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**THE ROLE OF TENURIAL SHELLS IN ECOLOGICAL SUSTAINABILITY:
PROPERTY RIGHTS AND NATURAL RESOURCE MANAGEMENT IN MEXICO**

by Janis B. Alcorn¹ & Victor M. Toledo²

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1 Biodiversity Support Program, World Wildlife Fund,
1250 24th St, Washington D.C. USA FAX 202-861-8324, TEL 202-861-8313

2 Centro de Ecología, Apdo 70-275, Universidad Nacional Autónoma de México (UNAM), Mexico, D.F. 04510, MEXICO. TEL (5) 622-9010;
FAX (5) 622-8995.

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ABSTRACT

Property rights options should be assessed for their performance in supporting ecologically sustainable development. Tenurial systems function as "shells" in the sense that they provide the superstructure within which activities are developed and operate. They are constraining and enabling structures with particular characteristics linked in very specific ways to the larger "operating system" in which the shell is embedded. Mexico has tested a mixture of private and community-based tenurial shells for over fifty years. We offer evidence from Mexican case studies that the best course of action for designing property rights shells to enable ecologically sustainable resource management is to support existing structures that have served this function. National recognition and policy support for existing, community-based property rights systems is a design principle that can be used to enable farmers to orchestrate natural processes, social processes, and multiple species to create sustainable agroecosystems that maintain forests and high levels of biodiversity while generating economic benefits and social services that complement those generated by urban development.

1. INTRODUCTION

In assessing the options as one sets out to design or reform a property rights system, one should consider the ecological and social impacts of the property rights regimes being considered as well as the impacts of the property rights options on market function and national economic growth. Property rights systems do not just define and grant rights to property; rather they establish the rights and responsibilities of system participants vis-a-vis each other (Crocombe 1971). Property rights over land have generally been assessed in terms of trends in annual agricultural production as related to progress in formal titling to individuals, because individual titling has been viewed as the property rights design to free the market to determine investments in land use. The property of concern in this paper, however, is broader than land considered as an agricultural input or real estate for sale. It is property comprised of ecosystems and their component parts and processes; i.e., land, forest, water, and other associated resources of economic interest. The longterm value of these assets depends on their ecologically sustainable management. Using annual commercial crop production and its monetary value as a lens to assess the appropriateness of property rights alternatives ignores ecological impacts and thereby produces a shortsighted and narrow focus (e.g., Porter et al. 1991).

Sustainable economic development requires a proper balance between urban economic growth and ecologically sustainable management of rural natural resources. Rural property rights options should be assessed for how well they support the

economically and ecologically sustainable development of both urban and rural sectors, including their performance in provision of essential safety-net features for the poor (World Bank 1990).

Sometimes the best design is to seek ways to support an existing structure. Designing ways to allow the market to work efficiently is an example of designing support for an existing structure (in this case, the market). In this paper we offer an insight into designing property rights to support an existing socio-ecological structure. We consider property rights where land use patterns exhibit ecologically sustainable adaptations to changing sets of opportunities and constraints. We conclude that national support for corporate, community-based property rights systems offers a design principle that can enable farmers to orchestrate natural processes, social processes, and multiple species to create complex, sustainable agroecosystems that maintain a high level of biodiversity while generating economic benefits and providing social services that complement those generated by urban development.

We focus on Mexico, a country which has tested a mixture of private individual and community-based property rights¹ within in a modern capitalist environment for decades. Although sustainable resource management was not the objective² of Mexico's land reform legislation enacted some 80 years ago, Mexican recognition of community-based tenure has enabled locally adapted agroecosystems to continue to develop and adapt in the face of changes, while at the same time maintaining the biological and cultural patrimony that provides the inputs and means for future adaptations. For the past 20 years, Mexico has supported the largest experiment with community-based forestry in the world (Bray 1995).

The Mexican experience offers lessons for other countries. Group property rights are not legally recognized in most countries although vestiges of pre-existing, customary property rights systems persist in many biodiverse areas. Legal support for community-based, corporate tenure is a policy option that is particularly attractive for sustainable management of forests and biodiversity in situations where indigenous peoples and other rural communities use locally-adapted resource management systems.

2. CONCEIVING OF PROPERTY RIGHTS AS SHELLS

Property rights systems provide the basic structure from which spring the opportunities and avenues for resource exploitation and management. We propose that property rights systems function as "shells" in the computer jargon sense, in that they provide the superstructure, or inner environment, within which activities are developed and operate. In other words, a shell is a constraining and enabling structure with particular characteristics linked in very specific ways to the larger "operating system" in which the shell is embedded. This aspect of the shell responds to local cultural, ecological and social factors, including those arising from externally generated stresses or opportunities. Such shells are generally nested within a hierarchy of shells; each outermost shell forming the

operating environment in which the next level of inner shell operates. Shells are created within nations by special recognition of local systems that function within a particular national framework. In turn, national shells operate within the global economy -- the ultimate operating system in the computer jargon sense.

Recognition of existing local property rights regimes by powerful outside entities creates a shell around local systems, a protective border around subsystems that could not remain viable if fully exposed to the outer environment in which they are embedded. Communities, however, do need to interact with economies and organizations outside their shell. Therefore, the tenorial shell has, in addition to its protective dimensions, a facilitating dimension that enables selected interactions across the boundaries of the shell -- rather like a cell membrane inside a living organism that separates one environment from another, yet at the same time facilitates essential transfers across the border between environments.

During colonial and neocolonial times, the shells of many local communities were disrupted and the more common interface became isolated local shells abutting an outside global community and state property regimes (Alcorn 1995, Alcorn and Molnar 1995). The historical trend has been increasing loss of local tenorial shells and the locally-based resource management systems they contain. Communities inside different local shells forge organizational links between themselves and with other national support organizations and networks in order to resist legal and illegal efforts to dismantle shells.

