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COLLABORATIVE LAND USE PLANNING: Zoning for Conservation and Development in Protected Areas

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Participatory zoning projects promise to balance conservation and development at a landscape scale, but such efforts face serious political and institutional challenges. Case studies from Bolivia, Philippines and Peru reveal that governance, funding commitments, ecological context, and the use of innovative mapping techniques can stall or advance zoning outcomes.



Zoning protection

IN THE PAST 25 YEARS, the area of land under legal protection increased exponentially, particularly in developing countries where biodiversity is greatest. Concurrently, the mission of parks and reserves expanded significantly. By global mandates, protected areas (PAs) now are supposed to do far more than conserve biological diversity. These areas are charged with improving human wellbeing and providing economic benefits across multiple scales (WPC 2003).

At many sites, management and donor agencies have initiated participatory zoning projects to balance conservation and development around PAs. Participatory land use planning is an offshoot of zoning, which was invented in the early 20th century as an urban land management device. Urban zoning is premised on managing incompatibility in land use relationships to optimize social and economic ends for the broad public. In the late 1920s, rural zoning was invented to address the dual problems of abandoned land and inefficient government expenditures (Rowlands 1933). Zoning in any context ultimately involves negotiating the rights of

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the individual and the rights of society. Thus zoning is an inherently political intervention that reveals underlying power struggles and social conflicts (Jacobs 1998).

Participatory zoning for environmental management purposes emerged in the zoning lexicon in the 1970s. PAs typically include substantial areas under customary and/or legal title, much of it pre-dating creation of the PA. It is financially and politically impractical to buy all these claimed lands for biodiversity protection, so conservationists have increasingly turned to zoning as a tool. Although participatory zoning projects typically focus on *where* resources should be preserved or extracted, they also designate, explicitly or implicitly, *who* has authority and access to these areas. Zoning aims to promote broad societal benefits, but this may cause some claimants to lose access to certain rights, while others gain (or regain) access (Jacobs 1998). In the large and valuable areas that typify most PAs, many groups claim authority and access. Managing PAs effectively means bringing these often-competing groups together to negotiate rules transparently and democratically for managing use and avoiding conflicts.

Ideally, participatory zoning balances conservation and economic development goals across large areas and among diverse stakeholders. In any one locale, tradeoffs between biodiversity conservation and economic development are likely, but at larger scales side by side integration may be possible (Robinson and Redford 2004). Buffer or multiple use zones can be established to soften the line between preserving biodiversity and extracting resources. Participatory zoning permits planners to draw boundaries that acknowledge pre-existing claims and/or highlight areas of special ecological importance. Community mapping, aided by GPS/GIS technology, can bolster traditional resource use claims. Boundary demarcation also ought to reflect dynamic ecological processes, including wildlife migrations and

disturbance regimes. Therefore, effective zoning for PAs requires sound science and innovative use of technology.

Participatory zoning promises to link customary and scientific knowledge and build alliances among competing groups (Healey 1999). Yet participatory zoning often is not truly participatory. Deeply political and often contentious governance decisions can be masked by bland planning terms such as “consensus” and “stakeholder.” Newly formed management committees comprising local leaders and government authorities to oversee the zoning processes may not be able or willing to resolve conflicts over land. Despite inclusive rhetoric, participatory zoning may be a coercive exercise designed to contain local dissent, or it may be a political maneuver to postpone or prevent enforcing unpopular rules or confronting powerful commercial interests. In such cases, zoning may actually reduce the size of PAs and set a precedent for carving up the area. Ideally, parameters of authority and decision-making are defined early in the zoning process.

Aside from these fundamental concerns, evidence from several PAs reveals that implementation and enforcement activities seldom match the complex zoning plans resting on office shelves. In the worst cases, “paper zones” have been drawn in “paper parks,” leaving diverse ecosystems and poor residents’ resources at risk to open access. To improve participatory zoning outcomes, it is critical to analyze global experiences. The following are snapshot case studies from three tropical PAs where participatory zoning attempted to link conservation with development, resolve conflict, and promote sustainability. All three cases engage the UNESCO Biosphere Reserve Model by attempting to demarcate a core protection area surrounded by zones allowing greater intensity of use. The three cases reveal that governance, funding commitments, ecological context, and the use of science and innovative mapping techniques can stall or advance zoning outcomes.

