, which is usually performed by private firms, often owned by military or ex-military persons. The most reliable contractor is the army itself, but it is also the most costly. The Yanomami demarcation cost US $3 million (ibid). 470 Menkragnoti Kayapo live in three villages within an area of 4.4 million ha. RFI raised US $600,000 toward the project, which was executed in cooperation with the Menkragnoti people and

FMV, an affiliate which RFI helped to establish in Brasilia.

METHOD: Technical details on demarcation are drawn from a proposal to FMV by Geonex (1992). This is in a discursive and abbreviated form and does not provide a complete picture of the method. The technique appears to have combined traditional geodesic methods with the use of GPS receivers. Twenty-six clearings, 80m x 80m, were opened up in the forest to enable GPS readings to be made and helicopters to land. The clearings will be planted with species of trees and shrubs that should be visible on satellite imagery. Watercourses delineate 950 km of the 1,050 km border. The remaining 100 km, called "dry lines", were demarcated using theodolite survey equipment, and were cut along a 4m-wide swathe. Concrete markers were installed every 2 km. It is not clear from the proposal whether the 26 clearings were placed along all boundaries or only along dry lines. The watercourses would provide openings large enough to receive GPS signals.

RESULT: The demarcation was successfully completed. The Menkragnoti are now moving on to a Post Demarcation Integration Program and are working with RFI, FMV and a group of experts to find ways to protect their demarcated land and to examine sustainable alternatives to industrial resource exploitation.

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6. Brazil: Paran< Land Titling / Satellite Imagery

PROJECT STATUS: Proposed.

LOCAL ORG: --

NATIONAL ORG: Fundacao Mata Virgem (FMV), Nucleus for Indigenous Rights (NDI), Centro ecumencio de documenta cao e informacao (CEDI).

EXTERNAL ORG: Environmental Defense Fund (EDF).

DONOR AGENCY:--

CONTACT: Steve Schwartzman, EDF, 1875 Connecticut Avenue, NW, Suite 1016, Washington, DC 20009, USA. Tel: 202-387-3500 Fax: 202-234-6049.

REFERENCES: EDF 1994.

OBJECTIVE: To reoccupy traditional territories from which they were evicted 20 years ago.

BACKGROUND: The Cuiaba-Santarem Highway penetrated Paran< lands in 1968, leading in 1973 to the first formal contact with the state of Brazil. By 1975, 80-90% of the Paran< had died from diseases associated with the incursion of the highway. In 1975, the 69 survivors were moved 400 km away to Xingu National Park. The Paran< have survived in this unfamiliar habitat and their numbers have increased to 145. Yet they have not abandoned the prospect of returning to their land. The area is contiguous with the now demarcated Menkragnoti Kayapo land, itself vulnerable to predatory resource exploitation, where several local communities have made contracts with logging and mining interests. The

land the Paran< intend to reoccupy is itself threatened by an illegal parcelling project of a group of local ranchers.

METHOD: The Paran have formulated a strategy for occupying, demarcating, and defending their lands from incursions, and for creating a regime for the sustainable use of their resources which could serve as a model for alternative practices within the region. With support from Brazilian and external NGOs, six Paran leaders visited their lands in 1991. They found that a large part has been degraded by logging, mining and ranching, but also that a large tract of 400,000 ha remains intact.

RESULT: The support groups have enabled the Paran to bring two suits against the government: one for indemnification, the other for legal recognition of their title. Overflights of their lands, combined with interpretation of satellite imagery, are thought to have abbreviated the time needed for preparation of these lawsuits by at least a year.

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7. Brazil: Xikrin Kayapo Forest Management and Land-Use Planning / GPS

PROJECT STATUS: Current.

LOCAL ORG: --

NATIONAL ORG: Centro ecumencio de documenta cao e informacao (CEDI) .

EXTERNAL ORG: Rainforest Foundation International.

DONOR AGENCY: Fundo Nacional do Meio Ambiente (Brazil), Companhia Vale do Rio Doce (Brazil).

CONTACT: Virgilio Viana, Departamento de CiLncia Florestais - ESALQ, Universidade de Sno Paulo, Piracicaba, SP 13400, Brazil, Tel: 55-194-334124 Fax: 55-194-336081.

REFERENCES: --

OBJECTIVE: To undertake mapping, inventory and selective resource utilization.

BACKGROUND: Xikrin are one of 13 Kayapo groups in the Brazilian Amazon. About 300 people occupy a demarcated reserve of 600,000 ha. Before this project commenced the Xikrin were assisted by a Brazilian NGO, Nucleus for Indigenous Rights, in a landmark conflict with loggers, which led to expulsion of the loggers. In seeking alternatives to industrial resource exploitation, the Xikrin called for support from the local mining company involved in the Grand Carajas project which, as a condition for proceeding with the project, is obliged to provide support to indigenous peoples in protecting their lands.

METHOD: An interdisciplinary team, based at the University of Sno Paulo, and with professional competence in forestry, biology and anthropology has collaborated with the Xikrin community on the first phase of the project, which included a number of joint surveys: satellite mapping, forest and land surveys with GPS, anthropological studies and economic analyses. As a result the reserve has been divided into a 550,000 ha area, to be reserved for traditional forms of use, and a 50,000 ha area, considered to have

good potential for selective timber extraction and gathering of palm hearts and brazil nuts. A conservative estimate for the annual net income from timber is $150,000. However, the Xikrin elected to commence with brazil nut collection, with which they are familiar, and then to gradually phase in timber production.

RESULT: The next step is an education program in forest management and silviculture. The Xikrin are also considering leasing a concession to reforest the part of the reserve which has been degraded by logging. They also plan to conduct more intensive inventories of other parts of the reserve, and develop methods for monitoring and protection, possibly including the use of an ultralight aircraft.

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8. Paraguay: Ache Mbaracuyo Reserve / GPS

PROJECT STATUS: About to start.

LOCAL ORG: Two Ache communities.

NATIONAL ORG: Fundacion Moises Bertoni.

EXTERNAL ORG: The Nature Conservancy.

DONOR AGENCY: The Nature Conservancy, Native Peoples and Tropical Conservation Fund, University of New Mexico.

CONTACT: Kim Hill, University of New Mexico, Albuquerque, NM 87131 USA. Tel: 505-277-6182 Fax: 505-277-0874.

REFERENCES:--

OBJECTIVE: To inventory resources, to assess effects of Ache resource use, and to develop ways to indefinitely monitor and protect the area.

BACKGROUND: For almost ten years the Ache have been trying to regain their lands, abandoned by a bankrupt logging company, to form an Ache Wildlands Area. The Nature Conservancy joined the process, bought 60,000 ha and donated it to a Paraguayan NGO, the Fundaci\n Moises Bertoni, with the understanding that they will manage the land as the Mbaracayo Reserve. There are two Ache communities, one within the Reserve and a larger one about 15 km away. Altogether 420 Ache retain rights to continue use of the resources in the reserve. Apart from a few tourist parties and non-Ache poachers, they are the most active group in the Reserve. Ten part-time Ache guards have been assigned the task of protecting 100,000 ha.

METHOD: With assistance for the University of New Mexico, the Ache plan to spend the next five years making an inventory of the resources in the area and recording evidence of the impacts of their resource use. The proposed method is to use GPS to make records along 15,000 km of random transects across an area of 100,000 ha coupled with focused surveys in the two most heavily used areas. For planning purposes, Landsat Thematic Mapping imagery has been used, at a scale of 1:100,000. This is too small a scale to record features that are significant to the Ache. Likewise the typical GPS resolution of 100m is

too large to fix such monitoring sites as individual trees thus, a differential method will be used to provide sufficient resolution (Trimble rover & base station).

RESULT: This project was to start in 1994. However, experimental GPS use so far has indicated two problems: 1) difficulty in obtaining satellite readings under the forest canopy, and 2) problems maintaining power during long field trips without access to battery supplies or main voltage for re-charging.

9. Peru: Communal Land Titling and Reserves / Basic Mapping

PROJECT STATUS: Current.

LOCAL ORG: --

NATIONAL ORG: Inter-Ethnic Association for the Development of the Peruvian Rainforest (AIDESEP).

EXTERNAL ORG: International Working Group for Indigenous Peoples (IWGIA), Copenhagen.

DONOR AGENCY: DANIDA (Denmark).

CONTACT: AIDESEP, San Eugenio 981, Santa Catalina, Lima 13, Peru.

REFERENCES:--

OBJECTIVE: To map community lands as a basis for obtaining title and to establish additional communal reserves.

BACKGROUND: Peru does not recognize indigenous title as such, but does recognize communal ownership of lands which are contiguous with villages and subjected to fairly regular use. As a result, support organizations have devised an adaptive strategy of mapping such lands in collaboration with local communities and submitting these for formal recognition.

METHOD: The strategy is to build up what are in effect ethnic territories through utilizing the laws under which land may be assigned to communities. Commencing in 1989, AIDESEP has assisted in the titling of 115 communities. Once lands are mapped by the communities, agency engineers formalize these by using conventional theodolite-based surveys. Over 2,000,000 ha have been titled as a result of this effort by AIDESEP. However, the government is displaying some reluctance to continue because of the size of the areas that are being mapped. However large, they still do not cover all the land that has been traditionally used by indigenous communities, only the tracts that are used with comparative intensity, such as the lands alongside river courses. To cope with those distant areas used less intensively for intermittent hunting and gathering, a second strategy has been devised: to press for the establishment of communal reserves which indigenous peoples would use only for traditional purposes and would protect from commercial exploitation. They would manage these reserves in trust for the state, a reversal of the more usual relationship between indigenous peoples and nation states. One such proposed communal reserve, for the Ashaninka, totals 1,000,000 ha.

RESULT: This relatively simple process for land titling has worked well for land-based communities and

some are contemplating a second form of protected area -- the communal reserve.

10. Peru: Land Titling / Basic Mapping

PROJECT STATUS: Current.

LOCAL ORG:--

NATIONAL ORG: Centre for the Development of Indigenous Amazonians (CEDIA).

EXTERNAL ORG: Environmental Defense Fund.

DONOR AGENCY: --

CONTACT: Lelis Rivera, CEDIA, Psje. Bonifacio 166, Urb. Los Rosales de Santa Rosa, La Perla, Callao, Lima, Peru. Tel/Fax: 51-14650708.

REFERENCES:--

OBJECTIVE: To map community lands as a basis for obtaining title and to establish additional communal reserves.

BACKGROUND: Peru does not recognize indigenous title as such, but does recognize communal ownership of lands which are contiguous with villages and subjected to fairly regular use. As a result, support organizations have devised an adaptive strategy of mapping such lands in collaboration with local communities and submitting these for formal recognition.

METHOD: CEDIA has engaged in similar titling projects, for both indigenous and colonist communities in the lower Urubamba valley. Between 1992 and 1993, they assisted in obtaining colonist title to 20,000 ha which effectively buffered another 80,000 ha of less accessible land. They have also commenced work on enlarging the land base of eight indigenous communities, which will secure another 90,000 ha. This completes the titling jigsaw puzzle for the valley and will effectively exclude intrusions by outsiders. CEDIA is now working to establish the 220,000 ha Vilcabamba Communal Reserve in the lower Urubamba valley.

RESULT: This relatively simple process for land titling has worked well for land-based communities, both indigenous and colonist, and their support organizations. It has also led some groups to contemplate a form of protected area, the communal reserve, designed to forestall industrial resource exploitation.

11. Venezuela: Ye'kuana Demarcation Project / Basic Mapping

PROJECT STATUS: Current.

LOCAL ORG:--

NATIONAL ORG: Otro Futuro.

EXTERNAL ORG: Assembly of First Nations, LEO Project, Canada.

DONOR AGENCY: Canadian International Development Agency (CIDA).

CONTACT: Nelly Arvelo-JimJnez, (Otro Futuro) Instituto Venezuelana de Investigaciones CientRficas, Carretera PanamJrica Km. 11, Apartado 21827, Caracas 1020-1, Venezuela. Tel: 52-2-501-1297 Fax: 58-2-501-1085.

REFERENCES: Arvelo-JimJnez and Conn 1995.

OBJECTIVE: To demarcate traditional Ye'kuana territory and produce a technical map of the results.

BACKGROUND: The Ye'kuana territory lies to the west of Yanomami land. Aware of the impacts of mining on their neighbors, and of plans to superimpose new political divisions upon their lands, the Ye'kuana have taken steps to assert traditional ownership. There is no legal framework in Venezuela for this, and 15 communities decided upon a unilateral demarcation. The Assembly of First Nations (Canada) obtained funds from the CIDA-supported Environment and Development Support Program to cover costs of a meeting and a project proposal.

METHOD: The meeting broke into four informal groups. Each drafted a sketch map of the collective territory of the 15 communities. Later, the assembly voted on the most representative map. By comparing the sketch map with a 1:500,000 map, they determined a boundary of 4-500 km and an area of about 1,000,000 ha. The meeting then debated and voted upon methods for marking the boundary, deciding upon a series of 24 clearcut circles, 30m in diameter and joined by a footpath - itself joined to the 15 villages by a web of footpaths. The perimeter was divided into 6 sectors. Each will be the responsibility of a team of 32 men and women from two to three nearby villages. Total effort was estimated at 12,000 person-days of work. The meeting then asked that the LEO project contribute by making a technical map of the boundary, one which used cartographic conventions and symbols acceptable to national agencies. This map would then be sent to the President and the Congress of Venezuela. The methodology for the map will be determined once the demarcation process is well underway.

RESULT: The planning meeting had an unprecedented unifying effect upon the communities. Opening speakers stressed this and urged that this unity be protected into the future. Already the demarcation is regarded as only the first step, preceding the compilation of cultural and economic maps, which will be used as a basis for long-term sustainable use of resources. The proposal for demarcation has since been approved.