Each community-based tenorial shell is constructed of linkages into institutions that pervade the lives of community members. The term "institution" is used here to mean the invisible bodies of rules, regulations, and processes that guide decision-making (Ostrom 1990, Ostrom et al. 1992). Such decision-making is often carried out within organizational structures -- organizations being groups of people acting in relationships governed by and legitimized by institutions. Examples of organizations include families, clans, cooperative societies, community organizations, the church, local government councils, unions, and state agencies. Organizations are frequently linked in hierarchical relationships.

Local organizations often manage community members' access to forest or other natural resources based on local common property institutions (Berkes et al. 1989, Bromley and Cernea 1989). Such institutions include rules about use and acceptable distribution of benefits, means by which tenure is determined, and conflict resolution mechanisms. These institutions contribute to the structure of the tenorial shells. Tenorial shells are created at the interface between competing social and political systems and their associated institutions. Hence, the tenorial shell includes gateways for political intercourse between the inside and the outside.

Tenurial shells and systems are invisible to those who don't participate in local political activity or directly manage local resources. For this reason, few natural resource managers, economists or ecologists have recognized or assessed the role of tenurial systems in ecological sustainability. Instead, they have uncritically accepted fee simple titling to individuals as a necessary step to facilitate development.

Our discussion focuses on old, local subsystems within the national and global economies where local feedback loops within local subsystems can lead to recognition of overexploitation of a resource and failure of ecosystem functions. When communities extract distant resources, recognition of overexploitation and follow-on harvest adjustment rarely occur. If ecosystem-level damage is registered by an extractor with longterm interest in maintaining his assets, alteration in exploitation or shifts in livelihood strategies are more likely to occur. In response to feedback and tensions between individuals seeking access to resources, local institutions have arisen to ensure community members' continued access to resources while restricting access by outsiders, as well as to manage the differentiated access rights of insiders. These institutions result from a political process of trade-offs between members of a community who must work together because of their interdependence in many other spheres.

Traditional shells are weakened by lack of state support. The community's traditional resource management systems and related institutions are often slowly undermined by new laws. Unsustainable resource use increases as the old shell is weakened and replaced by a new operating shell -- often an aberrant version of the legally-specified shell as it is interpreted and locally implemented by the politically powerful, including the military. In remote areas, traditional tenurial shells often continue to operate without legitimization by the government. Alternatively, communities in remote areas may have rights that have been legitimized by the government but be uninformed of their rights and therefore fail to seek state assistance in the face of illegal extraction of their resources (e.g., Cortez Ruiz 1992). Design for support of local shells should be based on an assessment of factors undermining those shells.

In the remainder of this paper, we briefly describe the tenurial shells in Mexico, summarize the attributes of sustainable tropical forest management, and demonstrate how sustainable forest management is related to design principles that support the protective, enabling shells of community-based tenurial systems.

3. THE MEXICAN CASE: NATIONAL SUPPORT FOR TENURIAL SHELLS

In Mexico, unlike most other countries rich in tropical forests, resource users gained the state's protection for community-based management of resources. The Mexican state formally recognized tenurial shells for communities after the Mexican Revolution, which was born, fought and won on the demand for the return and redistribution of land to peasant communities (Sanderson 1984). The 1917 Constitution supported land reform and

recognized community ownership of land under Article 27. The Constitutional recognition of community-based tenure has provided a protective shell for the functioning and evolution of resource management systems responsive to local ecological conditions.

Community land rights in Mexico are typical of community-based tenure systems elsewhere in the world. Tenurial rights and responsibilities within the shell are defined by local communities within the basic framework established by the state. We refer to these systems as community-based because the primary legitimacy of community-based tenure systems is drawn from the community and not from the nation state which recognizes them (Lynch and Alcorn 1994). In other words, the local community, not the national government, is the primary allocator and enforcer of rights to resources within the boundaries of the community. Responsibilities to the land and to the community are defined by the community, and the national government defends a community's rights to its resources against the claims of non-community members. At the same time, however, the Mexican state retains ultimate rights over the resources and places restrictions on rights to sell, lease or rent community properties.

In Mexico, two forms of community-based corporate ownership are currently recognized and supported by law: *ejidos* and *comunidades* (indigenous communities). The *ejido* is a creation of the Mexican revolution that enables groups of people to petition for access to resources to which they have no prior claim. The *comunidad*, on the other hand, is a pre-existing corporate entity whose rights are recognized if its members can demonstrate prior, longstanding, community-based use of the land and waters. The stated objective of legally establishing the post-Revolution *comunidad* was to return to the earlier corporate tenurial system originally recognized by Spanish colonial administrators based on similar European traditions of corporate land use (Sanderson 1984, Sheridan 1988). Traditional corporate systems derive strength from a cultural and social integrity which, on the one hand, reinforces a unified approach to management decisions and yet, on the other hand, offers individual households the freedom to benefit from differential, individual access to specific resources held within the community.³

During the Porfirian period (1876-1910) prior to the Revolution, the state withdrew its earlier support for the communities' tenurial shells. Federal laws eliminated communal property rights and claimed as state property all lands without official titles (Barthas 1994, Sanderson 1984, Stresser Pean 1967). The state in turn gave rights to those same lands to capitalists and owners of haciendas, leaving communities to depend on wages for their survival. The impact of these policies varied in different regions of Mexico, but nationwide, by 1910, nearly half of the rural population had become debt peons on *haciendas* and *ranchos*, 82% of all communities were located on *haciendas* and *ranchos*, and free agricultural villages held very little land (Sanderson 1984:16-18). As a result of the export-oriented

policies, prices for food rose significantly, while profits from growth in the export sector primarily accrued to foreign investors. Wages remained low, "verging on slavery" in some areas (Sanderson 1984). These conditions gave rise to the Mexican Revolution. Under the post-Revolution land reforms, despite the legally specified difference between comunidades and ejidos, most pre-existing communities were not recognized as comunidades on the basis of documented prior claims but were instead granted rights as ejidos for political reasons⁴.