Case studies

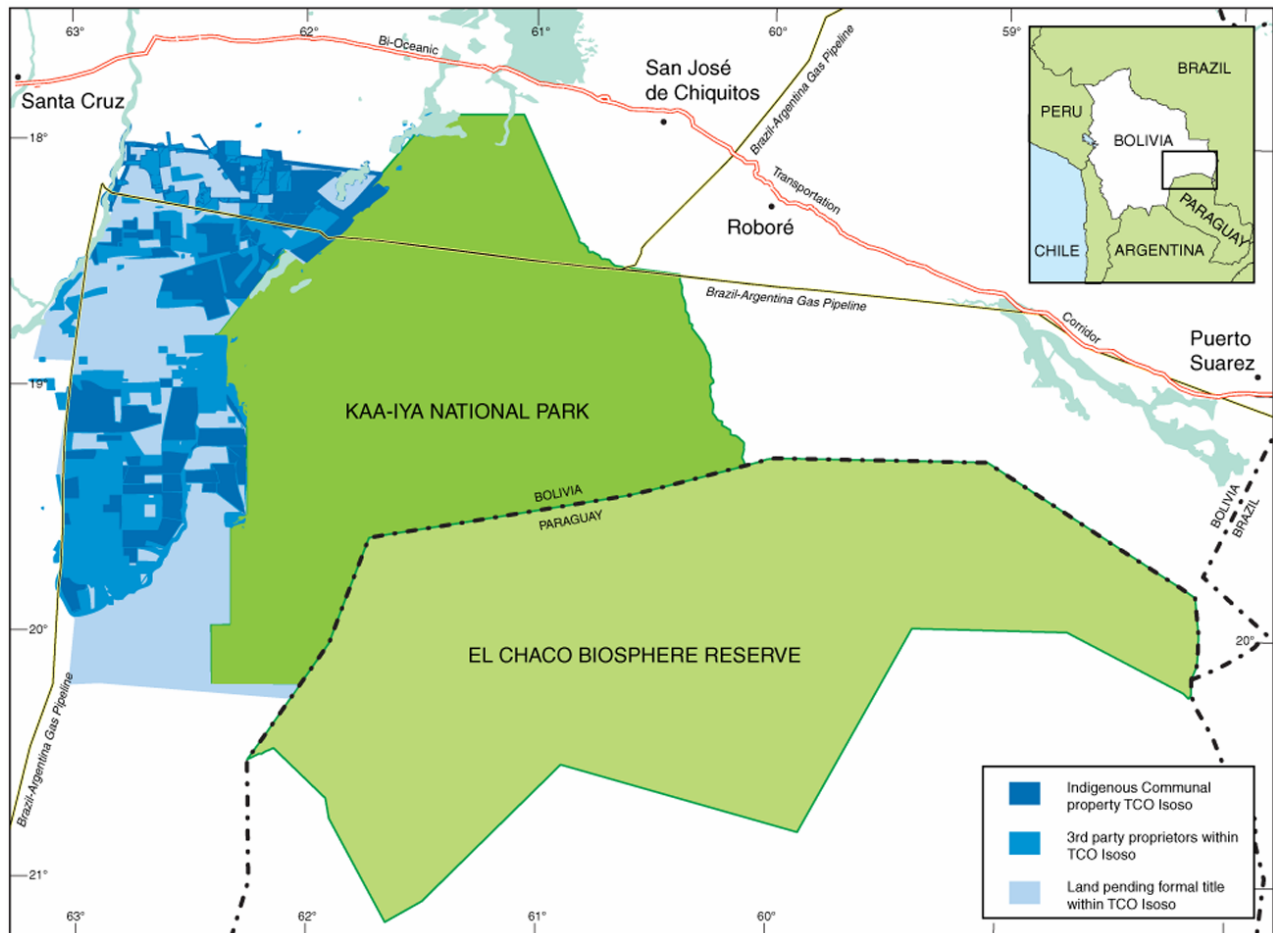
BOLIVIA: Kaa-Iya del Gran Chaco National Park

In the early 1990s, the indigenous Isoseño-Guaraní people proposed the creation of the Kaa-Iya del Gran Chaco National Park (KINP) in a sparsely populated lowland region of eastern Bolivia, where the Isoseño-Guaraní have farmed and hunted for centuries. With industrial agriculture and petroleum extraction encroaching upon the region, the indigenous people saw a park as a buffer that might slow immigration, especially from the city of Santa Cruz. Promoting creation of the park at the edge of their territory (see Map 1) would be a way to protect indigenous land and traditions.

The park proposal was reviewed and approved in community meetings. The negotiating group (and now administrative arm) for the indigenous people was the Capitanía del Alto y Bajo Isoso (CABI), representing some 10,000 people in 23 communities. In 1995, the Bolivian government approved the proposal and established a 3.4 million hectare park to be co-managed with CABI. A park management committee was formed including members of the three indigenous groups, and authorities from the regional and three municipal governments (Noss and Castillo 2007).

The direct local economic impact of the park creation was minimal due to its remote location. The original decree establishing the park also identified three integrated

Map 1. Kaa-Iya National Park, neighboring indigenous territory and Biosphere Reserve, Bolivia



Source: O. Castillo, GIS Program, WCS, Santa Cruz, Bolivia. Revised with permission by UW-Madison Cartography Lab.

management areas where indigenous groups would be able to extract resources in the future. The park decree also defined a core zone where no extraction was allowed. In the subsequent participatory development of the KINP management plan, biodiversity and socioeconomic teams that included indigenous and other local technicians generated maps of the PA and integrated these into a new zoning plan that includes additional core protected areas, extensive areas for non-extractive and extractive use (for example, livestock raising), special use areas for a gas pipeline, and recovery areas. This zoning was reviewed by local communities and approved by the national government.