12. COICA: Regional Land Management / PRA, GIS

PROJECT STATUS: Current.

LOCAL ORG: --

NATIONAL ORG: --

EXTERNAL ORG: Coordinating Organization of the Indigenous Peoples of the Amazon Basin (COICA).

DONOR AGENCY: OXFAM America, Pew Charitable Trusts, MacArthur Foundation, Leo Model Foundation, John Merck Fund, OXFAM-UK, Action Aid, Environmental Systems Research Institute (ESRI).

CONTACT: Richard Chase Smith, COICA, Casilla 18-0521, Miraflores, Lima 18, Peru. Tel: 51-14-453373 Fax: 51-14-463731.

ESRI, 380 New York Street, Redlands, CA 92373-8100, USA. Tel: 714-793-2853 Fax: 714-793-5953.

REFERENCES: Smith 1993 & 1995.

OBJECTIVE: " The COICA-OXFAM America Research Project is an ambitious attempt to examine and evaluate the impact of the market economy on indigenous peoples over the last three decades in five Amazonian countries. The project includes an important component for mapping distribution of population, property, land-use capability, actual land use and deforestation for each of five case studies, using both on-the-ground participatory mapping techniques as well as data from satellite images and aerial photographs. The project is interested in introducing and developing the use of GIS as a tool for long-range planning for Indian territories (Smith 1993)."

BACKGROUND: COICA includes membership from national-level indigenous organizations of nine countries: the 1984 founding members from Bolivia, Brazil, Colombia, Ecuador, and Peru, as well as members who joined in 1992 from French Guiana, Guyana, Suriname, and Venezuela. Over the last 25 years, these organizations have been actively engaged in the struggle to obtain legal recognition of indigenous lands. Smith (1993) reports on the Indian lands within the Amazon Basin that have been recognized since 1961: 83,000,000 ha in Brazil 25,000,000 ha in Colombia 8,300,000 ha in Ecuador. Altogether Smith estimates that current negotiations could lead to over 200,000,000 ha (30%) of the Amazon basin being recognized as Indian territory by the year 2000.

Recently, COICA and OXFAM America completed an evaluation of 15 programs aimed at regaining Indian territories. "Among other conclusions, the study showed that one of the most important strategies for the defense of secured territories is the careful development of the territory in ways which satisfy the growing and changing economic needs of the population while at the same time conserving and renewing the resources for continuous long-term use" (Smith 1993). The evaluation looks to this future on the basis of an examination of the changes over the 25 years from 1967-1992.

METHOD: Teams of Indian and external experts have completed case studies in five countries. Local participatory mapping methodologies have been used which closely resemble those which are familiar in PRA and are described in MYRADA (1991). They include the use of local materials to make maps upon the ground, transect walks, local histories and seasonal calendars. These expressions of local knowledge and activities act as focal points for discussing interests and priorities within the community. They also provide a comparative basis for interpreting aerial and satellite images. From this combination of local and external data sources, the teams have produced eight maps for each case study: five regional maps at 1:100,000 and three community maps at 1:50,000. These are:

1. Property structure/population (regional & community)

2. Actual land use/cover (regional & community)

3. Types of use areas/waters (regional & community)

4. Land-use capacity (regional)

5. Deforestation 1970-1992 (regional)

The Project used participatory mapping techniques to compare local perceptions of vegetation changes over 25 years with those detectable in aerial photographs and satellite images.

RESULT: The final report for the 1967-1992 study will be finished late in 1994. Its interim conclusions are summarized by Smith (1993) as follows: "With few exceptions, and despite the incorporation of most indigenous peoples into the market economy during recent decades, traditional subsistence activities continue to be the primary source of their sustenance... The menu of subsistence strategies is tremendously varied and, by taking advantage of the immense diversity of forest and aquatic resources available, turns this complexity of species and habitats into a subsistence blessing."

COICA is exploring the potential contribution that GIS can make to the management of Indian territories. Until now, neither COICA itself nor its member organizations possessed the resources to obtain and operate a GIS. COICA now has the necessary hardware and software and is in a position to develop an operational model. The project has linked with national cartographic agencies. The eventual goal is to establish an in-house GIS unit for each national indigenous organization. ESRI (Environmental Systems Research Institute) has agreed to donate PC ARC/INFO software to each organization.

CENTRAL AMERICA

Belize: Maya Land Use / Basic Mapping

PROJECT STATUS: Current.

LOCAL ORG: Toledo Maya Cultural Council (TMCC).

NATIONAL ORG: Maya Institute of Belize, Kekchi Council of Belize, Alcalde Association, San Antonio Land Reservation Committee.

EXTERNAL ORG: Indian Law Resource Center (ILRC), Center for the Support of Native Lands.

DONOR AGENCY: (possible) World Wildlife Fund, Indigenous Peoples Fund of the Inter-American Development Bank.

CONTACT: ILRC, 601 E Street, SE, Washington, DC 20003, USA. Tel: 202-547-2800 Fax: 202-547-2803.

Mac Chapin, Center for the Support of Native Lands, 3240 Wilson Boulevard, Room 220, Arlington VA

22201, USA. Tel: 703-841-9771 Fax: 703-841-9774.

REFERENCES: TMCC 1994.

OBJECTIVE: To produce a land-use map of the Maya villages and land in Toledo District. To collect information on land use, population, natural features,and plant and animal species in the Maya land area in Toledo District.

BACKGROUND: "The project is designed to gather comprehensive, useful and accurate information on Maya land-use patterns in the Toledo District. This information will be the basis for a strategy to secure a legally protected homeland for the Maya people in the Toledo District. It will also be used to develop a conservation management plan for the area" (TMCC 1994).

METHOD: This project is the latest to employ a methodology which is evolving through the experience of several similar projects in Central America (proj. 14,15,16) as the momentum to map and secure land has gathered in recent years. An effective operational structure and process is emerging. Coordinators assume responsibility for overall organization, logistics and relations with external groups. Coordinators and communities collaborate on selecting surveyors to gather basic data from local sources. A professional cartographer, to be approved by the TMCC, will coordinate technical aspects and oversee production of technical maps. TMCC summarizes the project design:

Community workshops

Data collection by use of questionnaires

Preparation of hand-drawn maps

Production of a technical land use map

Discussions about the specifics of the homeland proposal

Development of a plan to secure the homeland

RESULT: This project is about to start.

14. Honduras: La Mosquitia Land Use and Occupancy / Basic Mapping

PROJECT STATUS: Completed.

LOCAL ORG: --

NATIONAL ORG: Mosquitia Pawisa (MOPAWI), Moskitia Asla Takanka (MASTA), Federacion IndRgena Tawahka de Honduras (FITH), Organizacion Fraternal Negra HondureZa (OFRANEH).

EXTERNAL ORG: Cultural Survival, Southeastern Louisiana University.

DONOR AGENCY: --

CONTACT: MOPAWI, Apartado 2175, Tegucigalpa D.C., Honduras. Tel: 504-37-27-10 Fax: 504-37-28-64.

Mac Chapin, Center for the Support of Native Lands, 3240 Wilson Boulevard, Room 220, Arlington VA 22201, USA. Tel: 703-841-9771 Fax: 703-841-9774.

REFERENCES: Herlihy 1993, Chapin 1993.

OBJECTIVE: To enable indigenous communities in La Mosquitia to document and map their patterns of resource use and to present the results to other indigenous peoples and interested agencies at a congress on the indigenous lands of La Mosquitia.

BACKGROUND: The concept emerged from discussions between Mac Chapin, then of the Arlington office of Cultural Survival, and now with the Center for the Support of Native Lands, and members of the Honduran NGO MOPAWI. The project proposal was drafted by Peter Herlihy of Southeastern Louisiana University and Andrew Leake, both of whom later acted as project coordinator/cartographers.

METHOD: The data for the maps was collected by the Miskito, Tawahka, Pesch, GarRfuna and Ladino people of the region. The area to be mapped was divided in 22 sectors. After initiation at a MOPAWI seminar, surveyors administered questionnaires to communities in their assigned zones. News about the survey and congress was also broadcast on the local radio. During a second seminar, the data gathered by the surveyors was then plotted on 1:50,000 maps by the two cartographers. This took an average of 5 hours for each of the 22 sectors. Over 5,000 points were transferred in this way. Without knowing the coordinates, it was difficult to plot points located furthest from communities coordinates. Once all the points were plotted, lines were drawn around areas of regular or daily use. These outlines did not include distant areas used for such activities as timber extraction or gold-panning.

The community lands delineated on the 1:50,000 topographic sheets were then copied onto tracing paper, which displayed the use categories, landmarks and rivers. The surveyors then returned to the communities to verify these sketch maps and to address questions arising from the map transformation exercise. The presentation of these transformed maps served to elicit more details from local informants. At a third seminar, surveyors worked with the coordinators to correct the resulting maps. These were redrafted to clean copies by the technical staff of the National Geographic Institute. They were then condensed into a 1:250,000 scale composite map of the region for presentation at the national congress. The final project map, at 1:500,000, included 170 of the larger settlements, but inevitably excluded much of the detailed land-use data recorded on the 1:50,000 maps.

RESULT: The project was presented, mostly by the surveyors, at a national congress in Tegucigalpa attended by officials from line agencies. The two foreign coordinators were apprehensive about the project being interpreted as an effort to gain political or legal recognition of communal tenure to the lands shown as subject to traditional use. They felt that these issues were successfully circumscribed and that the "best indicator of the success of the First Congress on Indigenous Lands in La Mosquitia was the influence the event had in promoting the development of a protected areas system to ensure the future conservation of the natural and cultural heritage of the region" (Herlihy 1993).

A more tangible result has been the further evolution and refinement of this process of community map-making during subsequent projects in Panama and Belize, as well as in proposals for similar work in Nicaragua. After the Congress, the two project cartographers were engaged by the Honduran

government to help design and map a mosaic of protected areas and indigenous territories in La Mosquitia to be called La Solidaridad.

Nicaragua: Miskito Coast Protected Area / Cartography, Sketch Maps

PROJECT STATUS: Current, part of project in proposal stage.

LOCAL ORGS: MIKUPIA, The MCPA Technical Planning Team.

NATIONAL ORGS: IRENA (Environmental Agency).

EXTERNAL ORGS: Center for the Support of Native Lands, Indian Law Resource Center, University of California at Berkeley Ocean Conservation Group, Caribbean Conservation Association, World Wildlife Fund - US (WWF).

DONOR AGENCIES:--

CONTACT: MIKUPIA, c/o IRENA, Apartado 5123, Managua, Nicaragua, Tel: 505-2-40474 Fax: 505-2-63-1274.

REFERENCES: CSNL 1994, ILRC 1992, Nietschmann 1995.

OBJECTIVE: The four objectives include: 1) to produce a land and sea-use map 2) to collect data on use and habitats for a management plan 3) to develop information on land/sea-use and traditional resource management practices for discussions between local communities, officials, conservation groups, etc. and 4) to produce a set of recommendations on land/sea-use, natural resource management and conservation in northeast Nicaragua.

BACKGROUND: The coastal Miskito people live close to the largest expanse of shallow water in the Caribbean, the Miskito Shelf. There is a strong geographical correspondence between the Miskito Shelf, the land/sea area used by the 250,000 Miskito people, and the range of the green sea turtle. The Nicaraguan Government has recently recognized a Miskito Coast Protected Area, a 1,295,000 ha coastal complex of forest, mangroves, lagoons, estuaries, seagrass meadows and coral reefs. The area is subject to heavy pressure from resource pirates and the activities of transnational firms. The overall goal of the project is to enable the 32 Miskito communities to actively participate in the generation and administration of conservation strategies and regimes for the wildlands and marine environment of northeast Nicaragua.

METHOD: MIKUPIA, the Miskito conservation organization which represents the 32 communities within the protected area, will administer the project and will engage two or three coordinators. These coordinators will supervise community-level surveyors, organize workshops and logistics, and manage outside technical assistance. A zone containing four or five villages, including the surveyor's own village, will be assigned to each surveyor. IRENA will provide cartographers and equipment to produce final composite maps. The project falls into three different phases. The community-mapping element will build upon the experience gained in similar projects in Honduras and Panama. Nicanor Gonzalez, a Kuna from Panama and Regional Coordinator for the Center for the Support of Native Lands, has contributed to this evolving methodology.

PHASE ONE (three months):

Community visits by MIKUPIA to discuss the project and gain the essential local commitment.

PHASE TWO (five months):

Workshop I: Training workshop for the surveyors.

Field Work I: Surveyors' field work (three weeks), completing questionnaires and a census count, and working with community members on map-making.

Workshop II: Combining the results of surveyors' work, which will be hand-drawn community maps, with analysis of aerial and satellite images and existing maps to produce composite 1:50,000 maps.

Field Work II: Surveyors return to the communities to verify composite maps and fill in gaps (three weeks).

Workshop III: Final integration of field data to make a master map at 1:250,000. This will be the basis for a map showing land- and sea-use in combination with habitat types and biotic zones. This will be mapped using Miskito categories with Spanish and English translations.

PHASE THREE:

A regional forum to present and discuss findings and elaborate recommendations. The audience will be community members, government officials and policy makers, conservationists, local and international NGOs, and indigenous people from Nicaragua and Central America.

RESULT: The mapping element is still at the proposal stage.

Panama: Indigenous Mapping of the Darien / Cartography, Sketch Maps

PROJECT STATUS: Completed.