Under both ejido and comunidad systems, each household in the community has the right to exploit the community's natural resources necessary for livelihood. The household cannot sell or rent community lands to anyone outside the community (but see 1992 revisions below). Inheritance and membership is regulated by communities. The household is, in effect, a user-manager of a set of resources that belongs to everyone in the community. Resources are allocated to members of the community who exploit and manage these resources on an individual basis within the limits set by the community. Communities are heterogeneous, dynamic entities containing subunits that form shifting alliances within shared institutions and guided by shared ethics. Their tenurial shells form crucibles within which local conflicts and differing strategies can bubble together without being destabilized by external factors. Land disputes within communities are common, but they are generally resolved at the community level and do not become a burden for state agencies (Dewalt and Rees 1994). Land disputes between communities are also common, but they are settled through state agencies and the state's judicial apparatus⁵. Land disputes between communities and ranchers are also common, particularly in forested areas (e.g., Sandoval 1994), and the state apparatus offers the only peaceful recourse for justice in situations where ranchers have enormous political influence, and sometimes private armies.

The extent and impact of community-based resource management in Mexico are significant. Approximately 3 million households belong to the nearly 30,000 ejidos and comunidades⁶ that manage 59% of Mexico's land area (103 million hectares) and 66% of the total rural rural production units. Most indigenous communities operate ejidos, and long-established mestizo ejidos often retain the pre-Hispanic traditions of their indigenous ancestors. For these reasons, it is appropriate to assess ejidos and comunidades as a group. Most of the land operated by ejidos and comunidades is marginal for agriculture due to poor climatic and soil conditions. Of the comunidad and ejido lands, only 22 percent is agricultural (arable) and the remainder is under pasture or forest. Highly productive lands (particularly those that are irrigated) are privately owned under individual title. Mexican rural communities, whether indigenous or mestizo, are similar to peasant communities in other parts of the world in that, while they produce goods for their own consumption, they also rely on outside jobs and the sale of cash crops to meet their subsistence

needs and purchase other consumer goods.

Within the protective and enabling shells created by ejidos and comunidades in Mexico, communities apply an incredible range of innovative, sustainable, locally-adapted natural resource management systems in a wide variety of ecosystems ranging from desert to rainforest (e.g., Gomez-Pompa and Kaus 1990; Mora López and Medellín-Morales 1992; Wilken 1988; Nahmad et al. 1994; Toledo et al. 1984, 1985; Zizumbo Villarreal and Colunga García-Marín 1982). Indigenous peoples live within the borders of 80% of Mexico's protected areas, an indication of the level of biodiversity maintained by their land use patterns. An archipelago of communities linked as a network of *campesino* (peasant) ecological reserves could effectively cover Mexico's biodiversity (Toledo 1992b, 1994b).

Every ecological zone in Mexico supports rich reserves of biodiversity, but the forested areas are especially rich (Ramamoorthy et al. 1993). Between 70 and 80 percent of Mexico's forests is under management by some 7,000 to 9,000 ejidos and comunidades (A.Molnar personal communication 1995).⁷ From a cultural perspective, it is also noteworthy that 4.8 million indigenous people⁸ reside in ejidos and comunidades in forested areas (1990 Census).

In the next section, we summarize the attributes of sustainable tropical forest management. Then we briefly explore community-based property rights and resource management by long-established communities in two of Mexico's forest ecosystems -- the lowland humid tropical forest and the sub-humid temperate forest -- some 15 million hectares of which remains under the management of comunidades and ejidos (1990 census). Over the past few decades, ranchers have converted 20 million hectares of lowland and temperate forests into pasture (Toledo 1992a), and they continue to press on the edges of forested ejidos (e.g., Sandoval 1994), putting external stress on their tenurial shells and their forests. Given the high percentage of indigenous communities living in these two zones and the importance of these two forest zones, it is appropriate to select case study examples from indigenous communities from these two forest zones.

4. ATTRIBUTES OF SUSTAINABLE TROPICAL FOREST MANAGEMENT SYSTEMS

Patterns from tropical forests around the world suggest that the key elements of a sustainable management strategy are: 1) patchy disturbance; 2) controls over placement of disturbance, and 3) active development of crops and crop varieties adapted to the local agroecosystem patches within the forest matrix. These elements are found in indigenous resource management systems. Patchy disturbance (spatially and/or temporally) creates patches of different types of habitat. For ecosystem integrity to be maintained by patchy disturbance, patches must include undisturbed areas of sufficient size and coverage, and appropriate distribution and composition, to: a) ensure regeneration of the species and the communities; and b) maintain ecosystem services essential for habitat maintenance of the entire matrix and

adjacent ecosystems. The management system's ability to create and maintain patches that meet these criteria is challenged by changes in population size, political organization, market values, in-migration, intensity of resource mining and other non-biological factors.

Although most case-studies contain insufficient information to ascertain the key factors that determine whether a society can create or adapt a resource management system to meet the ecological criteria for forest maintenance, existing evidence suggests it is important that several things are shared within the user group, including: 1) cultural values, traditions, and socio-political organizations; 2) controls and incentives, and 3) attention to monitoring for negative changes.

Strong cultural traditions, social organizations and institutions have evolved in many forest-dwelling societies which have experienced forest loss and then reacted in an effort to manage or reverse the change. Values and institutions (such as *milpa* described below) evolved to support agricultural management systems adapted to the tropical forest ecosystem's limits. Controls (including tenurial rights and responsibilities defined by a community) and incentives to encourage community members to respond to evidence that forest is being damaged are also important. Finally, monitoring to recognize that the forest is being harmed or helped by certain changes may be a group or individual activity, but it must be linked through a feedback mechanism into an institution that can bring the community together to wrestle with a problem if it is detected. If loss of forest is not perceived or not recognized as a problem, then no conscious choice is made to keep or lose the forest, and the process proceeds as an accident. If it is perceived and recognized as a problem, then choices are made to hold losses to an acceptable level or arrest/reverse the process. The successful implementation of choices (whether individual or group) depends on the societies' shared values, appropriate organizations, and political power vis a vis outsiders who may be causing the changes.

5. INSIDE THE SHELL: RESOURCE MANAGEMENT IN A CHANGING ENVIRONMENT

5.1 INTRODUCTION

The cases from Mexico summarized below include: 1) strong tenurial rights held by individual families within a strong communal tenurial shell recognized and supported by the state, 2) some resources under communally-shared tenure; 3) evidence that potential negative impacts of land use options are considered in making choices; and 4) shared cultural values, institutions and organizations developed over centuries of changes *in situ*.