In 1996, under Bolivia's agrarian reform law, CABI requested a 1.9 million hectare indigenous territory adjacent to KINP. The government accepted, and an ongoing titling effort is expected to award roughly 1 million hectares of formerly untitled land to CABI, with the remaining 0.9 million hectares consolidated in private, non-indigenous ownership. At the time, there were also plans to run the Bolivia-Brazil gas pipeline through the area and hydrocarbon concessions were granted inside KINP.² Because of its standing as co-manager of the park, CABI was able to negotiate an agreement with the sponsors of the pipeline to establish a trust fund for managing the park, as well as additional funds for titling indigenous lands, strengthening local institutions and promoting development via the purchase of hand pumps to supply water to households and community livestock ranches. As the representative of the Isoleño-Guaraní indigenous people, CABI owns the indigenous territory under a communal title, which does not allow for sub-division or sale by individuals or even communities. Private landholders, however, can sell their properties.

² Exploration activities have stopped they were not economically viable, but the pipeline was constructed (Noss and Castillo 2007).

Anyone can build roads and otherwise develop their land, although legally, development must accord with government-approved land management plans. CABI's successful request for an indigenous territory actually exceeded the areas of current use identified in the participatory maps, but CABI based its claim on historical occupation plus future space requirements (Noss and Castillo 2007).

KINP is a largely successful example of the devolution of land rights to local groups, including co-management by an indigenous organization. A critical element has been a supportive national policy framework, within which the Government of Bolivia adopted the approach known as "parks with people" since 1991. Also, critical to successes was collaboration between local and international organizations and agencies. The Wildlife Conservation Society (WCS) and the United States Agency for International Development (USAID) provided financial and technical assistance and helped open political space for negotiation (Winer 2003). The international pipeline sponsors (including the World Bank) had policies favoring just compensation and indigenous peoples (Winer 2003). CABI's authority as park co-manager provided a final key ingredient, justifying their space at the negotiating table.

Recent significant political changes threaten to undermine this collaboration. The co-administration agreement expired in 2006 and has yet to be renewed. Moreover, a local municipality is pushing for changes in park boundaries so as to expand its authority and allow road improvements through KINP (Noss and Castillo 2007).

Mapping technology and social science also were and remain essential ingredients. In 1996, anthropologists worked with representatives from each community to map resource use in neighboring areas. GPS experts then helped community representatives transfer survey information onto topographical maps, which identified hunting and fishing areas, natural

resource collection areas, and sacred sites (Noss 2007).

Zoning at KINP improved local communities' welfare and advanced conservation goals by creating a park as a buffer from colonization. Moreover, in parallel with the park, the legal titling of the neighboring indigenous territory allowed residents to better defend their land claim and revitalize their traditional production systems. Secure tenure over resources motivated the indigenous groups to manage the PA actively. Local leaders hope this will reduce degradation of ecologically sensitive areas and promote sustainable use of animals and plants. Field data suggest that important species are being conserved, for example tapir and white-lipped peccary, which are important game species disappearing from surrounding regions (Noss 2007).

PERU: Tambopata National Reserve and Bahuaja Sonene National Park

Like KINP, Tambopata is a vast, sparsely inhabited lowland region. Indigenous groups, miners, agriculturalists, tourism agencies, loggers and oil companies all claim parts of this forested frontier. For 17 years, zoning negotiations have been ongoing, prompting four legal boundary changes to accommodate shifting socio-economic conditions. Such instability has made signaling and implementing zones more difficult.

Conservationists aimed large when they created the 1.5 million hectare Tambopata-Candamo Reserved Zone (TCRZ) in 1990. Although the founders did not initially consult many local residents, under Peruvian law a Reserved Zone is transitory, allowing time for subsequent negotiation and ecological assessments necessary for more permanent boundaries (Ricalde 1989). The TCRZ eventually resulted in (a) a National Park (the highest category of protection), (b) a National Reserve (a category that allows for limited use of natural resources) and (c) some areas remaining as private landholdings (see Map 2.)

Many local citizens initially opposed TCRZ for fear of losing access to land and resources. Peruvian NGOs sought to increase local support and negotiate public consensus for land use in TCRZ. With financial support from the MacArthur Foundation and USAID, these NGOs worked with local agriculturalists, indigenous groups, and state agencies to title land within and outside the Reserve. They also proposed the creation of a one million hectare national park, "Bahuaja-Sonene," at the uninhabited core of TCRZ. After a year of public meetings, local stakeholders approved the proposal to create a park in remote, largely uninhabited regions and agreed to participate in land use zoning for the nearby multiple use Reserve (Chicchón 2000).