LOCAL ORG: --

NATIONAL ORG: Congresses of the Embera, Wounaan and Kuna, Centro de Estudios y Accion Social Panameno (CEASPA), Instituto Nacional Geografico "Tommy Guardia".

EXTERNAL ORG: Center for the Support of Native Lands.

DONOR AGENCY: Sixteen international and Panamanian conservation and development organizations provided financial, technical and logistical support.

CONTACT: Mac Chapin, Center for the Support of Native Lands, 3240 Wilson Boulevard, Room 220, Arlington VA 22201, USA. Tel: 703-841-9771 Fax: 703-841-9774.

REFERENCES: Chapin 1993 & 1994, Contreras 1994, Denniston 1994, Gonzalez et al 1995.

OBJECTIVE: The three objectives include: 1) to produce a land-use map for indigenous areas of eastern Panama 2) to hold a national-level congress at which indigenous peoples of eastern Panama will present

the map and discuss the issues of their region with the general public, government officials and representatives of conservation groups and 3) to produce a set of conclusions and recommendations regarding land use, natural resource management and conservation in eastern Panama, and publish them as proceedings.

BACKGROUND: The forests and lands of the Darien are occupied by over 14,000 Embera, Wounaan and Kuna, living in 82 communities. In 1983, part of the Darien region was recognized as a "comarca" (an indigenous homeland with semi-autonomous political organization under the jurisdiction of the Panamanian federal government), but its borders remain demarcated on paper only. The region also includes the 579,000 ha Darien National Park. The Darien is exposed to threats from two sources. First is incremental deforestation by illegal loggers and colonists. Second is a plan by the governments of Panama and Colombia to link the Pan-American Highway through the "Darien Gap".

METHOD: The project lasted for six months in 1993. The method evolved from that initiated in La Mosquitia, Honduras (proj. 14). For this project, however, the coordinators were indigenous people: two Embera and one Kuna. They coordinated the activities of 23 surveyors, each responsible for a zone encompassing the lands of 5-6 communities occupied by the indigenous peoples of the Darien. The work fell into three phases:

PHASE ONE:

The coordinators held a workshop with the surveyors to develop land-use questionnaires and discuss the mapping methodology. The surveyors then visited the communities to complete the questionnaires, make a census count and compose maps on blank sheets of paper, showing natural features and patterns of traditional practices.

PHASE TWO:

During a second workshop, the surveyors worked with an external geographer to compile composite maps from aerial photographs and the community maps. This led to a second field trip for verification.

PHASE THREE:

Final maps produced with assistance by cartographers from the Instituto Nacional Geografico "Tommy Guardia" who commented that the maps were more accurate and informative than any other available sources.

RESULT: "One of the most important achievements of the process was refinement of the mapping methodology, which manages to combine maximum participation of the local people with the generation of a product of truly scientific value" (Chapin 1994). The final map is the property of the Embera, Wounaan and Kuna peoples. Collectively, they presented the maps at a forum, "Indigenous Culture and Resources, Indigenous Lands of the Darien 1993: Subsistence Zones," attended by over 500 people, and presented their views on the proper use of the Darien.

CARIBBEAN

Dominican Republic: Social Forestry Initiatives / PRA

PROJECT STATUS: Current.

LOCAL ORG: Federacion Campesina de Zambrana-Chacuey.

NATIONAL ORG: Instituto Superior de Agricultura.

EXTERNAL ORG: ENDA-Caribe, Marsh Institute (Gender and Environment Project), Clark University (ECOGEN Project).

DONOR AGENCY: USAID and Ford Foundation.

CONTACT: Dianne Rocheleau, Clark University, 950 Main Street, Worcester, MA, USA 01610-1477. Tel: 508-793-7526 Fax: 508-793-8842.

REFERENCES: Rocheleau 1994.

OBJECTIVE: "To encourage the recognition and maintenance of diversity in the farm-forest mosaics of the region and to fit new commercial tree crops into the existing systems without displacing the rich assemblages of plant species or specific groups of people whose livelihoods are most dependent upon particular species and land-use types in the current rural landscape" (Rocheleau 1994).

BACKGROUND: The area has been subjected to deforestation as well as efforts to develop agro-forestry and commercial tree crops.

METHOD: The researchers worked with villagers to identify the "distinct interests, species, products and places in the landscape by groups of land users, defined on the basis of gender, class and family composition and size and location of holdings" (Rocheleau 1994). Drawings, maps, interviews and questionnaires were combined to produce maps of 50 holdings to "inform the planning process for on-going forestry and agro-forestry projects, so that species choice, technology innovations and commercial production of timber by smallholders will enhance rather than reduce the existing economic and ecological diversity of the landscape" (ibid). At the household level, felt-board exercises used forms representing tree types, animals, crops, as well as landscape and infrastructural elements to display and discuss the logic and consequences of land-use decisions among groups of 5-15 people. It was felt that this technique could be expanded to the community level.

RESULT:-

NORTH AMERICA

Canada: Ditidaht Traditional Knowledge Mapping / GIS

PROJECT STATUS: Current.

LOCAL ORG: Ditidaht Band Council, Community Pacific Resource Group, Sofor Inforgraphics.

NATIONAL ORG: --

EXTERNAL ORG:--

DONOR: Government of British Columbia, Heritage Conservation Branch.

CONTACT: Chief Jack Thompson, Ditidaht Band Council, P.O. Box 340, Port Alberni, BC V9Y 7M8, Canada. Tel:604-745-3333 Fax:604-745-3332.

REFERENCES: Scott 1995.

OBJECTIVE: To develop a cartographic methodology appropriate for mapping traditional knowledge, occupancy and resource use.

BACKGROUND: The Heritage Conservation Branch of the Government of British Columbia is addressing the question: What would a cartographic knowledge base for First Nations communities look like? How can traditional land use and occupancy be translated into codes and topologies that would be generally useful in representing and managing indigenous lands? The Ditidaht Band, Nu'Chah'Nulth First Nation, is collaborating with the Branch on a pilot project to devise suitable symbols and categories.

METHOD: The information will initially be collected through conversations with elders, which may be audio or video recorded. The data will then be entered on 1:20,000 base maps (17 sheets) and digitized into a GIS. One problem encountered in using these maps, and satellite imagery, is that they are not detailed enough to record some features of traditional significance.

The community is working on a technique whereby a viewer can click onto any specific site shown on the digitized map and prompt either an audio or video account by an elder of the story and significance of that site. The band is also using a GIS to predict the likelihood of finding archeological sites. By applying such parameters as elevation, slope, distance from water, derived from analyses of known sites, the group has managed to predict occurrences with 95% accuracy.

RESULT: Current results are encouraging. The project is proving to be useful in terms of raising community awareness of land-related issues and in communicating knowledge and views between generations.

Canada: The Eagle Project / GIS

LOCATION: Great Lakes ecosystem.

LOCAL ORG: 63 indigenous communities.

NATIONAL ORG: Assembly of First Nations (AFN).

EXTERNAL ORG: Health and Welfare Canada.

DONOR AGENCY: Health and Welfare Canada.

PROJECT STATUS: Current.

CONTACT: Maxine Caldwell, Assembly of First Nations, 5th floor, 55 Murray Street, Ottawa, ON K1N 5M3, Canada.

REFERENCES: AFN 1993, Bird 1995.

OBJECTIVE: To determine the impacts of environmental change upon First Nations societies within the Great Lakes Basin.

BACKGROUND: The EAGLE (Effects upon Aboriginals of the Great Lakes Environment) Project is the first of its kind to be managed by First Nations, and is serving as a model for community-based regional health programs. The project is based upon the need to examine the high rate of consumption of freshwater fish and wildlife, as well as the resulting high exposure risk to contaminants among First Nations communities in the Great Lakes Basin.

METHOD: A GIS is used to keep track of progress in involving 63 First Nations communities in a 5-year program, which will integrate a vast amount of data including:

Related community health concerns

Relevant scientific reports

Conceptual models for community epidemiology

Levels of contaminants in country foods and fish

Local eating patterns of country foods and

Contaminant levels in human tissues and fluids.

This will enable EAGLE staff to study the socio-economic effects of food contamination, estimate contaminant exposure levels among indigenous communities and estimate risk.

RESULT: The project is underway.

Canada: Inuit Land Use and Occupancy Study / Basic Mapping

PROJECT STATUS: Complete.

LOCAL ORG: Inuit Communities.

NATIONAL ORG: Inuit Tapirisat.

EXTERNAL ORG:--

DONOR: Federal Government of Canada.

CONTACT: Inuit Tapirisat, Suite 510, 172 Laurier Avenue West, Ottawa, ON K1P 5V5, Canada. Tel: 613-238-8181 Fax:613-234-1991.

REFERENCES: Freeman 1976.

OBJECTIVE: To provide evidence of land use and occupancy to support Inuit land negotiations with the Canadian government.

BACKGROUND: The series of colonial-style treaty negotiations between First Nations and the federal government came to a close in the 1930's. In 1973, the government announced a readiness to settle outstanding land issues and this precipitated the current series of negotiations, concentrated first in northern Canada and now in British Columbia, where the provincial government did not recognize aboriginal rights until 1992.

METHOD: This was perhaps the first extensive attempt to work with communities, rather than merely studying them, to establish historical and traditional patterns of occupancy and land use. This project covers the entire Northwest Territories. External fieldworkers were assigned to communities where they worked with Inuit to trace seasonal movements in hunting, trapping and fishing onto sketch maps. These were later amalgamated into a large three-volume study describing the methodology, actual patterns (in 153 pages of maps), and a number of derived studies and commentaries.

RESULT: The Inuit Land Use and Occupancy Study was the basic geographic source for negotiating the Inuvialuit (Western Arctic) land claim and the Nunavut (Eastern Arctic) land claim, and is also a unique historical record. Original maps are stored in the National Archive.

Canada: Inuit of Quebec Land Use and Ecological Mapping / GIS

PROJECT STATUS: Completed.

LOCAL ORG: Makivik Corporation.

NATIONAL ORG: Inuit Tapirisat of Canada.

EXTERNAL ORG: --

DONOR AGENCY: Makivik Corporation.

CONTACT: Johnny Peters, Makivik Corporation, 650 32nd Avenue, Suite 404, Lachine, PQ H8T 3K4,

Canada, Tel: 514-637-3771 Fax: 514-637-3146.

REFERENCES: Brooke 1993, Kemp et al 1995.

OBJECTIVE: To map Inuit land use, occupancy and ecological knowledge.

BACKGROUND: Unlike other recent land-claim settlements, the James Bay Agreement, which was precipitated by the James Bay Hydro Project, was not preceded by a land-use and occupancy study. Inuit soon realized that they could not put the provisions of the Agreement into effect, on their terms, without collecting comprehensive data on their resource use and ecological knowledge. The project was financed entirely by Makivik Corporation, the Inuit implementing organization that emerged from the Agreement, and it was executed by the Makivik Research Department.

METHOD: Between 1976 and 1981, a base line was established from interviews with all harvesters and knowledgeable people. Thousands of field maps were transcribed, digitized and entered into a GIS. These were supplemented by written text and audio recordings. The database is entirely under the control of Makivik and contributing communities. Access is only possible through consent of individuals and communities concerned.

RESULT: Over the last ten years, the database has been continually updated and used for such purposes as dealing with further hydro development proposals, planning Inuit fisheries, presenting off-shore claims, land-use planning, wildlife management, curriculum development, and historical projects.

Canada: Mamo Atoskewin Association Impact Assessment / GIS

PROJECT STATUS: Current.

LOCAL ORG: Communities of Manawan, Wemotaci, Opitciwan and the Mamo Atoskewin Association (MAA).

NATIONAL ORG:--

EXTERNAL ORG:--

DONOR AGENCY:--

CONTACT: Michel Ares, Mamo Atoskewin Association (MAA), 540 St. Antoine, La Tuque, PQ G9X 2Y4, Canada. Tel: 819-523-9876 Fax: 819-523-5753.

REFERENCES:--

OBJECTIVE: To make a database and map of Atikamekw lands based on traditional knowledge, for use in dealing with the impacts of industrial logging.

BACKGROUND: Current Quebec forestry legislation does not contain any recognition of traditional

resource use or of land-claim negotiations between First Nations and the government. Therefore, the strategy for dealing with the impacts of forestry was to call for the observance of regulations of logging practices in relation to wildlife distribution and habitat, specifically moose and beaver.

METHOD: Since 1989 the Mamo Atoskewin Association (MAA) has been compiling a database and map of traditional patterns of resource use. Information was gathered by local volunteers through conversations with elders. It covered the occurrence of moose, beaver and waterfowl, and sites for gathering such materials as birch bark, berries and medicinal plants. The information was entered on 1:50,000 topographic sheets. Over the first four months data was gathered for 35,000,000 ha (49 map sheets) and then transferred to the 1:20,000 maps used for forestry management (120 sheets). To map moose yards (where moose gather at critical periods) and beaver lodges, three stages of verification were used: 1) presumed, based upon local discussions 2) potential, from addition of available scientific data and habitat type and 3) recognized, by field visit (usually helicopter).

Altogether 511 yards were presumed. Of these, MAA was able to check 117, and found 72 occupied by moose. The same process was used for mapping beaver. MAA devised a method for determining whether beaver lodges were active through aerial observation. Early in October, they could see stores of food near the lodge and visible signs of repair. MAA has used a GRASS (Geographic Resource Analysis Support System) GIS, available free from the U.S. military and compatible with Macintosh and UNIX hardware. Landsat TM satellite imagery has been used in conjunction with the topographic map sheets. A GPS was used to record elders' information from 186 sites. MAA is now training 3 local individuals to operate MAC graphic software, which is compatible with the GRASS relational database.