The *in situ* changes have included shifts from subsistence production to involvement with cash crop production, resistance to outside efforts to eradicate their cultural traditions, and efforts to counter increasing marginalization within the political economy. The specific resource management practices in the two

ecoregions differ. In both zones, individual households and community-wide land use patterns are constructed from core elements that include forest, fallow cycled fields, corridors of wild vegetation within agricultural areas, water bodies, housegardens, and permanent fields including plantations and pastures (Toledo et al. 1995b). A survey of forest use by indigenous people in the lowland humid tropical zone revealed that 1,052 forest species are used for a wide variety of products for consumption and sale, ranging from medicines and food to construction and fuel materials (Toledo et al. 1995a). This study emphasizes the economic value of Mexico's forests beyond their value as standing timber for paper or plywood production.

The specific type of tenurial rights within a community are probably less important for ecological success than are the legitimacy of the tenurial shell and the strength of the institutions which reinforce tenurial responsibilities and provide the capacity to take action on the basis of feedback from monitoring. In both cases, community institutions influence local property rights interpretation and resource management. These include state-imposed institutions and cultural institutions. The local institutions created by the state to regulate activities on comunidad and ejido lands in accordance with state law include the General Assembly to which all households are represented by one person, and two important elected three-person committees: the comisariado (which represents the community to outside authorities and settles land disputes) and the consejo de vigilancia (which monitors the activities of the first committee). Community decisions are made in General Assembly meetings or special meetings by majority vote; representatives of all households must attend these meetings or be fined. To varying degrees, elders and traditional leaders influence the functioning of these institutions.

5.2 LOWLAND TROPICAL MOIST FOREST

The 1990 National Census identified twenty-two indigenous groups operating ejidos and comunidades (population: 1.56 million) in the tropical humid zones of Mexico. The case study site is a representative example located in northeastern Mexico on the Gulf Coastal slopes of the Sierra Madre Oriental in the states of San Luis Potosi and Veracruz where rainforests reach their northernmost range in the Americas (Rzedowski 1978). Prior to the arrival of the Spanish, the area was occupied for thousands of years and supported complex civilizations. From the time of the earliest written documents, the tropical moist forest region has been characterized as a "hell" or a "paradise," depending on the viewer (e.g., Vetancourt 1689; Tapia Centeno 1960). If this ecosystem is managed properly it is a paradise, because it provides a wealth of short and long-term benefits. If its special resources created under hot, humid conditions are misused for short-term extractive gains or if conversion is attempted, then this ecosystem degenerates into a less valuable ecosystem

requiring external inputs to maintain production.

We focus on two user groups located in contiguous areas (southeastern San Luis Potosi and northern Veracruz) of this ecosystem who use similar resource management systems: the Huastec Maya (population 121,000; 1990 census Table 10, Cuadro 8) and the Totonac (population 208,000; 1990 census Table 10, Cuadro 8). Totonac and Huastec both retain their language and strong cultural traditions, but at the same time have participated in economies linked to the global economy for several centuries.

Economic differences do exist between families, but only a few families in any given community hold significantly greater resources than the rest. Huastec and Totonac communities occupy *comunidad* and *ejidal* lands where population densities average around 100 persons per km². Communities vary in size from five hundred to several thousand hectares.

While there are no significantly distinct subgroups of resource users within their communities, Huastec and Totonac communities are spatially distributed as islands in a sea of lands operated by a different group of resource users -- mestizos, the Spanish-speaking people who claim Mexican national identity. Mestizos' political power and domination of the economy influence the technical and organizational options available to indigenous resource users. Mestizos occupy towns, ranches, and citrus/sugarcane plantations in the more level lands and areas along roadways, while the islands of indigenous territories tend to be aggregates of communities grouped on steeper, less desirable agricultural lands. There is continued tension over borders between mestizo and indigenous lands and forests. Occasionally, powerful mestizos still assert their rights over these resources without any legal basis to back their claims (e.g., Briseño Guerrero 1994).

The land use patterns of the indigenous people and the mestizos who own private lands are quite different. Mestizos manage the majority of the land in the region. Mestizo households operate a wider range of land sizes than do indigenous households, ranging from large ranches to the small garden plots of landless laborers. On the margins of the Huastec and Totonac areas, mestizo *ejidos* also exist, and their land use varies from indigenous-like mosaic patterns to monocultures. Mestizo land use outside *ejidos* generally tends to follow the standard Eurocentric model of monocrops and pastures with intensive herbicide and pesticide use. Mestizos in this region dedicate most of their lands to cattle, although pastures are largely degraded and unproductive. This general pattern has been in place for several hundred years (Barthas 1994), but forest in mestizo areas decreased dramatically after World War II when mestizos gained access to machinery for clearing forest and used it to increase the area dedicated to cattle pasture (Aguilar-Robledo 1994).

Property within the borders of the *comunidad* or *ejido* is recognized, used and inherited according to local institutions. Almost all forested land is under family ownership -- a situation

in which the family, not others, make management decisions. Families are responsible for making management decisions that are appropriate to the context and rules shared by the community. The small patches of communally-shared forest are used to generate income to pay school expenses and maintenance of other buildings required by the state, as well as to provide materials for poorer community members who do not have access to forest resources on their own family lands. Decisions about community lands and forests are discussed at assemblies in which representatives of every family participate.

The specific lands that belong to each family are well defined, but border disputes do occur. Under the state-sponsored *comunidad* and *ejido* systems, a community-elected official adjudicates over land disputes and inheritance decisions in consultation with other community members. Community members understand the state's legal apparatus establishing *ejidos* and *comunidades* as an extension of traditional institutions that control human behavior in order to protect the community and the land and resources for which the community is collectively responsible. Middle American cultural concepts of ownership extend beyond the usual Western legal considerations. The real owners of the land and forest are divine beings and spirits (including ancestors). Another way of expressing this relationship is that the Earth (with its resources) is a member of the community, and the community has the obligation to treat the Earth and all other community members with respect and concern for their continued well-being (Briseño Guerrero 1994). In other words, ownership means that the human community has a moral responsibility to maintain the land, its resources, and society in good condition. Hence, despite the apparent clearcut borders between Huastec families' lands, members of one family have the right to ask another family to borrow land or harvest forest products to meet their subsistence needs. This system provides a social safety net for the poorer members of the community.