When the national government legally established the park in 1996, it reduced the park's extent by approximately 60% to accommodate a one million hectare exploratory oil and natural gas concession for Mobil Oil straddling the proposed park and adjacent area. Despite a stipulation that the Natural Resource Institute (INRENA) would incorporate the areas relinquished by Mobil Oil into the national park, once the oil exploration was completed, local citizens felt deceived and protested violently. Many felt they had agreed to forego logging and agriculture in this remote area, only to have an oil company enter instead. Some local leaders walked away from the planning process, others struggled to convince their constituents to remain involved.

Impetus for a renewed zoning effort came in 1999 when Mobil Oil released its concession due to inadequate reserves, and INRENA followed through with the plan to incorporate that land into the national park (Map 2). At the same time, Peru passed a new law promoting zoning in PAs.

Peru's 1999 Protected Areas Law (enacted in 2001) delineates categories of PAs according to levels of resource use and requires zoning within the master plan of each PA, guided by a

Local Planning Committee formed of representatives of agriculturalist and indigenous federations, mining cooperatives, conservation NGOs, tourism companies and staff from Peru's National Council for the Environment and INRENA. Thus a new zoning effort was launched in Tambopata. According to NGO and government staff, they served as "catalytic agents" and technical advisors, but leadership came from the Committee as a whole.

Simultaneous to this third phase of zoning at Tambopata, the Research Institute of Peru (IIAP) began zoning the broader region (Madre de Dios) following the Amazon Cooperation Treaty plan for "ecological-economic" zoning (Sombroek and Carvalho 2000). This larger process heightened public interest in land use planning, and by some accounts made the Tambopata effort longer and more conflictive because it was now taken seriously.

After months of meetings, the Local Planning Committee reached consensus on the creation of a National Reserve in the area bordering Bahuaja-Sonene National Park. Any legally documented land claims within the Reserve could be excised if owners demanded to be "liberated" from the Reserve. The local plan was then sent to the national office of INRENA where it sat for six months. Local citizens subsequently learned that INRENA had developed a separate zoning proposal for TCRZ, with seeming disregard for the local plan. This rebuff added to local protests regarding logging and mining restrictions. In 2000, the agriculturalists' federation mobilized the local population to demand significant reductions in the size of TCRZ. To draw attention to their campaign, protesters marched in the street and temporarily closed the regional airport.

Facing bureaucratic stalemate and local unrest, the Local Planning Committee urged the national office of INRENA to consider the locally developed zoning proposal. Later that year, INRENA announced the official zoning

of TCRZ. The northern sector of TCRZ became the Tambopata National Reserve, and Bahuaja-Sonene National Park was doubled in size (Map 2). This final zoning plan largely followed that of the Local Planning Committee regarding land use outside the Reserve. Several communities were "liberated" from TCRZ per their wishes. Also excised was the headwater region of a major tributary of the Tambopata River, an ecologically important area and home to an indigenous group in voluntary isolation. These headwaters became part of a buffer zone, an ambiguous category that failed to prevent the subsequent proliferation of illegal gold-mining and logging. Other communities in the south found themselves within the expanded park, apparently due to cartographic error.

The Local Planning Committee's 1999 proposal for *internal* zoning of the Tambopata National Reserve was largely ignored. Government officials explained that the local plan had not incorporated sufficient scientific and ecological considerations, and erroneously proposed illegal land uses. In 2001, the Local Planning Committee was renamed the "Management Committee" and a fourth phase of zoning began to sort out land use within Tambopata Reserve. Several zoning "veterans" participated a fourth time. Workshops were held in communities within the Reserve in which citizens were asked once again to draw maps delineating their resource use areas.

This time, however, ecologists and foresters also demarcated ecologically sensitive areas for restoration or protection, and by local accounts, their voice carried special weight. In the final plan, use zones within Tambopata Reserve generally conformed to previous patterns of extraction, although one area of intact forest was zoned for "special use" due to the recent arrival of colonists. Another area of active mining was re-zoned for tourism and ecosystem restoration, but this has not been enforced.

The outcomes of zoning efforts at Tambopata are mixed. On the positive side, information

was generated and disseminated, which encouraged public dialogue. A large area was eventually legally designated for protection after Mobil Oil rejected it. However, some indigenous communities, such as the Ese'ejá, believe they lost part of their territory in the process. Conservationists are meanwhile concerned that buffer zone rules are too ambiguous to protect forest and wildlife. Even some zones within the Reserve are neither publicly recognized nor enforced (for example, miners work in the ecological restoration zone). Local PA managers blame budget shortfalls, pointing out that in some years donors spent more than \$100,000 on participatory planning, while INRENA has less than \$10,000 to implement such plans (Landeo 2006).