RESULT: The maps showed that some moose yards had been clearcut and established that the logging company has not observed regulations regarding the proximity of tree-cutting to beaver lodges where they occur in specific densities. The maps were sent to government agencies, but there has been no official response. However, MAA has learned that the data on moose yards has been used by resource management agencies without consultation, even though these were considered to be confidential. MAA has not yet been able to contain industrial logging on its lands, but has demonstrated the advantages of generating a superior database. MAA now possesses evidence of poor management and intends to challenge both the industry to observe, and the responsible agencies to apply, existing regulations. The onus then falls on these other interests to accept the MAA database, or question it by collecting yet more information with their own resources.

Canada: Manitoba Keewatinowi Okimakanak / GIS

PROJECT STATUS: Current.

LOCAL ORG: Manitoba Keewatinawi Okimakanak (MKO).

NATIONAL ORG: --

EXTERNAL ORG: --

DONOR AGENCY: 25 Cree communities.

CONTACT:Stewart Hill, MKO Natural Resources Secretariat, 3 Station Rd, Thompson, MB R8N ON3,

Canada. Tel: 204-778-4431 Fax: 204-778-7655 / 800-442-0488.

REFERENCES:--

OBJECTIVE: To provide a range of environmental and mapping services for member communities.

BACKGROUND: In the late 1980s, 25 Cree bands in Manitoba decided to combine their resources to form MKO as a resource secretariat serving the needs of member communities.

METHOD: The Secretariat commenced by gathering information from elders and from traditional users of the land and entering it on a GIS. The GIS database now covers 10 million ha in Manitoba and the Northwest Territories and is reportedly the largest and most comprehensive land-information source in the region. The traditional knowledge baseline information is drawn from about 400 map biographies. This is overlaid with information from aerial photography and remote sensing. Like the GIS database generated in Quebec by Makivik Corporation (proj. 21), the MKO system is entirely owned and operated by the indigenous organization, without government involvement or support.

RESULT: The MKO database is in constant use to support treaty and land settlement selection, claim negotiations, environmental impact management, resource management, forestry operations and the resource initiatives of member communities. It has also proved stimulating in visually communicating knowledge and perspectives and related traditional values between generations. It will play a role in the BOREAS Project, a $40 million NASA initiative on Cree lands to test various local airborne methods for ground-truthing the satellites of EOS (Earth Observing System) due to be launched in 1996. The database has also enabled MKO to earn revenues from non-indigenous sources for various land planning and inventory exercises.

Canada: Sanikiluaq / Aerial Photographic Animal Census

PROJECT STATUS: Completed.

LOCAL ORG: Weasels Hunters and Trappers Association, Sanikiluaq.

NATIONAL ORG: Boreal Institute.

EXTERNAL ORG: --

DONOR AGENCY: Department of Indian Affairs.

CONTACT: Lucassie Arragutainaq, Weasels Hunters and Trappers Association, Sanikiluaq, NWT, Canada. Tel: 819-266-8983 Fax: 819-266-8903.

REFERENCES: Arragutainaq et al 1989.

OBJECTIVE: To obtain a complete aerial count of reindeer as baseline data in developing a ground-based census methodology.

BACKGROUND: Caribou vanished from the Belcher Islands in the nineteenth century. In the early 1970s, the government air-lifted 63 reindeer (domesticated caribou) from a herd in the Western Arctic. Inuit from the community of Sanikiluaq refrained from hunting the herd until numbers reached the estimated carrying capacity for the islands. A government survey in the early 1980s indicated a healthy and growing population, but later computer-based projections from these results indicated that it was exceeding range capacity. A quota was recommended to Sanikiluaq, but both the total estimate (800-900) and the quota (140) were felt locally to be too high.

Since the reindeer is technically a domesticated animal, the Government of the Northwest Territories Wildlife Service was unable to provide the needed technical support, despite the fact that the transplanted reindeer had effectively returned to their caribou origins and become completely feral. Instead, the Inuit of Sanikiluaq managed to obtain funds from the Federal government to enable them to develop their own management plan for reindeer and other resources. The community decided to start by devising an innovative method to conduct an annual reindeer census by snowmobile.

METHOD: The Sanikiluaq decided to conduct an aerial survey and compare the results with a ground-based census. The survey was conducted with an Inuit-owned Beaver aircraft and a survey crew of four local hunters, an external photographer and the Inuit pilot. The objective was to secure a total, rather than a sample count. On survey transect, the hunters spotted groups of reindeer the pilot then flew over, while the photographer recorded the group. Two of the hunters were unable to count but they were confident that they had seen all the reindeer. The furthest sighting was by the pilot -- a group of five at a range of 2 km.

RESULT: he air survey lasted four hours and the resulting photographic count was 479, with the largest concentration of 222. The subsequent ground survey, conducted by five snowmobiles over five days, yielded an estimate of 462, 95% of the aerial estimate. The results were questioned by the Wildlife Service on the grounds that the survey lines were too far apart and too high, and that the ground survey was conducted after the aerial estimate was completed. They further contended that the Inuit knew the location of the herds from the air survey. The Inuit observed that such prior knowledge offers no advantage as the main herd was seen to move halfway across the entire Belcher Island archipelago during the four hours of the air survey. However, it was decided to run a second survey the next winter, as a compromise to address the comments about flight lines and altitudes, and to not process the film until the ground survey was completed. During the second year, the air count was 437 and the ground count was 416, again 95%. Both counts indicated an annual after-quota increase of 17%, which is encouragingly high for caribou/reindeer.

Canada: Shuswap Nation Tribal Council / GIS

PROJECT STATUS: Current.

LOCAL ORG: Shuswap Nation Tribal Council (SNTC).

NATIONAL ORG: --

EXTERNAL ORG: --

DONOR AGENCY:--

CONTACT: Verna Billy, SNTC, 355 Yellowhead Highway, Kamloops, BC V2H 1H1, Canada. Tel: 604-828-9808 Fax: 604-374-6331.

REFERENCES:SNTC 1993.

OBJECTIVE: To realize the potential of GIS for locally based land and community management.

BACKGROUND: The Shuswap Nation's interest in GIS can be traced to the late 1980s when the SNTC refused to join in the Canadian census, as the previous one had been determined to be extremely inaccurate. Eventually, the SNTC agreed to join as long as the census was locally controlled. This led the SNTC to assume responsibilities for local demographic data, and to later extend this to cover land and resources.

METHOD: The SNTC convened a workshop of other GIS users in 1991. This led to the following conclusions (SNTC 1993): 1) establishing GIS is time-consuming and expensive 2) data acquisition and updating is the most expensive component of a functioning GIS 3) without specific applications it is difficult to evaluate the effectiveness of GIS software packages 4) careful analysis of the available base maps' accuracy and usefulness must be conducted and 5) it is crucial to develop both the educational (theoretical) and technical (practical) GIS skills in-house to ensure continued usage.

The SNTC have explored the potential of several GIS systems. Shuswap communities are using one of the more simple GIS systems, Quikmap, to produce digitized charts of their traditional territories. These will be amalgamated as the basis for the Shuswap comprehensive land claim. A Quikmap/ARC-INFO interface is being developed to map the local data needed for communities to manage infrastructure and lands. The people of Neskonlith have used a Terrasoft GIS to produce a model land-management system covering about 4,000 ha. The central SNTC GIS services the needs of 13 communities. When the source is traditional knowledge rather than freely available demographic data, this information remains under the control of individual communities, with SNTC using only a more generalized version for GIS integration.

RESULT: The SNTC has demonstrated an appropriate niche for GIS as a central operation serving member communities.

United States: Colville Confederated Tribes / GIS

PROJECT STATUS: Current.

LOCAL ORG: Colville Confederated Tribes (CCT).

NATIONAL ORG: Bureau of Indian Affairs (BIA), Indian Integrated Resource Information Program (IIRIP).

EXTERNAL ORG: --

DONOR AGENCY:--

CONTACT: U.S. Department of the Interior, Bureau of Indian Affairs, Geographic Data Service Centre, 730 Simms Street, Room 101, Golden, CO 80401, USA. Tel: 303-231-5100 Fax: 303-231-5122.

Michael Marchand, Planning Director, Colville Confederated Tribes, Box 150 Nespelem, WA 99155 USA. Tel: 509-634-4711 Fax: 509-634-4116.

REFERENCES: Marchand and Winchell 1994.

OBJECTIVE: As one of ten pilot projects, to introduce GIS to tribal authorities in the United States.

BACKGROUND: In 1983, the BIA established a National Center in Colorado to assist tribes interested in acquiring a GIS capability, specifically ARC/INFO. The initial idea was that tribal GIS units could gain access to a central database stored in a main frame computer. CCT is one of these tribal groups and its experience has lessons for similar organizations.

METHOD: Problems arose when tribal members felt that the BIA was reluctant to provide some basic data, such as land titles and forest records. The initial GIS application was in forestry this, along with resource management in general, has proven effective in technical terms. However, these applications tended to monopolize the system, making it difficult to expand in order to cover other local applications such as planning, housing, and infrastructure.

On a second project, the Tribes funded a collaborative project with the University of Eastern Washington to use GIS for an environmental impact study of a proposed ski resort and recreational development. Problems with long distance communications and interactions eventually led the Tribes to compromise and combine GIS products with hand-drawn maps. On the positive side, maps of such resources as berries and medicinal plant areas, compiled from interviews with elders, played a crucial role in this impact assessment. The IIRIP adopted a neutral position on whether the BIA or local authorities would control GIS operations. However, the complexity of GIS management coupled with the lack of local skills meant that, in effect, the BIA assumed a dominant role over GIS applications, particularly in forestry.

RESULT: This experience convinced tribal members of the need to create a tribal-based program in which they would gain full access and control of GIS data. Such an extended system would require more hardware, staffing and training. The Colville project showed that GIS of this sophistication is not suitable for part-time operations but requires full-time systems analysts and programmers. Finally, the project raised concern that sensitive traditional knowledge, once stored in GIS, would neutralize traditional informal controls.

United States: Tulalip Fisheries / Aerial Videography

PROJECT STATUS: Current.

LOCAL ORG: Tulalip Fisheries.

NATIONAL ORG: --

EXTERNAL ORG: --

DONOR AGENCY:--

CONTACT: Dave Somers, Tulalip Fisheries, 3901 Totem Beach Road, Marysville, WA 98272, USA. Tel: 206-653-4585 Fax: 206-653-1234.

REFERENCES:--

OBJECTIVE: To improve shellfish shoreline and riparian habitat management.

BACKGROUND: Tulalip land lies in the centre of the once abundant Puget Sound shellfish beds, of which 70% have been closed as a result of dairy cattle-related fecal bacteria pollution.

METHOD: The Tulalip are heavily involved in water quality assessment and the prevention of further pollution. They have developed a water quality assessment laboratory which is now qualified to do outside contractual work. They have also used a GIS for reservation land-use planning and water-quality studies. To obtain base-line data on fish habitat condition, Tulalip Fisheries have developed a technique using a video camera suspended from a weather balloon. The balloon is held by two people, one on either side of the stream, to prevent the camera twisting.

RESULT: The resulting imagery has been analyzed using a frame-grabber. It has proved useful, but problems with controlling the video camera from the ground have inhibited the Tulalip from taking full advantage of this aerial video technique.

United States: Zuni Sustainable Resource Development Plan / GIS

PROJECT STATUS: Current.

LOCAL ORG: Zuni Nation.

NATIONAL ORG: U.S. Geological Survey.

EXTERNAL ORG: --

DONOR AGENCY: Ford Foundation.

CONTACT: Jim Enote, Zuni Nation, P.O. Box 339, Zuni, NM 87327, USA. Tel: 505-782-4481 Fax: 505-782-2700.

REFERENCES: Enote 1992.

OBJECTIVE: To recuperate the Zuni land base and create a sustainable resource use regime based upon Zuni traditions.

BACKGROUND: The Zuni reservation covers 170,000 acres of remote arid highlands. The population is 9,000, of whom 90% are Zuni. In 1981, the Zuni sued the U.S. for damage to the Zuni River watershed cause by upstream mismanagement. The Zuni won the case, and in 1990 Congress passed the Zuni Conservation Act which provided $17 million to set up a trust fund to be used for implementing the plan. The Act requires that Zuni resources be protected and managed sustainably.

METHOD: The watershed rehabilitation project is the largest in the U.S. and is being executed in collaboration with the U.S. Geological Survey. It calls for a computerized system for resource management and the training of Zuni professionals and technicians in the survey, inventory and collection of geomorphic and hydraulic data, their analysis for watershed modeling, and mobile river-bed analysis. An ARC/INFO GIS is being used as the information base for monitoring and managing the project.

RESULT: The Zuni Conservation project has become widely regarded as a model for reinforcing traditional and cultural values within the context of an advanced and complex land restoration project. Clear vision and authority by tribal leaders and project managers ensure that ultimate decisions are grounded in Zuni values and traditional practice.

AFRICA

Ethiopia: Local Land Use Planning / Aerial Photography

PROJECT STATUS: Completed.

LOCAL ORG: --

NATIONAL ORG: --

EXTERNAL ORG: International Institute for Environment and Development (IIED).

DONOR AGENCY: Band Aid, Concern.

CONTACT: Dick Sandford, IIED, 3 Endsleigh Street, London WC1H 0DD U.K.
Tel: 44-71-388-2117 Fax: 44-71-388-2826.

REFERENCES: Sandford 1989.

OBJECTIVE: To use aerial photography for planning resettlement and for involving settlers in the process.

BACKGROUND: Band Aid and Concern have been supporting two resettlement projects in Ethiopia since 1985 and were interested in understanding the effects of environmental factors and involving settlers in this process of reflection.