Disputes over land borders and harvest rights are common and can disrupt congenial relationships between families within a community. Accusations of witchcraft are made against those who attempt to appropriate resources for private gain. A belief in witchcraft provides a strong social sanction against actions that go against conservative use of resources and a commitment to the corporate group. Traditional curers reinforce socially appropriate behavior during their interactions with patients, looking for illness causes in the patient's or others' misuse of resources. Here the importance of the relationship between the divine powers and the land comes into play, as well as the relationship between people. Clearing a private forest along a community watershed, for example, would result in strong pressure (including witchcraft accusations) against the family as well as be interpreted by the curer as causing illness or misfortune because the person went against religious sanctions about protecting water (ecologically unwise). Hence, ecologically-sound

land use is supported by cultural values and belief in the ethical commitments made between people and spiritual powers when people make land use decisions. The tenurial shell created by the state supports the traditional belief structure, which in turn supports ecologically-sustainable land use.

The effects of these moral commitments and beliefs are visible in the stark contrast between land use on either side of the border where indigenous ejidos/comunidades abutt mestizo lands. The tenurial shell that reinforces community and cultural values is physically visible at the border. At the border, people tell stories of how their way of life and forests were threatened before the Revolution, and how they were unable to reclaim parts of their territory (now outside the border). They say that the Revolution was terrible, but they acknowledge that the Revolution saved their forests and their way of life. Without the ejido and comunidad, there would be no borders and no islands, only a sea of pasture.

Within the borders of their territories, both Huastec and Totonac apply a high level of knowledge about species and ecosystems (Alcorn 1984, 1989; Barrera-Bassols et al. 1991; Toledo and Medellín-Morales 1994). Huastec use 679 plant species and specifically "manage for" 349 of those species. Totonacs use and manage 355 species of plants and animals. Useful species are harvested from lands managed by risk-spreading strategies to make multiple use of available resources while maintaining the natural processes on which agricultural and forest-based systems rely. A survey of indigenous communities in the Mexican lowland humid tropics revealed that 1,052 species are used for consumption and sale (Toledo et al. 1995a). Lowland forests have economic value far beyond the value of their timber.

The Huastec and Totonac agroecosystem is a fluid mosaic of various resource zones: permanent planted fields, periodically planted fields, fallows, dooryards, orchards, forests, and streams. People use and manage the natural ecosystem for human benefits -- crops, wild plants, wild animals, and ecological services. Simply put, the two systems create a shifting mosaic of replicates of three standard pieces: forest patches, swidden milpa patches, and cash crop patches.

In this shifting mosaic, the milpa cycled fields are the most "mobile" and the managed forests the least mobile part of the shifting mosaic. Managed forests, especially along streams, on ridges and steep slopes, have never been cleared in living memory. Approximately 25% of an average Huastec community's land will be under forest; 50% in milpa-fallow cycled land; and 25% in sugarcane. In a typical Totonac community, 30% of the land was under forest, 36% under milpa, 10% under cash crops (aside from vanilla), and 23% was in pasture (Toledo et al. 1994). The Huastec and Totonac system is generally similar to that of other Mesoamerican milpa agriculturalists (Alcorn 1990). Milpa is the Mesoamerican version of integral swidden agriculture (Warner 1991) applied in most tropical areas of the world. Milpa is a central

institution from which other institutions draw strength. From a property rights point of view, milpa is an institution which reinforces reciprocity and community-based control of natural resources. Making milpa requires reciprocal labor exchange and decisions made by following a specific regime associated with rituals and culturally-appropriate rules of proper behavior. One analyst has argued that the milpa system requires corporate ownership (Rees 1974).

Farmers manage their forest patches through selective removal of unwanted individuals and selective encouragement of desirable species. In many cases, the high value crops coffee (Huastec) or cacao (Totonac) are planted in the understory and then allowed to reproduce themselves naturally there where they are treated like any other useful wild species. These systems have been detailed extensively elsewhere (Alcorn 1981, 1983; Medellín-Morales 1986)

An economic assessment of costs and benefits of operating a typical Huastec community's lands yielded a net benefit of cash and subsistence goods valued at \$598 per hectare per year (Alcorn 1989b). This number compares favorably with the benefits generated by other systems (e.g., Godoy et al. 1993). Despite the relatively high population density, approximately 25% of the area is still forested although it could have been cleared. People chose not to clear it. The reasons they give for their decision to maintain biologically diverse managed forests include: commercially valuable products; direct access to products (firewood, fruits, medicine, construction materials and other items having use values); the option value of unknown products they may find useful in the future; the superior quality of life offered by fresh breezes, shade, clean water and clean air; protection of the Earth; and ecological services such as soil quality protection, prevention of erosion, and site improvement for swidden agriculture (Alcorn 1989b). Instead of clearing more forest, the milpa system was modified to use short fallow periods before all high forest was cleared, and people have chosen to increase cash crops and take outside jobs instead of increasing staple production by clearing more forest. This has enabled people to meet increasing needs by means other than clearing forest. In fact, increased dependence on cash from outside jobs is associated with increased area under forest.

5.3 CASE TWO: SUB-HUMID TEMPERATE FOREST

Community-based systems in the sub-humid temperate forest ecosystem (a zone that covers 33 million ha and occupied by 1.55 million indigenous people) are also adapting to changes. The case study covers two areas managed by Purépechan people (Tarascans) in the state of Michoacan. The first site is located in the Lake Pátzcuaro basin which includes lake islands, shore, hillsides, mountains, and intermontane valleys. The second site is the community of San Juan Nuevo in pine-oak forest on the high plateau of western Michoacan. The oak-pine forests and the intervening grass and shrubland areas support an estimated flora of some 1,000

species. Archaeological research indicates human settlements in the area from approximately 3500 BP, and Spanish records indicate that the area supported a large population during the 1500s. Hence, these forests have also been disturbed for thousands of years, and local communities have adapted to a series of stresses and changes over time.