PHILIPPINES: Mt. Pulag National Park

Mt. Pulag encompasses 11,560 hectares of mid-elevation forest and grassland in the Philippines, a biodiverse habitat threatened by agriculture, hunting, logging, tourism and road construction. Park boundaries were originally set in 1987 without any ground survey work. Zoning efforts began at Mt. Pulag as prescribed under the National Integrated Protected Areas Systems Act of 1992, with funding from the European Commission. This process included community consultations and ecological surveys. The Philippines is one of the few Asian countries to officially endorse indigenous peoples' presence and resource use within PAs. Specifically, the Indigenous Peoples Rights Act (1997) supports the transfer of title and management authority for ancestral domains within PAs to defined indigenous communities. But other national legislation (Local Government Codes) confers management authority to municipal governments.

Zoning decisions were complicated by the presence of four overlapping indigenous groups' territories within the park (see Map 3). Competition for the mountain itself was intense, given its spiritual significance and tourism value. To resolve conflicting land

claims, a Protected Area Management Board (PAMB) was created, comprised of indigenous leaders, municipal officials and park staff. Yet the PAMB had uncertain authority and, after approximately 10 years of deliberation, failed to reach consensus. As funding dwindled in 1999-2000, PAMB rushed to finalize a zoning plan. Two rounds of public meetings and hearings produced two conflicting resolutions. Two communities neighboring the park (the Kalanguya tribal organization and the Kabayan municipality) endorsed the park boundaries but claimed ancestral domain rights to the entire park area. Park officials rejected this proposal on the grounds that no such "ancestral park" category existed, and this would exclude other local municipalities. In a second proposal, two indigenous communities proposed excising certain areas from the park (Pinel 2007).

Rather than changing park boundaries, the Department of Environment and Natural Resources (DENR) delineated a core area and multiple use zones. The PAMB approved the zoning plan, as did one municipality (Kabayan). However several stakeholders filed objections with support from provincial political bodies. As a result, the DENR never recommended the plan to Congress. As public meetings continued (and consumed nearly 80% of the park budget), two roads were built illegally in cloud forest habitat within the park. These roads were sanctioned and funded by municipal authorities, including those serving on the PAMB, which as a body publicly rejected such actions. The roads signal the limited power of zoning in light of municipal politicians' drive to improve infrastructure and please voters.

Mt. Pulag's boundaries were never changed and a Congressional Act promoting indigenous management of park areas was never adopted. The DENR currently retains authority over the park. In the future, indigenous communities within the park will hold overlapping authority if the Indigenous Peoples Rights Act is

enforced and title is transferred. The DENR has meanwhile attempted to implement the management zones through the use of forest rangers and local officials, but enforcement is hindered by shortages of staff, funds and authority. Conflicts persist in the multiple-use zones where there is steady encroachment.

Although local communities appear to support the strict protection zone, they too have limited authority and negligible budgets. The PAMB recently requested funding to mark the physical borders of zones, hoping this would effectively limit agricultural expansion into the park.

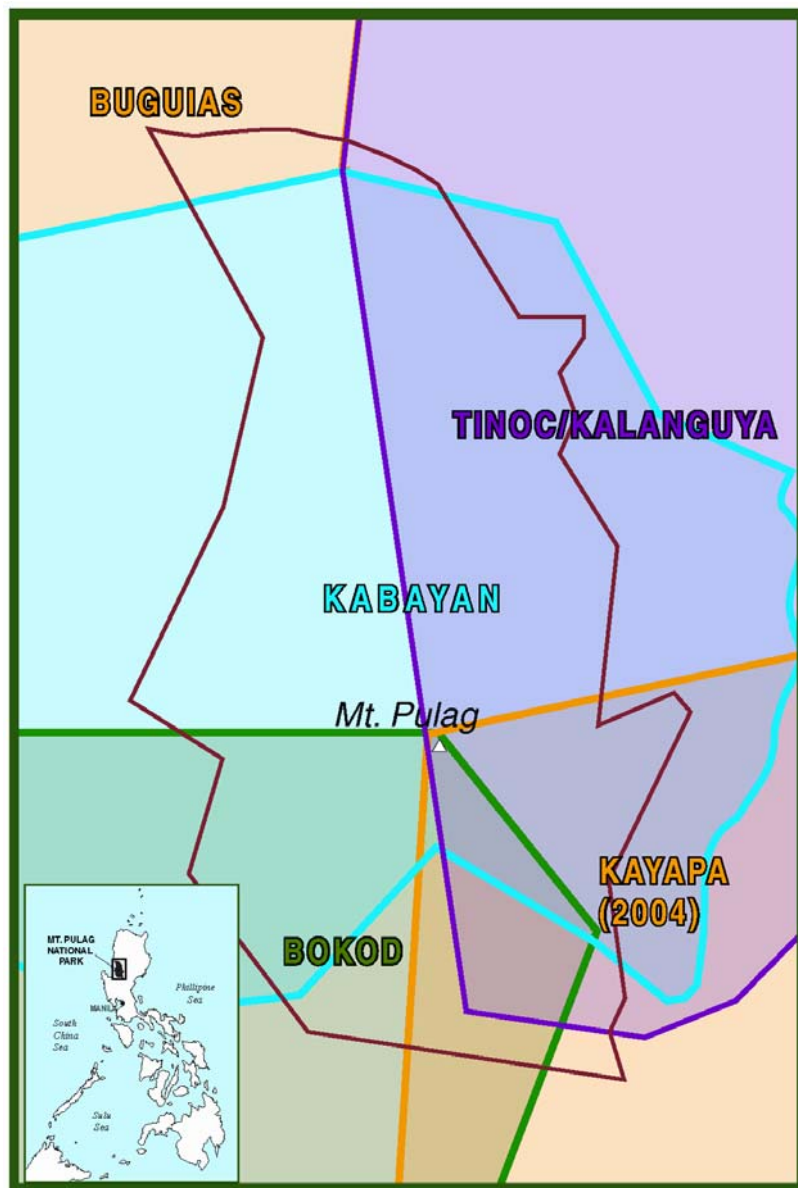
Participatory zoning has had limited success from both a governance and ecological standpoint at Mt. Pulag. Despite considerable investment and years of deliberation, zoning has not resolved land use conflicts. Contradictory and shifting national policies hindered collaborative planning, as have overlapping claims by indigenous groups and municipal governments.