METHOD: The sites were photographed at a scale of 1:20,000. External consultants used the imagery to complete a conventional land capability survey, but photographs of this scale proved to be of limited use in communicating with the settlers. This problem was overcome when the photography was enlarged to a scale of 1:5,000 and formed into mosaics for each village resettlement area. None of the settlers had seen an aerial photograph before. But Sandford (1989) reports that they were able immediately to recognize their land and its boundaries, to identify significant ecological and social features, and to use the mosaics for conducting ground walks. Subsequently, the villagers, the NGOs and agricultural officials attended a land use planning workshop. The mosaics were introduced by the settlers and the agreed land use allocations were marked upon transparent acetate overlays. Sandford (1989) points out that aerial photography of this kind proved to be a useful medium for farmers to communicate and explain their knowledge and reasons for decisions to developers, and in turn enabled developers to gain useful and accurate information without walking each part of the land.

RESULT: One result has been the adoption of such photo mosaics as a tool for local communication as part of a longer term land use planning program by the Ministry of Agriculture.

Guinea-Bissau: Wetlands / Aerial Photographs

PROJECT STATUS: Completed.

LOCAL ORG: Village of Co-Timate.

NATIONAL ORG: SHAS (Servicos de Hidraulica Agricola e Solos).

EXTERNAL ORG:--

DONOR AGENCY:--

CONTACT: Koos Neefjes, Environment & Development, OXFAM, 274 Banbury Road, Oxford 0X2 7DZ U.K. No tel/fax given: contact through IIED (proj. 28).

REFERENCES: Neefjes 1993.

OBJECTIVE: In Guinea-Bissau, farmers use traditional methods to convert mangrove swamps for rice cultivation by building Abolanhas@ - polders with a system of dams and dikes designed to capture freshwater and prevent the inflow of seawater.

BACKGROUND: Aerial photographs and topographic maps were used in two cases: one to discuss future plans, the other to attempt to resolve a dispute over access to a newly built bolanha.

METHOD: For the first case a 1:50,000 map from the 1950's and a 1:30,000 aerial photograph from 1989 were taken to a village meeting to discuss the future construction and management of the bolanhas. The farmers were able to locate feature such as houses and paths in the photography but not the smaller dikes and dams. In the second case, the same photography was used but in conjunction with a 1:5,000 scale map. This time a magnifying glass was used for examining the 1:30,000 imagery, and it yielded more useful information.

RESULT: Neefjes (1993) concluded that 1:30,000 aerial photographs were of limited use for detailed mapping in a local setting but the use of a magnifying glass to increase the scale improved its utility. He notes that a photograph of 1:30,000 scale can be enlarged and printed on tracing paper at a scale of 1:5,000 for $175.

Kenya: Ukambani Mapping Land-Use Changes / PRA

PROJECT STATUS: Current.

LOCAL ORG: Ukambani.

NATIONAL ORG: African Centre for Technology Studies.

EXTERNAL ORG: --

DONOR AGENCY: World Wildlife Fund Osborn Centre and United Nations University, Marsh Institute Critical Environmental Zones Project.

CONTACT: Dianne Rocheleau, Clark University, 950 Main Street, Worcester, MA, 01610-1477, USA. Tel: 508-793-7526 Fax: 508-793-8842.

REFERENCES: Rocheleau 1994.

OBJECTIVE: To use maps and sketches to gather information from local people and to involve them in decision-making processes.

BACKGROUND: The project is entitled APolicy History, Land Use Change and the Future of the Dry Forest in Ukambani: Case Study and Analysis of Alternative Options for the Future.@ Its basic proposition is that the pressures causing changes in rural social and economic patterns are also affecting the biodiversity that is linked to local land use patterns. One cannot be treated separately from the other. The project seeks to elucidate these connections and look for ways in which they can be factored into local decision-making.

METHOD: The approach uses maps in a way similar to Participatory Rural Appraisal. For three communities, histories of changes in land use and landscape were constructed through discussions based on maps, sketches and oral accounts. These served to illustrate the linkages between development and environmental policies and local changes and elicited suggestions from villagers about future activities.

RESULT: This produced an account of these historical experiences as well as suggestions from the communities for the future of their landscapes and for resource use and management.

Kenya: Machakos Land Use Changes / PRA, GIS

PROJECT STATUS: Commencing.

LOCAL ORG:--

NATIONAL ORG: African Centre for Technology Studies, University of Nairobi, National Museum of Kenya.

EXTERNAL ORG: New England Science Center.

DONOR AGENCY: National Science Foundation, USA.

CONTACT: Dianne Rocheleau, Department of Geography, Clark University, 950 Main Street, Worcester, MA 01610-1477, USA. Tel: 508-793-7176 Fax: 508-793-8842.

REFERENCES: Rocheleau 1994.

OBJECTIVE: ATo identify the landscape characteristics that promote maintenance of biodiversity in rapidly changing rural land use systems@ (Rocheleau 1994).

BACKGROUND: Machakos District is a heavily populated mosaic of villages, agricultural land,

savannah and woodland experiencing rapid changes.

METHOD: Sources include satellite imagery, aerial photographs, oral history and local sketch maps. Project work combines local participatory research methodologies with conventional field survey and sampling techniques. Data from aerial photos from 1948 to 1985 will be combined with local histories to generate a time series analysis of land use changes, using an IDRISI GIS.

RESULT: The intended result is a typology that reflects habitat values, human use and human impact on biodiversity.

Kenya: Aerial Photography and Household Studies / Aerial Photography

PROJECT STATUS: Completed.

LOCAL ORG: --

NATIONAL ORG: --

EXTERNAL ORG: Oxford Forestry Institute.

DONOR AGENCY:--

CONTACT: No address, contact through IIED (proj. 28).

REFERENCES: Dewees 1989.

OBJECTIVE: To take and use aerial photos for the identification of specific and complete small-holdings.

METHOD: Flight lines were planned on 1:50,000 maps. A Nikon FG 35mm camera with a 50mm lens was clamped to the window of a Cessna 152. Reversal film was used and slides were printed as 2cm x 17cm (Scale 1:2,000) for field use. Planned height above ground (HAG) was 650m.

Two problems were encountered: one was maintaining a constant HAG over areas of high relief. Aircraft altimeters (and GPS) give absolute height above a constant sea level. For high altitude aerial photography, this problem is minimized, but it is amplified in the case of low level surveys. The problem is not so acute when the photography is being used for recognizing certain features or marking boundaries, but it is significant when measuring areas on the ground, as the HAG directly affects the scale of the image. Dewees (1989) found that the scales on the images they produced varied between 1:10,000 and 1:15,000. Given the lens/HAG combination reported by Dewees, the constant image scale should have been 1:13,000. This problem has been resolved elsewhere in Kenya by using a radar altimeter, an instrument costing $5,000-$10,000. The second problem was maintaining the transects, the flight lines marked on the 1:50,000 sheets, owing to the lack of conspicuous ground features. This problem always arises on conventional aerial surveys and is the reason why survey navigation is a highly skilled craft. However, this problem is becoming obsolete with the advent of GPS.

RESULT: Dewees was able to map small-holdings to an accuracy of 100m, corresponding closely to GPS accuracy. The prints worked well in household interviews, which aimed at noting specific land uses and delineating small-holdings. They were also found useful in correcting the biases inherent in making

transect walkers, where there is a tendency for field workers to walk contour line or ridge tops and follow established paths. Features could be noted on the photographs first and transects planned accordingly.

Namibia: Ju/'hoansi Bushmanland Land-use Planning / PRA, GPS, GIS

PROJECT STATUS: Completed.

LOCAL ORG: Environmental Planning Committee (EPC) of Bushmanland (Nyae Nyae)

NATIONAL ORG: Ministry of Environment and Tourism, Namibia Nature Foundation

EXTERNAL ORG:--

DONOR AGENCY: Biodiversity Support Program, World Wildlife Fund (WWF) LIFE Project (USAID-funded)

CONTACT: Jo Tagg, Natural Resource Planning Officer, Directorate of Environmental Affairs, Private Bag 13306, Windhoek, Namibia

Benjamin Aiae Aice, PO Box 45, Grootfontein, Namibia

REFERENCES:--

OBJECTIVE: The two major objectives were: 1) to integrate Ju/'hoansi local land-use planning with national land-use planning, and to assist the Ju/'hoansi in articulation of their needs, problems, plans, and resource management practices to outsiders and to government.

BACKGROUND: The Bushmen of Namibia have mostly been dispossessed of their former land by other groups and are dependent on wage labor from farmers and government, as well as food-aid schemes. The Ju/'hoansi of eastern Tsumkwe district in north eastern Namibia are one of the few Bushman groups to retain some control over their own land, ironically because the area was a tribal homeland under Namibia's pre-independence apartheid system. The Ju/'hoansi still depend to a large extent on gathering of bush food and hunting, and they are developing subsistence livestock, millet, and vegetable farming. The area supports several big game species including elephant and the major predators and its pan system is a seasonal wetland of international and regional importance. The Ju/'hoansi use regulated burning as a resource management tool and have a traditional system of tenurial rights to regulate access to particular resource areas. Outsiders have not appreciated the sophistication of this system. In the 1980s, government plans to declare a game reserve in the area were halted because the people would have lost their land rights. Now government is passing legislation which will give communal area residents rights over wildlife and tourism.

METHOD: PRA surveys were done by an outside researcher in collaboration with two Ju/'hoansi Community Rangers who were trained to elicit detailed land-use information linked to sketch maps of local resource areas owned and managed by particular households. GPS was used to geocode resource-use locations so that local information could be integrated with more general regional information to create district land-use plans. The information was further developed as communities used existing data for community-based Environmental Impact Assessments during community and EPC discussions of potential development activities and optional land-use changes. One aim was to provide

GIS-generated maps which could be used by the Ju/'hoansi as well as outsiders.

RESULT: Sketch maps and surveys were completed in key areas, but a workshop to integrate local data with regional land-use planning proved unsuccessful. The raw data and resource maps collected by the outside researcher have been left with the community, but no GIS maps were completed. However, a new project is combining the existing information with new data gathered by community rangers and others in a GIS. Maps are being produced which are available for community and outside use and which can be used for locating resource areas and participatory planning of resource management actions. The map production takes place in the capital, but the methodology is being developed with the community rangers in the field. A system of grids and symbols for local resource maps is being developed so that community rangers can plot information themselves.

ASIA

Indonesia: Asmat Traditional Forest Use / GIS

PROJECT STATUS: Current.

LOCAL ORG: --

NATIONAL ORG: --

EXTERNAL ORG: Conservation International.

DONOR AGENCY:--

CONTACT: Cynthia Mackie, Conservation International, 1015 18th Street, NW, Suite 1000, Washington, DC 20036, USA. Tel: 202-429-5660 Fax: 202-887-5188.

REFERENCES: --

OBJECTIVE:To map traditional forest use, ecological knowledge and occupancy by sketch mapping, then on a GIS.

BACKGROUND: The Asmat occupy a 2,000,000 ha tidal swampland along the coast of Irian Jaya, a complex of mangroves, lagoons and freshwater swamps. They are famous for carvings made from the hardwood trees growing in this sensitive and changeable habitat. Timber concessions have now been permitted in their forests. However, conventional logging machinery cannot operate in this swampy terrain and the concessionaires are obliged to rely upon Asmat people to cut and move the trees manually, causing divisive social impacts within Asmat communities. A few years ago, a group of Asmat contacted Conservation International (CI) while exhibiting their carvings in the U.S. They expressed an interest in acquiring a GIS to assist in ongoing efforts to document the traditional use of their lands.

METHOD: While the Asmat data is compatible with GIS, the Dutch maps used for base maps are old and inaccurate. A project has been designed whereby CI will generate a base map and the Asmat will draft overlays showing their resources, their names, their patterns of use and clan boundaries. CI will also sponsor ethnobiological research and Asmat leaders will learn GIS techniques. The Asmat also plan to establish their own development NGO and a national NGO will assist in this effort.

RESULT:--

Indonesia: Bentian Dayak / Basic Mapping

PROJECT STATUS: Current.

LOCAL ORG: Sempekat Jato Rempangan.

NATIONAL ORG: PLASMA.

EXTERNAL ORG: Endangered Peoples Project (EPP), Canada.

DONOR AGENCY: Canada: Environmental and Development Support Program.

CONTACT:Longgena Ginting, PLASMA, Jl. Pertahanan Kompleks Yeschar No. 1, P.O. Box 1/Smrbb, Samarinda 75119, East Kalimantan, Indonesia. Tel/Fax: 62-541-35753.

REFERENCES: Royo 1994.

OBJECTIVE:To use oral history and traditional knowledge in order to to make sketch maps of Jelmu Sibak customary land and its boundaries.

METHOD:PLASMA, a community development group, is engaged in learning and disseminating sketch-mapping techniques. With the assistance of the EPP, a community training workshop has been completed and PLASMA intends to hold other training sessions in the district.

RESULT:The mapping exercise was locally recognized as a vehicle for community-based planning. It helped to settle local tensions over land and also indicated how the community as a whole could defend its customary rights against external interests.

Indonesia: Bukit Baka-Bukit Raya National Park / Basic Mapping

PROJECT STATUS: Current.

LOCAL ORG: --

NATIONAL ORG: Indonesian Ministry of Forestry/Natural Resource Management Project - USAID.

EXTERNAL ORG: Associates in Rural Development, USA.

DONOR AGENCY: USAID.

CONTACT:Associates in Rural Development, Jl. Mediun 3, Central Jakarta, Indonesia. Tel: 62-21-390-5841 Fax: 62-21-327-301.

REFERENCES: NRMP 1993.