Purépechan communities and many of the mixed mestizo settlements around Lake Pátzcuaro retain their language and a strong Purépecha cultural heritage including tenure systems, resource management systems, and social organization. All major basin settlements were in place and occupied by Purépecha people at the time of the Spanish Conquest around 1500. Purépechans recognize and name 400 plant species and 138 animal species. Two hundred twenty-four plant and mushroom species have multiple uses for food, medicine, and utilitarian values. Purépecha economy is based on a combination of seed-, tree- and vegetable agriculture, hunting, fishing, gathering, cattle raising, forest management, handicrafts (including weaving based on aquatic plants, wheat and palms), bakeries, and textile weaving. Purépechans recognize fourteen different management systems and agricultural landscapes: three rainfed, one dryland and six irrigated agricultural types; two silvicultural systems; and two homegarden types. They use ten different types of fishing systems. Many of the products from these systems are sold in local markets.

In contrast to the Lake Pátzcuaro communities, San Juan Nuevo Purépecha (population 10,000) has used its forest resources and organizational connections to acquire modern machinery for a vertically integrated forest products industry, including factories for moldings, parquet, furniture, packing crates, charcoal and sawn wood for export markets (Alvarez Icaza 1993). Although forestry is the main activity at San Juan, families also rely on milpa fields, homegardens, forestry activities (wood, resin and gathering of medicinal and food plants, mushroom species, lumber, etc.) and cattle raising. While nationally some 65% of forested ejidos and comunidades exploit their forests for commercial sales, San Juan Nuevo is among the few internationally recognized for its successful and profitable forest management. Since 1983, San Juan Nuevo's forestry enterprise has grown in both size and scope. In the last 10 years, profits have increased 2,000 percent, and the personnel from 100 to 1,000, with salaries well above the minimum wages for the region. Part of this administrative and economic success lies in the community decision to continue reinvesting all profits, rather than distribute them.

San Juan Nuevo illustrates a process of entrepreneurial efficiency and modernization within the traditional tenurial shell. Tenurial rights create a delicate balance between family rights, communal responsibility and enterprise efficiency. Family rights to land and natural resources have been respected as the exploitation of tracts of forests (for wood and resin extraction) by the communal enterprise affects portions of household parcels.

Purépecha communities, like the Huastec and Totonac, have communal ownership of their lands and resources, but individual households exercise ownership over their own agricultural lands. Community members may rent or mortgage his lands to other community members. Forest, pasture and lake resources, are considered community property with rules regulating their access and use. Different communities have managed their communal resources in different ways. In Pichataro, for example, 4,000 ha of pine oak forests have been divided evenly between eight subdivisions of the community, thereby giving each of the 559 households equal access to forest resources for resin, wood, firewood, and food. The lake is used by 700 fisherman from 21 settlements, 19 of which are Purépechan. The lake territory has been divided into sections to be exploited by each community. Each community, in turn, has divided the lake into fishing grounds and shore areas for each fisherman through collectively established rules. Shore areas are physically divided into territories by artificial channels lined by tule reed plants.

In San Juan Nuevo, forests were divided into family patches for exploitation on an individual basis for resin extraction and small-scale woodworking shops. Until 1970, marketing was controlled by middlemen and much of the forest eventually became degraded from overextraction. But during the 1970's, the comunidad joined the Union of Forest Ejidos and Comunidades and worked for government authorization of community-based forest management and production. By 1981, the community's General Assembly approved the formation of a community enterprise which successfully competed with middlemen by offering a better price. Sale to the community mill requires sharing rights with the enterprise; the participants enter into co-management arrangements so that the community's forest has slowly come under stronger community control. Forest recovery has occurred because of the tenurial authority exerted by the community. The community as a whole moved to reduce individual rights in order to sustain the forest. It is unlikely that similar state-level action could have prevented clearcutting through zoning or harvest regulations, given the poor record of state-level interventions.

The San Juan Nuevo Purépechans have developed a new local institution associated with the operation of the community's forestry enterprises and the forest co-management rules linked to sustainable extraction for the enterprises. A Communal Council was established which includes 10 representatives from San Juan Nuevo's six sub-units, the enterprise directors, property administrators, and a technical committee (Alvarez Icaza 1993). This group oversees and directs the community's projects, and serves as a forum for developing consensus. The comunidad has agreed to reinvest all profits into the enterprise, rather than distributing the profits.

As among the Huastec and Totonac, Purépechan culture supports values placed on reproduction of the community, conservative use of resources, protection of natural processes, economic equity

among community members, concensus building, and collective resistance to intrusion by outsiders. Equitable distribution of the communities' resources among individual families prevents overuse by any one family, while communally shared values and institutions maintain resource use within acceptable bounds.

5.4 DISCUSSION

Experiences from other areas of Mexico indicate that community-based tenure by itself is not a recipe for ecologically sustainable resource management.⁹ Knowledge of and commitment to ecologically-sustainable management regimes, strong organizations, and state implementation of supportive policies are required elements of the recipe. For example, newly-founded "communal" ejidos of people resettled into tropical moist forest areas from other ecological zones during the 1960-70s were encouraged by Mexican government policy to use capital-intensive inputs and heavy machinery for commercial agriculture (Ewell and Poleman 1980, DeWalt and Rees 1994). These ill-advised agricultural schemes failed and resulted in massive deforestation followed by unproductive cattle ranching. On the other hand, in some cases, spontaneous migrants into forests have attempted (with no government support) to apply the locally-adapted, low input agricultural systems found in long-established communities and successfully established new communities that recreated the land use patterns of the older communities (Ewell and Poleman 1980). Past policy support was sufficient to enable ecologically-sustainable systems to persist, but support was insufficient to enable those systems to spread and prosper.