Lessons

Participatory land use planning may be slow and uncertain, yet it remains one of the few options for managing landscapes for conservation and development. Therein lies its prominence in regional conservation efforts. In all three cases reviewed here, participatory zoning initiatives fostered dialogue and introduced a sense of landscape-level conservation among multiple stakeholders. The participatory process also partially redressed boundary-drawing “errors” from the time of the PAs’ creation; for example, those boundaries that erased ancestral claims and/or excluded critical

Map 3. Ancestral domains claimed by indigenous representatives in zoning initiative, Mt. Pulag National Park, Philippines, 1997

(For illustrative purposes only)



Source: DENR, Philippines, and Pinel 2007. Revised with permission by UW Madison Cartography Lab.

ecosystems.³ In the best instances, customary and scientific knowledge were brought to bear on land allocation decisions.

PAs face increasing management complexity, however, and the case studies underscore the need for better understanding of governance, science, and innovative mapping methods to improve planning exercises.

Governance

Legal framework. State and national legal frameworks fundamentally shape the outcome of participatory zoning efforts. Like many other developing countries, Bolivia, Peru, and the Philippines all recently passed legislation promoting participatory zoning in PAs and the creation of park-level management committees or boards to guide the process and build public alliances. These reforms conform with international donors' call for participatory PA management, as well as national campaigns to decentralize environmental governance.

New legislation helped launch and legitimize zoning initiatives in PAs, but new laws can also create uncertainty and result in overlapping jurisdictions. In Mt. Pulag, competing and unclear national policies about indigenous territories and municipal-level authority within PAs confused local negotiations. Amid uncertainty and shifting rules, competing interest groups may be reluctant to negotiate or compromise. National governments also may undermine local collaborative

planning more directly. In Tambopata, one government agency sponsored local deliberations about conserving a pristine area, while another issued an oil concession in the same area.

Lessons

Participatory land use zoning is a slow and uncertain endeavor yet remains one of the few options for integrating conservation with development at the landscape level.

Ecological context matters. Highly imperiled habitats may require more agile strategies (e.g., conservation concessions).

Within parks, areas of fertile soil or high tourism potential often attract multiple and conflicting claims.

Institutions strongly shape zoning outcomes. New national policies promoting participatory planning open opportunities for negotiation but may also create confusion. Amid shifting and/or ambiguous policies, local stakeholders will be reluctant to compromise in land use planning exercises.

Amid decentralization, municipal governments have more power and this needs to be considered carefully in zoning negotiations.

Newly created local park management committees have uncertain authority. Their role deserves critical attention.

Support for implementation is often grossly neglected. Zoning is most likely effective if scaled to managerial capacity and viewed as legitimate by local citizens.

Field research and monitoring is essential for lasting conservation. Science needs to be presented in a transparent fashion. Opportunities to adapt and rezone for biodiversity purposes need to be built into plans, just as such opportunities are offered for future economic development.

Innovative mapping promises to link customary and scientific knowledge and facilitate negotiation. Yet donors shouldn't spend money on elaborate maps if that means that there is no funding left for implementation.

³ The literature is peppered with references to "erroneous" boundaries drawn at the creation of the parks, yet case studies show that there never will be perfect, conflict-free boundaries.

In KINP, planning worked more smoothly because of government recognition of the indigenous groups, through CABI, which

proposed the park. The government ceded park administration to CABI, yet maintained the management of concessions. When the government imposed an oil pipeline through the park as in the national interest, this superseded local rights to resource use. Yet, as the administrator of the PA, CABI was able to negotiate with the pipeline sponsors to establish a trust fund to support park management and provide resources for communal land titling and development activities.