OBJECTIVE:To get a spatial picture of traditional land use, the land-tenure system and traditional boundaries of the Dayak communities situated on the periphery of Bukit Baka-Bukit Raya National Park

in order to develop a park management plan and to plan community development activities in the support zones outside the park while developing and testing new traditional forest area concepts.

BACKGROUND:Dayak communities have been practicing swidden cultivation for generations in this mountainous region on the border of West and Central Kalimantan. The park was established in 1992. It is surrounded and abutted by several logging concessions that have been operating since the early 1980s on the traditional lands of several Dayak communities. Although there are no communities within the park, several village territories extend into the park. The NRM project is working with local communities, the Ministry of Forests, and the concessionaires to plan a local development program based upon traditional Dayak forest use practices.

METHOD:Villagers first drew their territory free-hand on blank paper. These drawings were used to plan a rapid field surveying strategy and to pose questions to help fit the drawing onto a topographic map. The villagers' sketches were based upon the local river network and were found to be extremely detailed and correct in sequence and relative size and positions of rivers. It is a mountainous area, so where topographic maps were available, triangulation was mainly used to locate features. Where no topographic maps were available, field surveys (compass and chain) were made in strategic parts of the territory in order to better proportion the sketches. After the base map of natural features and local names was completed, thematic maps of land use, land tenure, historic migration, etc., were sketched on tracing paper during evening village meetings.

RESULT:The maps have been used by community members to show their land use and historical occupancy through locations of sacred sites, family-owned tree groves, hunting and gathering territories and swidden rotations. The maps will be used to plan community development programs and in discussions with neighboring communities, concessionaires and forestry staff.

Indonesia: Kayan Mentarang Reserve / PRA, GPS, GIS, Aerial Imagery

PROJECT STATUS: Current.

LOCAL ORG: --

NATIONAL ORG: Indonesian Ministry of Forestry, World Wide Fund for Nature - Indonesia Programme (WWF-Indonesia), PHPA, Lembaga Ilmu Pengetahuan Indonesia (LIPI).

EXTERNAL ORG: --

DONOR AGENCY:WWF-Indonesia.

CONTACT:Jeff Fox, East-West Center, Program on Environment, 1777 East-West Road, Honolulu, HI 96848, USA. Tel: 808-944-7248 Fax: 808-944-7298.

Tim Jessup or Frank Momberg, WWF-Indonesia, Jl. Pela 3, Gandari Utara, Jakarta Selatan 12079, Indonesia. Tel: 62-21-720-3095 Fax: 62-21-739-5907.

WWF-Kayan Mentarang, c/o Mathilde Snel, Jl. Katamso 12, Samarinda 75117, Kalimantan Timur, Indonesia Tel/Fax: 541-43970.

Perlindungan Hutan dan Pelestarian Alam/Protection of Forests and Preservation of Nature (PHPA),

Indonesian Ministry of Forests.

REFERENCES: Royo 1994, Momberg et al 1994.

OBJECTIVE:To gather information on local resource utilization for zoning a national park.

BACKGROUND:Kayan Mentarang is currently a Nature Reserve. The objective of this WWF-supported project is to change its status to that of a National Park. This change would enable the 10,000 indigenous people living in the area to obtain some rights of access to resources within the park, in which zones would be created for hunting, gathering and swidden cultivation.

METHOD:PRA will be used to generate local maps of traditional practice within Kayan Mentarang. 1:50,000 radar images and aerial photographs will be used in producing base sketch maps. GPS will be used for local people to position features entered on the sketch maps during PRA sessions. Biophysical data will be added using GIS.

RESULT:There has been some local concern over the production of maps with this exotic technology. It has been felt that the mapping process enabled outsiders to control information over local resource use which had previously been reserved to the community. These doubts could be reduced if local people were more involved in the process of map production, and if the aims of mapping and ownership of the maps were more clearly articulated and understood.

Indonesia: Kenyah Uma Lung, Long Uli Village / GPS, GIS

STATUS: Completed.

LOCAL ORG:--

NATIONAL ORG.: World Wide Fund for Nature - Indonesia Programme (WWF-Indonesia), Indonesian Ministry of Forestry.

EXTERNAL ORG.: East-West Center Environment Program.

DONOR: Ford Foundation.

CONTACT: Jeff Fox, East-West Center, Program on Environment, 1777 East-West Road, Honolulu, HI 96848, USA. Tel: 808-944-7248 Fax: 808-944-7298.

REFERENCES: Sirait 1993.

OBJECTIVE:To map the customary land of Long Uli Village.

BACKGROUND:Recently the people of Long Uli found their traditional land overlaid with a Forest Concession and a Nature Reserve, both designated on maps with a scale too small to show either the village or the boundaries of its customary land.

METHOD:The 18,231 ha of village land is divided into areas of both communal and individual ownership, but most decisions about resource use are made communally. To anticipate border disputes, meetings were held with neighboring villages and consensus reached on the purposes of the work.

The approach was to map customary land using oral history and traditional knowledge and to use GPS for georeferencing. Local research assistants gathered data from knowledgeable informants and entered it on sketch maps and topographic maps, using a compass and altimeter to derive locations. Over ten days, 117 GPS locations were derived from the sketch maps and extrapolated to the topographic map. Where forest canopy was dense, the GPS antenna was raised on a 5m pole. Two GPS units enabled improved positional accuracy through using the differential GPS technique.

RESULT:The final map was entered into a GIS (PC ARC/INFO) and the boundaries of the forest concession and nature reserve were superimposed upon the customary lands. This revealed that in fact, under traditional management, 12,173 ha were already protected as community forest, whereas the areas designated as nature reserves protected areas covered only 7,154 ha. AJust the process of recording the villagers' knowledge of their land and their history is empowering... This research does not mean anything unless it is taken back and used by the villagers. The maps give the villagers some means of communicating with other land users, and some negotiating platform if there are conflicts@ (Sirait 1993).

Indonesia: Wasur National Park / Sketch Mapping, GPS

PROJECT STATUS: Current.

LOCAL ORG: Wasur National Park, Merauke and other communities.

NATIONAL ORG: World Wide Fund for Nature - Indonesia Programme (WWF-Indonesia).

EXTERNAL ORG:--

DONOR AGENCY:--

CONTACT:Timothy Jessup, WWF-Indonesia, Jl. Pela 3, Gandaria Utara, P.O. Box 7928 JKSKM, Jakarta Selatan 12079, Indonesia. Tel: 62-21-720-3095 Fax: 62-21-739-5907.

REFERENCES: Bowe 1994.

OBJECTIVE:To develop plans and methods for the continuance of traditional resource use in the park through community consultations.

BACKGROUND:National policy and legislation prohibits both habitation and resource use within protected areas. The Project in Wasur National Park in Irian Jaya had been successful in securing certain local rights despite these prohibitions. The focus in this part of the Project was upon activities in the park core zone, where all activities except scientific research are prohibited in principle.

METHOD:Extensive community consultations were coupled with local mapping of traditional activities and boundaries. The local WWF forester listened for hours to elders singing in order to recall the boundaries -which were afterwards located with the help of younger villagers and GPS. The villagers also created a ground map, 30m x 30m, using leaves, vines and sago fronds as symbols of trails, land uses, tree groves and sacred sites. These sites were then fixed on a GPS-based map. For consultations, the villagers' map was used, and the results transferred to the GPS map. Project staff discussed the core zone with the communities. The park administration is most concerned about the impacts of hunting. The villagers acknowledge the concept of the core as a reservoir of animals for depleted areas. However, they

pointed out the need to control the size of the wild pig population if their habitat is to be maintained in its current state, an issue also recognized by the park. It was felt that hunting issues relative to the park core could be resolved.

RESULT:The mapping and consultations resulted in the communities developing a set of core zone rules, which provide for regular visits to sago gardens for tending and harvesting, unrestricted access to sacred sites, and en route travel to visit relatives across the Papua New Guinea border. In addition, a few border revisions excluded significant hunting and fishing sites. These proposed changes and core zone rules have been submitted to the Forestry Department and are still under review.

Nepal: Land Use Planning / Aerial Photography

PROJECT STATUS: Complete.

LOCAL ORG: Belpatha Village, Nepal.

NATIONAL ORG: --

EXTERNAL ORG: --

DONOR AGENCY:--

CONTACT: --

REFERENCES: Carson 1987.

OBJECTIVE:To demonstrate the utility of enlarged aerial photography as a medium for communication between villagers and planners, that provides a more appropriate reflection of landscape and social complexities compared to topographic maps.

BACKGROUND:Carson (1987) advocates strong community participation in village-level planning designed to deal with environmental degradation resulting from population and economic pressures upon traditional practices and resources. On several counts, he holds that aerial photography is a more appropriate medium for this than topographic maps.

METHOD:For a planning exercise in the village of Belpatha, standard 1:20,000 panchromatic aerial photography was enlarged to 1:5,000. With a ground coverage of 1150m x 1150m (132 ha) a single image is usually sufficient to cover an average Nepalese village and surrounding agricultural and foraging land. Carson points out that to produce a topographic map of this coverage and scale produced would cost $1,000, compared to $20 for the single enlarged photograph.

RESULT:Carson found that rural Nepalese with no formal training were adept at interpreting aerial photographs. He attributes this to the time they spend gazing down upon their villages from the surrounding mountains. He considers aerial photography to be an appropriate medium for communication between planners and villagers, especially for those people who cannot read.

Finally, Carson proposes that the density and complexity of ecological, economic and social information contained in aerial photographs obliges planners to recognize these interconnections and to respond with an interdisciplinary and integrated approach to community-based development.

Papua New Guinea: Resource Appraisal / Aerial Photograph

PROJECT STATUS: Completed.

LOCAL ORG: --

NATIONAL ORG: Department of Agriculture.

EXTERNAL ORG: Institute of Development Studies, University of Sussex, U.K.

DONOR AGENCY: World Bank.

CONTACT: --

REFERENCES: Mearns 1989.

OBJECTIVE:To assess how people used, valued and gained access to local lands which had been pre-classified by external agencies as Land Mapping Units (LMUs) and to discover what social factors need to be taken into account in realizing the physical potential signified by LMUs.

BACKGROUND:Southern Highlands Rural Development Project (SHRDP) included a conventional land evaluation to generate LMUs (a conventional FAO classification) as a basis for agricultural and rural development. Mearns (1989) sought to discover how social factors mediated local decisions on how to use LMUs. The local discussions focused upon clans as the basic social unit governing access to land.

METHOD:Panchromatic aerial prints of 23cm x 23cm (scale 1:4,000) worked well as a medium for conversations with clan leaders and elders and with discrete groups of women and men. These conversations focused on local preferences for using the pre-classified LMUs to discover the degree of correspondence between these local intentions and the potential signified by the LMU categorization. These interviews were carried out on local vantage points, such as ridge tops, from which the photographed land could be seen. The images' most important use was for walking clan boundaries with elders and marking these directly on the photos with chinagraph pencils. Common boundaries were walked twice, once with each neighboring clan.

RESULT:The photographs proved a valuable asset in discussions of local land disputes.

Philippines: Ancestral Domain Mapping / Basic Mapping, GPS, GIS

PROJECT STATUS: Current.

LOCAL ORG:Communities and confederations in many different parts of the Philippines, including the Luzon Cordillera, Mindoro, and Mindanao.

NATIONAL ORG:Department of Environment and Natural Resources (DENR), Center for Development Programs for the Cordillera (CDPC) Philippine Association for Inter-Cultural Development (PAFID), National Mapping and Resource Information Authority (NAMRIA), Natural Resources Management Program (NRMP), Legal Rights Center (LRC), PANLIPI, and others.

EXTERNAL ORG: Biodiversity Support Program, Biodiversity Conservation Network.

DONOR AGENCY: USAID, Ford Foundation, Asian Development Bank.

CONTACT:Dennis Uba, UNAC, 59 C. Salvador Street, Loyola Heights, Quezon City, 1108 Metro Manila, Philippines. Tel/Fax: 632-985-538.

LRC, National Office, 3rd Floor Puno Building, Kalayaan Avenue, Diliman, Quezon City, Philippines. Tel: 632-922-32-13 Fax: 632-95-21-97.

PAFID, 71 Malakas Street, Diliman, Quezon City, Philippines. Tel/Fax: 632-984-580.

PANLIPI, Room 303, JGS Building, #30 Sct. Tuason corn. Dr. Lazcano, Quezon City, Philippines. Tel/Fax: 632-842-5511.

Del McCluskey, U.S. Agency for International Development (USAID) Manila, Philippines Mission, c/o Department of State, Washington, DC 20523-8600. Tel: 632-521-7116 Fax: 632-522-2512.

Janis Alcorn, Biodiversity Support Program, c/o World Wildlife Fund, 1250 24th Street, NW, Washington, DC 20037, USA. Tel: 202-861-8313 Fax: 202-861-8324.

REFERENCES: CDPC 1994, Royo 1994, PAFID 1994.

OBJECTIVE:To determine and map boundaries of Indigenous Cultural Communities (ICCs), to use these to obtain Certificates of Ancestral Domain as vehicles for recognizing indigenous peoples' tenure, and to ensure indigenous peoples' participation in sustainable development of the natural and forest resources.

BACKGROUND:The absence of tenurial security has prevented ICC's from exercising management and control over their traditional lands - which include most of the surviving forests of the Philippines. A number of projects, current or in the proposal stage, are designed to take advantage of a new program of the DENR which will respond to applications for tenure provided the geographical information is presented in a specific form. PAFID, tribal leaders, and other upland NGOs have agreed to collaborate in supporting the mapping of ancestral domains for ICCs. The PAFID program is described below.