6. NEW CHALLENGES TO SHELL INTEGRITY AND FUNCTION

Challenges to tenurial shell integrity affect ecological sustainability. Over the past several thousand years, community-based management of forest ecosystems has faced a variety of stresses, from colonization, massive depopulation, incorporation of tribute and then cash cropping, forced concentration of populations, introduction of foreign crops and livestock, and loss of land rights. Yet the system has proven resilient under the protection of the state's authority; indigenous resource management systems continued to adapt to their changing context within the space provided by the protective shells of ejidos and comunidades. Today, however, there is a new threat to community-based management as the ejido shell is being altered.

In 1992, in preparation for the North American Free Trade Agreement (NAFTA), President Salinas revised Article 27 of the Constitution to change the tenurial shells of communities, and Congress passed enabling legislation in the form of the new Agrarian Law, using haunting echoes of the reasoning used during the Porfirian period when the government moved to eliminate the "unproductive" community-based landholdings (Briseño Guerrero 1994:45) in order to make land available to politically powerful elites. Salinas' actions created sweeping changes in the rules regulating ejidos, although comunidades were technically exempted

from these changes. Among the changes are the following: ejido members can now rent, sell or mortgage their lands; ejido members no longer have to work the land to retain rights to it; and they can enter into joint ventures with outside entrepreneurs to exploit their resources (Dewalt and Rees 1994). Although they offer opportunities for communities to gain much needed capital and marketing services, these recent changes also have great potential to undermine the community-based sector and expand the rights of private individual property to mine resources in ecologically fragile areas instead of supporting ecologically-sustainable agricultural systems (Toledo 1995). In effect, the new Agrarian Law tacitly recognizes the existing illegal largeholdings ("latifundios") of politically powerful ranchers (supporting the nationally infamous political bosses -- "caciques" -- of the Huasteca and other primarily indigenous areas) (Briseño Guerrero 1994) and supports expansion of an inefficient and ecologically-damaging land use.

These changes may weaken the recent strength shown by communities that are using traditional communal values to compete in the marketplace. New peasant movements during the past decade have been using collective organization based on traditional values of reciprocity, communal property, and voluntary labor to create business corporations that provide quality products at competitive prices in the open market, despite resistance from local elites (Briseño Guerrero 1994, Nigh 1995).

Given the agriculturally marginal nature of the ejidal lands, capital intensive agriculture is unlikely to result ecologically sustainable uses. Ecological analysis did not accompany the economic analysis that led to reform of the Agrarian Law. Furthermore, economic analyses did not consider recent studies that have demonstrated that many of the small-scale, labor intensive systems operated by peasants achieve higher yields than large scale agriculture in the same areas (Gómez-Pompa et al. 1993, Toledo 1993).

It is too early to evaluate the impact of these changes on community-based resource management practices, but negative ecological and social impacts can be predicted. Economically marginal people will be dispossessed of secure access to resources, and longterm local ecological costs will be ignored in favor of short term gains for outsiders. One can expect an expansion of the situation on the borders of the Lacandon Forest today where big ranches expand and drive landless poor to clear forest in nature reserves. Outside entrepreneurs are putting pressure on communities to cut their forests for immediate sale, or replace standing forests with eucalyptus plantations. It will be difficult for politically weak communities and weak community members to resist pressure from politically powerful people who seek personal gain from such deals.

Political movements in rural Mexico are seeking a route that includes control of productive processes, including marketing, and ecologically sustainable use of their natural resources as a means

to maintain their social and ecological systems (e.g., Bray 1991, 1992, 1995; Declaración del Foro Nacional sobre el Sector Social Forestal 1992; Merino 1992). A shell of community-based property rights is critical for the ecological and socio-economic success of this fledgling strategy. Without strong organizations to protect communities' rights and develop supportive policies under NAFTA reforms, the Mexican experiment with community-based tenurial shells will be terminated, and an opportunity for ecologically sustainable development will be lost.

7. CONCLUSIONS AND POLICY IMPLICATIONS

7.1 CONCLUSIONS

Tenurial shells, in and of themselves, do not guarantee ecologically sustainable development. Tenurial shells can shelter unsustainable use as well as promote sustainable management. For example, shells offered private corporations in order to attract foreign investment often results in unsustainable use of resources. Community-based tenurial shells, however, are a necessary condition for ecological sustainability in certain situations. Specifically, tenurial shells offer a way to protect existing indigenous and other traditional community-based resource management systems in biologically diverse and ecologically fragile areas. The state's interface with local shells, and the community-based legitimacy of the shell are critical elements determining the shell's contribution to ecological sustainability. In addition, many communities depend on outside jobs because they are unable to derive sufficient income from their lands. Rural populations continue to grow and many young people migrate to cities to seek work. Policies that support economic growth in urban areas are also necessary to support sustainable resource use by communities, because they support the absorption of excess labor. Without more non-farm employment opportunities, people will eventually be driven to nonsustainable resource use in order to survive (Thiesenhusen 1991) despite their reluctance to mine their resources.

In sum, despite the erosion, invasion, and disruption of old tenurial shells, the remnants that are in place today are associated with natural resource management systems that are much more ecologically sustainable than land use patterns outside these shells. Not all community-based tenurial shells contain ecologically-sustainable systems; but ecologically-sustainable systems are most frequently found inside shells.

While the results of our analysis can be used to support proposals to engineer new community-based shells where none exist, success in such an endeavor is less likely than success through recognition and bolstering of existing shells. Furthermore, because most of the remaining bastions of natural areas overlap with remnant shells of customary tenure systems, salvaging those shells will contribute more to the longterm global ecological sustainability than will struggles to reconstitute shells in degraded areas bereft of biodiversity. If one accepts that

biodiversity represents invaluable future options for development, then the value of conserving these shells should be obvious. Local, dynamic subsystems are essential for sustainability of the larger global system. Actions taken to sustain these local shells are actions taken to sustain Earth's larger ecological and economic systems for future generations.