Collaboration. Not all stakeholders will be winners, yet building alliances and collaboration among multiple stakeholders can lead to more equitable and less costly management and monitoring for PAs. As environmental governance is decentralized, local participation becomes more important, though planners should not assume shared goals among various constituents. Local citizens may see PAs as an imposition on their land rights, and enforcing conservation can be a sensitive issue, given the exclusionary and abusive record of some park administrations. In turn, local demands can be politically charged and may not include biodiversity conservation as a goal.

In Machalilla National Park, Ecuador, zoning initiatives raised public expectations that land use restrictions would be entirely lifted; in essence some citizens hoped the park would be “de-gazetted” (Alvarez 2006). Thus some conservation agencies resist granting control of forests and wildlife to local groups. For example, park authorities at Tambopata were reluctant to accept the original zoning plan negotiated by NGOs and local communities for fear it would downgrade the protection of key ecosystems. Elsewhere, the responsibility for PA management has been transferred to local institutions, but without economic support, implementation has stalled (Larson and Ribot 2004).

People will participate in a meaningful way if they think it is in their best interest. At KINP, CABI worked with conservationists to

establish a park and thus gained their support for titling indigenous land in the adjacent area. By contrast, as the Mt. Pulag case illustrates, buy-in to the process may be lost if the rules change midstream, or if the PA management committee has uncertain authority. Participants may then merely go through the motions of participation and negotiation, or may actively subvert the process. Leaders of participatory processes ought to publicly acknowledge the uncertainties involved and elicit people’s involvement in participatory adaptive management—including evaluation and adaptation of the process.

The merits of zoning as a conflict-management strategy are uncertain. In KINP, zoning helped secure claims and reduce conflict between indigenous communities and other stakeholders. Yet, efforts to draw boundaries among indigenous groups heightened competition at Mt. Pulag (Pinel 2007). Zoning can destabilize communities’ traditional management practices in common areas and lead to an acceleration of ecosystem degradation if communities do not understand the rationale of zoning or were not involved in its design and implementation. Zoning efforts are most likely to be effective if they are scaled to managerial capacity and are viewed as legitimate by local citizens and key stakeholder groups.

Financial and institutional support. Participatory planning is costly and slow.⁴ Defining and identifying property rights can be a contentious and lengthy process. In all three case studies, participatory zoning lasted well over a decade and exhausted scarce financial resources. For example, 80% of the annual budget for Mt. Pulag was spent on planning meetings. Critics argue that rapid deforestation and biodiversity loss leaves no time to wait for

⁴ So slow in some cases as to show no progress whatsoever. One community neighboring Mt. Pulag held 28 meetings over a 10-year period to discuss a boundary location. They never reached consensus.

public consensus. The case studies reveal a serious problem in following plans through to implementation. Far more is spent on planning and public meetings than on implementation. Zoning plans may come to nothing if managing institutions are powerless. In such cases, zoning may not be an appropriate intervention and alternative strategies (conservation concessions, for instance) may prove more effective.

Planning for change. In principle parks are permanent, and thus promise protection in face of future economic demands. Yet conservationists must recognize, respond and manage for change over time. At all three sites, zoning negotiations took place amidst shifting resource use and political alliances. In Tambopata, earlier zoning plans focused on balancing agriculture with forest conservation. Later efforts had to contend with booms in mining, tourism and logging. In the 1990s, Tambopata's citizens voted in a mayor who declared the region "the biodiversity capitol of the world." They later elected a governor who promised to degazette the regions' parks and reserves for local benefit. Some communities of subsistence farmers who had originally lobbied to be "liberated" from Tambopata Reserve later regretted being excluded when they faced subsequent colonization of their lands. Experts stress that zoning rules are not intended to be permanent (Jacobs 2007). For example, in the Brazilian Amazon, ecological-economic zoning projects assume a 5-25 year planning horizon (Sombroek and Carvalho 2000). Zoning thus offers flexibility, but ever-changing boundaries are difficult to administer and leave biodiversity vulnerable to economic and political instability.

Another critical change factor is population growth within PAs. The sparsely populated landscape of the Bolivian Chaco apparently favored zoning efforts while claims to the more densely settled, fertile lands of Mt. Pulag were seriously contested. In Latin America, indigenous communities in PAs are growing faster than populations in surrounding areas.

This accelerated population growth may undermine sustainable use, or it could sustain biodiversity if such growth translates into political strength and a pro-conservation stance (McSweeney 2005).

Role of science

Zoning is meant to separate incompatible land uses within PAs (for instance, mining and ecotourism). A key role of science is to define what uses are indeed incompatible and set area parameters for sustainability. Many scientists involved in zoning favor assigning land uses based on land aptitude, priority of use, ecological functions, or ease of protection. Some conservation biologists advocate spatially explicit modeling that combines the abundance of species with the cost of protection for the maintenance of regionally important biodiversity. However, such approaches demand a balance of scientific rigor and political acceptability, a compromise that may not satisfy any of the participants. Scientists may assume a similar approach for delineating agricultural areas, hunting territories or logging tracts. Decades of zoning experience in the North American context reveal the limits of top-down, science-based land use.