METHOD:Preliminary Delineation: With maximum participation by tribal elders, the program aims to identify the preliminary boundaries on NAMRIA topographic maps, and to achieve verification of these preliminary boundaries by a group representing PAFID, DENR and tribal elders of the ICC.

Community Validation: The ICC will review and validate the preliminary delineation and proceed to discuss a community development plan. The plan and the boundary maps will be used as the legal basis for recognizing ancestral domain.

Supporting Activities: Community/NGO seminars and workshops on land-tenure options for the uplands, training of NGO and local workers in techniques for perimeter surveys and delineation which will introduce conventional transit methods and GPS, and examination of ways in which this technology can be combined with traditional methods for boundary delineation and observance. The program of CDPC (CDPC 1994) follows similar lines, stressing the importance of tenure as a precondition for local generation of development and resource management/land-use plans.

RESULT:The results expected from these projects will be recognition of ancestral domains and long-term sustainable forest management based upon secure community-based tenure.

Philippines: Cagayan de Oro / Sketch Mapping

PROJECT STATUS: Current.

LOCAL ORG: Fishing and farming communities.

NATIONAL ORG: Centre for Alternative Rural Technology (CART).

EXTERNAL ORG: --

DONOR AGENCY: Internal.

CONTACT:Orlando R. Ravanera, CART, 3rd Floor, Comfoods Building, Cor. Osmena-Hayes Streets, Cagayan de Oro City, Philippines. Tel: 63-8822-5462/8822-726933.

REFERENCES: Royo 1994.

OBJECTIVE:To establish the communities' access to, control of and/or ownership of resources and to alleviate poverty by using a community-based and integrated approach to improve watershed management.

METHOD:Natural resource and farming areas will be sketch-mapped, leading to border dispute resolution and court litigation where appropriate. Supporting this will be organization and mobilization of the communities, as well as issue and policy advocacy.

RESULT:Expected results include the rehabilitation of watersheds, reduced upland migration, increased farmer income and increased capacity of communities to manage their resources.

Philippines: Iraya Mangyar, Mindoro / Basic Mapping, PRA

PROJECT STATUS: Completed.

LOCAL ORG: MAL-ANGGATAN, MAL-AMBUYAN, BATAY-KAPYAAN, of the Iraya Mangyan communities.

NATIONAL ORG: Organization for Training Research and Development Foundation (OTRADEV).

EXTERNAL ORG: --

DONOR AGENCY: Internal funding.

CONTACT:OTRADEV Foundation, c/o Aleli Bawagan, Nilda Fortunado, Dolores Llagas, No. 48 Tindalo Street, Project 3 (1102), Quezon City, Philippines.

REFERENCES: Royo 1994.

OBJECTIVE:To establish boundaries for Iraya Mangyan communities and to establish environmental baselines for reforestation, soil and water conservation and grazing lands.

BACKGROUND:Mangyans are swidden agriculturalists who have been pushed by colonization and trade from the coasts to the mountains. Much of their ancestral land, forests and farms has been lost to commercial logging. Their lands have been degraded to the point where their traditional management systems are no longer viable. Because of this the present focus is on the recuperation of their resources.

METHOD:OTRADEV organized a PRA approach which conformed to the ancestral domain framework (proj. 39) and employed sketch mapping.

RESULT:A five-year environmental rehabilitation and community resource management program was prepared. In addition, the project prepared the community for furthering its ancestral domain claim for eventual delineation.

Philippines: Kalahan Reserve, Nueva Vizcaya / Sketch Mapping

PROJECT STATUS: Completed.

LOCAL ORG: Kalahan Educational Foundation.

NATIONAL ORG: Upland NGOs Assistance Committee (UNAC).

EXTERNAL ORG: --

DONOR AGENCY: Internal.

CONTACT:Pastor Delbert Rice, Kalahan Educational Foundation, Imugan, Santa Fe, Nueva Vizcaya, Philippines.

REFERENCES: Royo 1994.

OBJECTIVE:To secure the perimeters of the Kalahan Reserve.

BACKGROUND:Kalahan Reserve was surveyed by the Department of Environment and Natural Resources (DENR) in 1973, but was not officially confirmed. Therefore, a verifiable map was designed to serve the needs of the Kalahan people in managing resources and resolving land disputes.

METHOD:Working with privately trained local people, the community made sketch maps as part of development planning. The Kalahan Foundation used its own foresters and surveyors to produce triangulated parcel surveys from these maps which were accurate enough to meet DENR standards.

RESULT:The self-generated map was used by the Kalahan Foundation for its own developmental purposes. But the Foundation pointed out that the maps could not be submitted to the government, because the DENR is interested only in boundary maps made to its own specifications.

Philippines: Palawan / GIS

PROJECT STATUS: Current.

LOCAL ORG: National Tribal Filipinos Organization of Palawan (NATRIPAL).

NATIONAL ORG: Department Environment and Natural Resources (DENR).

EXTERNAL ORG: Clark University.

DONOR AGENCY: Biodiversity Support Program, Biodiversity Conservation Network.

CONTACT:Atty. Gerthie Mayo-Anda (NGO Rep.) Unit 2, Garcellana Complex, Rizal Avenue, Puerto Princesa City, Palawan, Philippines.

NATRIPAL/Tribal Filipino Apostolate (TFA), c/o Apostolic Vicariate of Palawan, Quasi Parish of San Jose, 5300 Puerto Princesa City, Palawan, Philippines.

Frank Hicks, BCN Regional Representative/Philippines, 151 B. Gonzales Street, Quezon City, 1108 Metro Manila, Philippines. Tel: 632-992-017 Fax: 632-984-997.

John Auble, IDRISI Project, Clark University, 950 Main Street, Worcester, MA 01610-1477. Tel: 508-849-2310 Fax: 508-793-8842.

REFERENCES: Royo 1994.

OBJECTIVE:To use GIS to both integrate and locate points of conflict between three overall project objectives: 1) preservation and development of indigenous communities, 2) environmental conservation, and 3) creation of economic opportunity and to use GIS as a comprehensive assessment and planning tool shared by groups with potentially divergent interests who seek to arrive at a common perspective by virtue of involving these groups in a shared purpose.

BACKGROUND:This project is designed to deal with the same situation confronted by other Philippine projects. The methods differs in that it proposes to use GIS.

METHOD:The main method will be Extended Gap Analysis, which adds socio-economic data to the biophysical data covered by the more limited Gap Analysis. The project has wide scope and presumably much of the analytical and GIS work will be done at the NGO rather than community level. Satellite and aerial imagery will be used for generalized mapping of landscape. Information on elevation will be obtained from topographic maps. GPS will be used to obtain supplementary geocoded data, including geocoded socio-economic data from local communities. This will include ancestral boundaries as well as land-use practices within those boundaries.

RESULT:It is expected that this GIS-based process will go beyond straightforward data analysis and serve as a tool for conflict resolution among competing interest groups.

Thailand: Participatory Land Use Planning / 3-D Maps

PROJECT STATUS: On going.

LOCAL ORG: Three pilot project villages.

NATIONAL ORG: Chiang Mai University (CMU), Royal Forestry Department (RFD).

EXTERNAL ORG: --

DONOR AGENCY: Ford Foundation.

CONTACT:Dr. Uraivan Tan-Kim-Yong, Chiang Mai University, Chiang Mai, Thailand.
Tel: 66-53-221699, x3573 Fax: 66-53-222763.

REFERENCES: Uraivan 1990.

OBJECTIVE:To introduce participatory methodologies to improve relationships between farmers within hill communities and also between the communities and the RFD.

BACKGROUND:Recent changes in settlement and land-use patterns have precipitated tensions between groups in the hill regions. People from highland and lowland zones have been migrating into an intermediate zone, between 600m and 1500m. Deserted Karen villages have been occupied by non-Karen. Participatory methods have been used over the last four years to address the resulting friction between these communities and the Karen and the increasing pressure upon intermediate zone resources.

METHOD:First, a 1:5,000 base map was produced by an anthropologist and a geographer from existing maps and aerial photos. For this, and for local consultation, the 1:50,000 scale photos were enlarged to 1:5,000. The two then worked with villagers to update the map with current land-use practices. Combined with three-dimensional models, these maps were effective in animating local discussions over land-use conflicts. They exposed activities of individual landholders to open discussion, providing an objective focus which may transcend cultural differences. They also illustrated the interactive effects of land-use practices on adjacent lands. Uraivan (1990) found that Agroup visualization@ stimulated fruitful local cooperative efforts and decision-making.

RESULT:AVisibility is critical in stimulating the meeting to share common concerns... Parties proceed to compromise on their perceived problems when the same set of information on maps and aerial photos provide visible relationships of land-use patterns and ecological impacts@ (ibid).

Thailand: Sam Mun Watershed Planning / 3-D Maps

PROJECT STATUS: Completed.

LOCAL ORG: Sam Mun communities.

NATIONAL ORG: Royal Forest Department.

EXTERNAL ORG: --

DONOR AGENCY:--

CONTACT:Dr. Uraivan Tan-Kim-Yong, Chiang Mai University, Chiang Mai, Thailand.
Tel: 66-53-221699, x3573 Fax: 66-53-222763.

REFERENCES: Poffenberger and McGean 1994.

OBJECTIVE:To develop community-based forest management regimes based on cooperation between forest agencies and local groups.

BACKGROUND:The 200,000 ha Sam Mun watershed is a critical source of water for central Thailand. People from six language groups live in 60 villages, many of them immigrants bringing new strategies for land use, and sometimes conflict, to the valleys. People living in the intermediate slopes suffer from upstream deforestation and further migratory pressure from downstream.

METHOD:The Sam Mun watershed strategy adopted an unusual approach by deciding that communities must be given rights and responsibilities to effectively stabilize and manage the forest environment@ (Poffenberger & McGean 1993). In 1987, two community organizers (COs) took up residence in the watershed. Two years passed before they overcame local suspicions and started work. They organized monthly meetings of community working groups, microwatershed planning by village committees and a coordinating network. For local discussions, the COs and villagers constructed three-dimensional models from topographical maps and aerial photographs. Each model took 2-3 weeks to make: cutting, gluing and painting the cardboard layers.

RESULT:The interactive process of creating the three-dimensional maps... helped the community focus its attention on the spatial location of problems and management options. The maps have cultivated a keen sense of ownership, interest and responsibility among the village members, assisting them in visually understanding the upstream-downstream river linkages and serving as discussion tools for land-use planning at monthly meetings@ (ibid).

Thailand: Karen Natural Resources Management Planning / 3-D Maps

PROJECT STATUS:Completed.

LOCAL ORG: Villages of Laiwo Sub-district, Kanchanaburi Province.

NATIONAL ORG:Wildlife Fund Thailand (WFT), Royal Forest Department (RFD).

EXTERNAL ORG: Chiang Mai University.

DONOR AGENCY: Biodiversity Support Program, USAID.

CONTACT: Surapon Duangkhae or Chan-ek Tangsubutr, Wildlife Fund Thailand, 251/88/90 Phaholyothin Road, Bangkhen, Bangkok 10220, Thailand, Tel: 66-2-552-2111, 66-2-552-2790 Fax: p66-2-552-6083.

REFERENCES: --

OBJECTIVE:To produce three dimensional (3-D) maps of the six village clusters of Laiwo Subdistrict located inside the Huay Kha Khaeng-Thung Yai World Heritage Site in order to 1) promote participatory land-use planning and to 2) discuss Karen resource management with government agencies and GEF project teams in light of proposals to resettle Karen outside the Wildlife Sanctuary.

BACKGROUND:Karen have lived in the forests near Three Pagoda Pass for several hundred years, but

are now faced with possible resettlement by a World Bank Global Environment Facility (GEF) biodiversity project. The mapping effort was part of a larger project to provide information requested by RFD to justify its provisional decision to allow the Karen to continue to live in the forests of Western Thung Yai. The project objectives focus on strengthening local people's ability to defend forests in partnership with sincere government initiatives. WFT hopes to reverse the present policy trend of moving local populations and provide a clear example and model to show how local communities can participate in genuine and long-term conservation activities. Other project activities include demographic and socio-economic surveys, historical research, plant and animal baseline surveys, cultural support activities, study tours for Karen to visit other forest-based communities in Thailand, and policy seminars.

METHOD:Following the methodology created by Dr. Uraivan at Chiang Mai University (proj. 48,49), topographic maps were used as a pattern for creating large three dimensional maps from layers of thick posterboard cut on contours, then glued together and painted to indicate residential areas, land use, forests, paths, and waterways. Karen project staff interviewed village households and Karen Buddhist priests to map current land use and sacred areas, and to develop a natural resource management plan that builds on their traditional land use.

RESULT:Maps were completed and presented to a province-level meeting with the Royal Forest Department and other concerned agencies. Publicity about the mapping and other project components led to study tours from other parts of Thailand and Vietnam through the Regional Community Forestry Center (RECOFT) in Bangkok. Village opinion is that maps are most useful for communicating with outsiders who are not familiar with Karen rights and their traditional use of the forest, but the Karen are also using them to plan intensification of agriculture with assistance from northern Karen communities who plant on terraces (not a tradition in this area). Discussions of historical events associated with the landscape were especially animated and provided a means for young people to learn history. The maps are also useful to discuss wildlife movements and poaching activities with RFD forest guards. Border police have found the maps so useful they have borrowed them occasionally for use in their helicopters.

BRIEF MENTIONS

This section summarizes cases included in the survey, but in which mapping or geomatics were not the main objective, and for which limited information was available.