7.2 POLICY RECOMMENDATIONS

- 1) Priority should be given to supporting community-based tenure in areas rich in biodiversity and forests¹⁰. Steps for such a program include: a) locating existing community-based tenurial shells that shelter locally-adapted resource management systems, b) assessing how such shells can be best supported within the existing state framework, c) assessing how current policies are hurting these systems, and d) enacting supportive policies, including those that support generation of off-farm jobs. Lynch and Talbot (1995) offer some basic, practical legal steps toward supporting community-based tenurial shells.
- 2) Assessments of options for group titling for indigenous peoples and other long-established communities should be done before a single strategy of individual titling is pursued. Around the world, Multilateral Development Banks are encouraging governments to enact private titling programs that focus on individual titles¹¹. Too often private titling enables powerful individuals to capture titles and then mine forests and other natural resources for short-term private gains -- resulting in negative, longterm ecological, social and economic costs. In the Mexican case, this is an immediate concern as a new national individual titling program is being developed (DeWalt & Rees 1994, Goldring 1995).
- 3) Under the assumption that the reinforcement of community-based systems will promote and facilitate sustainable management of natural resources, policies should be implemented in order to: a) reinforce community-based organizations, local and regional self-reliance; b) create economic incentives derived from ecological economics; c) provide social recognition to the efforts of community-based units; d) provide incentives for commercialization of organic products (including direct links with urban "green" markets), e) promulgate programs for appropriate technical assistance and loans to support forest management by indigenous peoples in forested areas and assist them with market research for potential community-based ventures, and f) vigorously prosecute those who trespass into and mine communities' forests. The World Bank and Government of Mexico's current collaborative Resource Conservation and Forest Sector Review has produced similar policy recommendations specifically for Mexico.
- 4) National and global environmental laws and donor's internal regulations should recognize the force of traditional community-based rules that govern the use of natural resources and should seek to articulate with them as appropriate. Environmental assessments for development projects; should require that

development agents meet the communities' rules for forest, land, and water use.

5) Opportunities to support existing, corporate tenurial structures should be sought in sectoral policy reform. For example, the recent creation of a new Mexican Ministry of Environment, Natural Resources and Fisheries, and the opportunity for senior policy dialogue at cross-sectoral levels within the context of the Environmental Action plan offer unique opportunities to initiate a set of policies directed to convert natural resources management to a more ecologically-sustainable pattern. The small-scale, community-based sector is positioned to play a central role in both ecologically-sound rural production and biodiversity conservation. In situations where agricultural conditions are marginal, it is unrealistic to apply the agro-industrial model of rural development based on private individual control of medium and big scale properties, because returns from marginal lands increase under management by smallholders. Instead, a strategy inspired by both indigenous and modern traditions should be applied (Toledo 1992b, 1994a). A revised agrarian law is needed to reverse the recent trend away from ecologically-sustainable resource management. It should be inspired by the principles of ecological theory and the goals of sustainable development, and it should be developed with the broad participation of producers, scientists, conservationists, NGOs and government sectors.

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¹ The mix includes: corporate community-based landholdings (66.3%

Mexico); private individual holdings (comprised of 30.8% of the production units and covering 40.9% of the land area); and mixed systems (including 2.9% of the production units and covering 0.1% of the land area) (National Census 1990).

² The political purposes and difficulties of Mexico's land reform program are evident in the unusually slow and sporadic way in which it was implemented. The process "fostered dependency on the apparatus of the state" (Powelson and Stock 1987:29). Programs ostensibly established to support agriculture and marketing services were also designed to build political patronage and power bases for the ruling party rather than to assist communities to develop and market their products. These factors affected the productive performance of the ejidos and comunidades, as well as the judicial process for recourse when laws were violated.

³ Land-holdings of individual farm families may be fragmented in order to provide each family with access to available soil types and microhabitats. This acts to strengthen in situ conservation of traditional crop varieties (Oldfield and Alcorn 1987, Brush and Bellon 1994).

⁴ The rights of ejidos are spelled out more clearly than those of comunidades in the agrarian reform legislation (Reyes Osorio et al. 1974). The process of forming an ejido is much simpler than the tortuous process required to receive recognition as a comunidad. In addition, the state strongly favored the option of granting land to ejidos rather than recognizing pre-existing rights to comunidades; the former option placed the state in a more powerful position (Powelson & Stock 1987, Sanderson 1984). In practice, there are greater operational differences within the range of ejidos than there are between ejidos and comunidades. Communities that purchased their own lands when threatened with eviction at various times in past centuries have enjoyed stronger state support for their tenurial security when threatened by invasions. As of 1995, however, all ejidos and comunidades are functioning as longstanding communities with prior rights.

⁵ Inefficiencies, rent seeking behavior of bureaucrats, and political intrigues have often made settlement difficult. Nonetheless, despite analysts' focus on specific local cases where the government failed to resolve the problems (e.g., Powelson and Stock 1987, DeWalt and Rees 1994), from a national perspective the majority of ejidos and comunidades have continued to function successfully without seeking government intervention in border disputes.

⁶ Although the comunidad was expressly created for indigenous communities, due to the reasons described above there are only 1,231 comunidades covering some 9 million ha (Sheridan 1988).

⁷ A recent World Bank sector review has found wide variation in published estimates of forest held by ejidos and comunidades and in the numbers of ejidos and comunidades who hold forest.

⁸ Mexico's total indigenous population is 10.5 million (1990)

Census). There are 54 major indigenous groups.

⁹ We are not claiming that the ejido and comunidad system, as it has been administered in the past, is a perfect system. It has, however, proven to allow ecologically-sustainable management in a subset of cases with shared characteristics described in this paper. Much could be done to improve the economic performance of resource management under ejidos and comunidades, but assessments of options need to also consider the need for ecologically-sustainable management for longterm maintenance of the natural resource assets.

¹⁰ Common property forest management systems are widespread globally (Messerschmidt 1993). Other countries also offer examples of successful corporate tenure systems and other tenurial options (e.g. Davis and Wali 1993, Fox 1993, Herlihy 1990), and the basic elements of strategies for supporting community-based forest management have been offered from experiences in many countries (Legal Rights Center 1994, Lynch and Talbott 1995, Poole 1995).

¹¹ In Mexico, for example, the World Bank has been considering post-NAFTA individual titling, and part of that project preparation work is considering options for an "ejido and communal land regularization and titling project."