Scientists likely may want more precisely defined categories than what participatory processes yield. After all, measuring management effectiveness is difficult when categories are vague. Yet efforts to reach public consensus often lead to the creation of ambiguous categories. For example, a guard at Tambopata explained that he was unsure how to enforce a large zone designated for "economic development harmonious with biodiversity conservation." Such vague designations reflect pragmatic ambiguity or the political advantages of avoiding difficult decisions about priority land uses; in other words, building public consensus on zoning plans can be easier (though not ultimately

effective) if the management objectives for contested zones remain vague.

In a participatory process, scientists usually don't make the decisions, or, if their decisions defy local priorities, their decisions may not be implemented. Scientists involved in ecological zoning are more likely to be effective if they are transparent in their work, incorporate local ecological knowledge, and clearly communicate the benefits of protective zones for neighboring communities. Recent advances in GIS technology and participatory mapping open the way to better communication and collaboration. In all three case studies, public dialogue was aided significantly by participatory mapping.

Innovative mapping methods

Methods that emphasize community participation in the mapping and zoning process to capture the cultural importance of land, as well as geographic characteristics, include participatory 3-dimensional modeling, and community integrated geographic information technology. In the former, projects build 3-D maps of zoned areas with input from

the communities. In the latter, projects use technologies such as GIS to capture community knowledge and perceptions of place. Innovative mapping approaches ought also to include information on resource control and governance.

Satellite imagery allows practitioners to compare large areas of land and to differentiate land types. Zones are delineated according to the analysis and weighting of land attributes such as type of soil, topography, hydrology, and prevalent agricultural use. Public construction of maps helps participants visualize pressure on protected areas and understand overlapping resource claims. In short, participatory GIS mapping can aid in the analysis of complex spatial data and also facilitate public dialogue. Yet caution is warranted. Practitioners keen to utilize new mapping technologies ought not to intimidate local stakeholders or confer inappropriate formality or legitimacy to proposed zoning boundaries (Harris and Hazen 2006).

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Annex: Terminology

Adaptive co-management

An approach that recognizes the evolving, place-specific nature of governance over social-ecological systems. The emphasis is on collaborative planning and decision-making among multiple stakeholders that cross community, regional and national levels. Recognizing that socio-ecological urgencies and stakeholder needs may change over time, adaptive co-management promotes trust building as the basis for governance, which involves dialogue and feedback from stakeholders, periodic monitoring, and a willingness to modify process, goals and outcomes.

Bioregional planning

Stresses the integration of social, economic and ecological factors in regional planning and management, and seeks to unite stakeholders to own and build a dynamic plan for a bioregion. Wolmer (2003) notes that bioregional planning tends to be devolved and bottom-up, with power to local communities (compare to “ecoregional planning”).

Buffer zones

Areas surrounding the core zone where only low impact activities are allowed, such as research, environmental education, and recreation. On a larger scale, buffer zones can also surround the entire PA.

Collaborative spatial planning

Involves a variety of decision-makers with divergent backgrounds and interests and seeks to bring these voices and interests into the planning process as a way of reconciling individual approaches and leading to satisfactory solutions for all participants (see Healy 1997).

Core zone

Strictly protected areas within parks or reserves. Often these zones are used scientifically to monitor natural changes in representative ecosystems.

Corridors (biological)

Areas linking habitats to allow interchange of species, migration, gene exchange, etc. These corridors can link PAs with important habitats that are not protected.

Counter-mapping

Any effort that fundamentally questions the assumptions or biases of cartographic conventions, that challenges predominant power effects of mapping, or that engages in mapping in ways that upset power relations (see Harris and Hazen 2006).

Cultural landscapes

Geographic area that includes cultural and natural resources associated with an historic event, activity, person, or group of people. In PAs, these often exist in relationship to an ecological context, such as ceremonial activities around wildlife or other natural resources.

Ecoregional planning

Wolmer (2003) notes that ecoregional planning tends to be expansive and top-down, with power to scientists and technocrats (compare to “bioregionalism”).

Extractive zones

Areas zoned for a particular use, specifically, extraction of certain natural resources. Limitations may be placed on the type and quantity of resources extracted from these zones, as well as those with the right to do the extracting. Often, industrial extraction is prohibited in these areas.

Land tenure

The relationship, whether legally or customarily defined, among people, as individuals or groups, with respect to land (in this case, “land” includes other natural resources located on or within the land, such as water and trees). It can describe institutions that determine who can use what resources, for how long, and under what conditions.

Scenario planning

Strategic method for making flexible long-term plans. Scenario planning combines known facts about the future with plausible alternative trends to illustrate examples of what could happen under particular assumptions and

conditions. Scenarios within a set are not defined in terms of relative probabilities; rather, they are contrasted against one another to provide a tool for thinking about the relationships among choices, dynamics, and alternative futures.



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