Bangladesh: Social Forestry Opportunity Maps / Satellite Imagery

As a medium for engaging local villagers in decision-making on land and resources, a Bangladeshi NGO updated large-scale topographic maps with remote sensing data. Villagers used these to propose sites for protecting Sal forest, for forest plantations and for reforestation of degraded lands. These were combined by the villagers with geographic data on other resource uses and land tenure arrangements to compile a series of Asocial forestry opportunity maps.

REFERENCE(S): Flavelle 1993.

Brazil: Xavante Border Monitoring / Satellite Imagery

Over the last 40 years, 80% of Xavante lands have been lost to incursions. They have regained control over 6 areas but these are still subject to encroachment from plantations and ranches. Association of the Indigenous Community of Tso'repre (ACIRK) is now determined to create agro-ecological projects for the 6 areas and to monitor them by satellite.

CONTACT: Aniceto Tsudzawere, Director, ACIRK, Aldeia Sno Marcos, CEP 78.600, Barra da Garcas, Mato Grosso, Brazil.

Canada: Ayuukht Nisga'a Mapping Land Ownership / Protected Knowledge

This project was initiated in 1982 by the Nisga'a Tribal Council to strengthen their claim to the fishery in negotiations with the Federal government. The model that was mapped reflected the traditional Nisga'a tenure system, in which kin groups own fishing territories and harvesting rights. This ownership is transmitted via the knowledge of wilp (house) traditions. Only the chief can decide to reveal this knowledge. The study produced 8 volumes of mapped place names, territories and resource information, including an atlas of Nisga'a owned territories. These belong to the Tribal Council and have never been made public.

REFERENCE(S): Brooke 1993.

Canada: Chipewayan Land Use, Northwest Territories / Map Biographies

This study was undertaken to establish traditional use of the Northwest Territories by Chipewayan people living in Saskatchewan, to be used in settling a boundary dispute with the Inuit in Nunavut. Covering three bands, the study obtained map biographies from 91 active hunters, a 50% sample. The mapping focused upon travel and habitation. Map biographies were traced on to 1:1,000,000 overlays, then digitized and compiled with an AutoCad program for the study report.

REFERENCE(S): Prince Albert Tribal Council 1990.

Canada: Cree, Fort George Resource Use and Subsistence Economy / Basic Mapping

This study was conducted by the Cree of Fort George to establish their dependence upon subsistence resources on land slated for the James Bay Hydroelectric Scheme. This study differed from other land use and occupancy mapping in that harvest levels were attached to specific areas.

REFERENCE(S): Weinstein, no date.

Canada: Cree & Beaver, Infrastructural Impact Assessment / Map Biographies

When the Alaska Highway was proposed as a pipeline corridor, 5 Cree and Beaver Bands in northwestern British Columbia obtained funds for an impact study, to be based on a historical comparison of the impacts of the highway itself since its construction in 1942. Map biographies from all adult men were compiled for the periods before and after 1942 and drawn directly onto 1:250,000 sheets, together with data on trails and animal habitat. These were compared with maps of settlement and industrial resource use.

REFERENCE(S): Union of British Columbia Chiefs 1980.

Canada: Inuit Halibut Fishery, Pangnirtung / GPS

In the late 1980s, Inuit of Pangnirtung developed a local halibut and scallop fishery. Halibut are taken in late Winter, on 600m lines let through holes in the sea-ice of Cumberland Sound, a large stretch of water

close to the community. Although preliminary surveys indicated that there were enough halibut to sustain a local fishery, these were not comprehensive enough to ascertain seasonal distribution and abundance of the halibut. As a result, the fishermen sometimes dig barren holes through 1-2m of sea-ice. In 1990, the community obtained a GPS unit for use in local search and rescue. Another potential application was realized when the fishermen began to utilize GPS to georeference each fishing hole, record the catch, thus generating a map of relative halibut distribution.

Canada: Manitounuk Sound Waterfowl Ecology Mapping

This ongoing mapping project was initiated in 1991 by the Grand Council of the Cree to document Cree use and knowledge of waterfowl ecology in expectation of an environmental review of the Great Whale Project, an extension of the James Bay Hydroelectric Project.

Canada: Nimpkish Kwakiutl Resource Management Study / Basic Mapping

Frustrated by lack of access to governmental planning processes and concerned about deforestation and dwindling salmon populations, the Kwakiutl decided to compile their own database on resource use on their traditional lands in the Nimpkish Valley, British Columbia, for use in public hearings and meetings in support of their call for an integrated approach to managing the valley. This was not a conventional land use and occupancy study instead it focused on resources, habitat, alienation, industrial resource exploitation and settlement. Overlay maps were made on 1:50,000 topographic sheets and their comparison allowed the identification of major areas of resource conflict. The overlay process also demonstrated that, in some cases, government planning decisions had been based on faulty or incomplete data. This data is now being transferred to GIS.

REFERENCE(S): Brooke 1993.

Canada: Nisga'a / Aerial Video-Mapping

The Nisga'a Tribal Council commissioned aerial video imagery to classify and map shoreline types, to make an inventory of associated biological resources, and to assess the potential for kelp and seaweed harvesting and for shellfish culture. A twin-engine aircraft was used, with a super VHS 6mm video camera mounted in a perspex dome under the tail, controlled remotely by a joystick and video monitor in the cabin. The imagery was georeferenced by using a GPS to record aircraft position on the tape. The aircraft was flown at an altitude of between 35-120m and 400 km of shoreline was mapped.

REFERENCE(S): Nass, Bryna L. 1993.

Canada: Whapmagoostui Land-Use Study / GIS

This study was commissioned by the Grand Council of the Crees as part of their strategy to contest The Great Whale Project, an extension of the James Bay Hydroelectric Project. The information was to be used for litigation, impact assessment, negotiations and project modifications. The maps illustrate how Cree use resources and perceive their limitations. They are supported by harvest studies, a community profile and needs assessment, and archeological reports. All geographic data has been processed on a GIS.

REFERENCE(S): Brooke 1993.

Ecuador: Shuar Land Claims / Basic Mapping

Shuar land claims were mapped with cartographic methods using standard survey technology over a period of twenty years after a U.S. Peace Corps program initiated the effort and trained the Shuar in the techniques. The process included organizational efforts to educate communities about the value of community land title, to mobilize the contribution of community labor toward the border demarcation of their territory, and to develop organizations for border negotiations between neighboring communities. As a result, hundreds of communities have received land titles.

REFERENCES: C. Kleymeyer, Inter-American Foundation, personal communication.

Senegal: Ndam Mor Fademba Boundaries / RRA

A Rapid Rural Appraisal was carried out by World Vision for five days in October 1991. Local maps were drawn in the sand as a means of articulating the relationships between villagers and their lands. This was one of 6 Ndam communities. This process illustrated how boundaries between the six villages tended to be fluid, to accommodate inter-family transactions, whereas the collective Ndam boundary was more clearly defined, with reference to natural and introduced features.

REFERENCES: Schoonmaker-Freudenberger 1991.

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DIRECTORY OF MAPPING SUPPORT PROGRAMS

The following list identifies programs, both active and proposed, informal or dedicated, which have supported, stimulated or assisted in the kinds of projects described in this report, and which combine one or more aspects of local mapping, indigenous land recovery, demarcation, and biodiversity conservation. Contact information is provided along with brief descriptions of activities known at the time of preparation of this report.

BIODIVERSITY SUPPORT PROGRAM has provided support to local mapping projects in Indonesia, Namibia, Panama, the Philippines and Thailand. c/o WWF, 1250 24th Street, NW, Washington, DC 20037, USA. TEL: 202-861-8313 FAX: 202-861-8324.

BUREAU OF INDIAN AFFAIRS has set up a program, Indian Integrated Resource Information Program, to support the introduction of GIS to Native American resource groups. U.S. Dept. of Interior, Bureau of Indian Affairs, Geographic Data Service Centre, 730 Simms Street, Room 101, Golden, CO 80401, USA.

CENTER FOR THE SUPPORT OF NATIVE LANDS has provided support for the series of community-based mapping projects in Honduras, Panama, Nicaragua and Belize. 3240 Wilson Boulevard, Suite 220, Arlington, VA 22201, USA. TEL: 703-841-9771 FAX: 703-841-9774.

CLARK UNIVERSITY, Clark Labs for Cartographic Technology and Geographic Analysis, has developed a GIS, IDRISI, designed to meet the needs of developing areas. 950 Main Street, Worcester, MA 01610-1477, USA. TEL: 508-793-7526, FAX: 508-793-8842.

CONSERVATION INTERNATIONAL has developed a geographic information system, CISIG,

designed to meet the needs of environmental and indigenous NGOs throughout the Americas. Obtainable for $5K. Works in English, Spanish, Portuguese. 1015 18th Street, Washington, DC 20036, USA. TEL: 202-429-5660, FAX: 202-887-5188.

EAST-WEST CENTER has supported mapping research within Indonesia. East-West Center, Program on Environment, 1777 East-West Road, Honolulu, HI 96848, USA. TEL: 808-944-7298.

The ENDANGERED PEOPLES' PROJECT, with support from the Environment and Development Support Program has initiated a series of community-based training workshops in SE Asia. EPP, Vancouver, BC, Canada. Alix Flavelle, 1040 Lakewood Drive, Vancouver, BC V5L 4M2, Canada.

The ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI) has a program to train and support environmental and indigenous groups in using ARC/INFO GIS. ESRI, 380 New York Street, Redlands, CA 92373-8100, USA. TEL: 714-793-2853, FAX: 714-794-5953.

FIRST NATIONS AVIATION (FNA) AND THE LOCAL EARTH OBSERVATION (LEO) PROJECT are developing low-cost aerial methods to assist First Nations in environmental mapping and monitoring. FNA, RR1, Deseronto, Ontario K0K 1X0, Canada. TEL: p613-396-3100, FAX: 613-396-3761. LEO Project, 4491 Harriet Street, Vancouver, BC V5V 4K4, Canada. TEL/FAX: 604-876-1958.

The INDIAN LAW RESOURCE CENTRE has provided legal and advocacy support for several of the reported projects in Central and South America. 601 E Street, SE, Washington, DC 20003, USA. TEL: 202-547-2800, FAX: 202-547-2803.

The INTERNATIONAL INSTITUTE FOR ENVIRONMENT AND DEVELOPMENT has supported and stimulated PRA projects and publishes *RRA Notes*, a valuable source on methodologies and local experiences. 3 Endsleigh Street, London WC1H 0DD, UK. TEL: 71-388-2117, FAX: 71-388-2826.

The INTERNATIONAL WORKGROUP FOR INDIGENOUS AFFAIRS has assisted in land titling projects in many areas. IWGIA, FiolstrFde 10, DK-1171, Copenhagen K, Denmark. TEL: 33-124724, FAX: 33-147749.

LIGHTHAWK is in the process of acquiring an advanced video-based multispectral scanner, to be mounted in a light airplane, which can mimic the spectral windows used by remote sensing satellites and which will be used for local mapping projects for environmental NGOs and indigenous resource groups. P.O. Box 8163 Santa Fe, NM 87504-8163, USA. TEL: p505-982-9656, FAX: 505-984-8381.

The RAINFOREST FOUNDATION INTERNATIONAL has assisted indigenous peoples in the Amazon in demarcation projects and is continuing to support post-demarcation projects. RFI, 270 Lafayette Street, New York, NY 10012, USA. TEL: 212-431-9098, FAX: 212-431-9197.

SURVIVAL INTERNATIONAL has supported indigenous peoples demarcation and mapping of traditional territories. SI, 6 Walton Manor Court, Oxford, England, OX1 6EL, UK.

The UNIVERSITY OF SUSSEX INSTITUTE OF DEVELOPMENT STUDIES has been a major source in the development of PRA methodologies and local village mapping. University of Sussex, Brighton BN1 9RE, UK. FAX: 273-621-202.

The WOODS HOLE RESEARCH CENTER has assisted in community-based training in satellite image analysis in the Amazon. P.O. Box 296, 565 Woods Hole Road, 13 Church Street, Woods Hole, MA 02543, USA. TEL: 508-540-9900, FAX: 508-540-9700.

The WORLD RAINFOREST MOVEMENT has developed a proposal: AIndigenous Territories and Resource Use Mapping Project: South East Asia Region to assist forest peoples in mapping. WRM, 8 Chapel Row, Chadlington, OX7 3NA, UK. TEL: 60-876-691, FAX: 60-876-743.

WORLD WIDE FUND FOR NATURE and WORLD WILDLIFE FUND - US (WWF) have supported mapping in Indonesia and Central America. WWF/Indonesia Programme, Timothy Jessup, Jl. Pela 3, Gandari Utara, Jakarta Selatan 12079, Indonesia. TEL: 21-720-3095, FAX: 21-739-5907. WWF/Central American Program - Pam Hathaway, 1250 24th Street, NW, Washington, DC 20037, USA. TEL: 202-293-4800, FAX: 202-293-9211.

ABOUT THE AUTHOR

Peter Poole has spent his career working on a broad range of indigenous and natural resources issues, including trade, wildlife resource inventories using remote sensing, increasing local food production and self-sufficiency, and national park design and management. In addition he has worked internationally with a diverse range of institutions such as the Shuswap Nation Tribal Council, World Bank, Global Environment Facility, among others. Based in Vancouver, Canada, Dr. Poole received his first degrees in sociology and economics from the University of London, followed by an M.A. in geography from Columbia University in New York, a Post-Graduate diploma in aerial photo interpretation for landscape and ecological services from the International Institute for Aerial Survey and Earth Sciences in Enschede, the Netherlands, and a Ph.D. in Geography from McGill University in Montreal. Dr. Poole currently works for The Local Earth Observation (LEO) Project, 4491 Harriet Street, Vancouver, BC V5V 4K4, Canada.

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