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EXPLORING MARKET-BASED DEVELOPMENT: MARKET INTERMEDIARIES AND FARMERS IN CALAKMUL, MEXICO

Market intermediaries play important roles in the development of tropical-forest frontiers but are often overlooked in the assessment of land-change dynamics. Consistent with research beyond land-change studies, intermediaries are found to be a pivotal element in land-use and land-cover change in southeastern Mexico. They have stimulated commercial chili cultivation in

this development frontier, providing transportation and other services to smallholders who could otherwise not enter the chili market. This role comes at the cost of a near monopoly on chili marketing. The various roles played by these intermediaries, or coyotes, the means by which they operate, and the consequences for smallholders and land use are detailed for the Calakmul Municipality, Campeche, Mexico.

Keywords: land-use and land-cover change; market intermediaries; Mexico; smallholders; tropical development; Yucatan

Preservation of tropical forests lies at the nexus of conservation strategies and market forces. Guided by concerns about globalization, neoliberalism, sustainability, and global environmental change, various research communities have addressed the development or degeneration of tropical forests. Many researchers are particularly concerned with the ways in which tropical forest communities and their habitats are tied into the larger ecological and economic world beyond their immediate locale (see, for example, Blaikie and Brookfield 1987; Lambin and others 2001; Lawrence and others 2004). For these scholars the specific research question is often less significant than their overriding concern with how global markets reach into and threaten the viability of tropical habitats and the livelihood activities of their inhabitants. The global influence of markets is examined directly, in terms of the dynamics of commodity chains, by Jeffrey Sachs (2000,2005), Jagdish Bhagwati (2004), and Martin Wolf (2004), and more indirectly through the remittances of migrants on their places of origin (Selby, Murphy, and Lorenzen 1990). Other scholars have explored how ramifications of entitlements (Sen 1999), social capital (Bebbington 2000), and unequal power relationships (Peet and Watts 1996; Roberts 1996; Marsden and others 1996) affect the sustainability of tropical forest ecosystems.

Market dynamics clearly are recognized as major drivers promoting change in tropical forests, but the mechanisms and linkages by which these forces operate, as well as the interpretation of their relative importance, remain a topic of vigorous debate (Angelsen and Kaimowitz 1999; Geist and Lambin 2001; Keys and McConnell 2005; McConnell and Keys 2005). Markets and corruption are implicated in the deforestation of much of Indonesia, the Malay Peninsula, and the Philippines (Kummer and Turner 1994; Brookfield, Potter, and Byron 1995). In Mexico, forest ejidos (communally governed lands awarded by the government) frequently seek "certified production status" in order to gain access to markets, particularly specialized niche markets, in the United States and the European Union (Klooster 2003).^[1] Structural adjustments in both international and global markets influence the rate and intensity of investment in resource extraction in Amazonian rain forests, drive speculative investments in rural land acquisition, and affect everything from the viability of commercial logging operations to market demand for exotic pets and products (Kaimowitz, Thiele, and Pacheco 1999; Pfaff 1999; Sierra, Tirado, and Palacios 2003). Equally important is the investment made by governments and private parties in the development of improved road infrastructure. At all levels, from the local to the regional, better roads open up tropical forests and their products to worldwide markets as well as spontaneous and centrally planned agrarian settlement (for example, Humphries 1998; Cropper, Griffiths, and Mani 1999).

The past decade has witnessed the rise of various forms of integrated environmental science involving tropical forest biomes, ecosystems, and landscapes as coupled human-environment systems. Self-labeled as "land-change science" (Gutman and others 2004), "sustainability science" (Kates and others 2001), "ecosystem service studies" (Daily 1997), "political ecology" (Zimmerer and Bassett 2003; Robbins 2004), or "vulnerability science" (Luers and others 2003; Turner and others 2003), these research orientations and interests are applied to the interactions among forests, the uses of forests, and their human-environment consequences. Expansion of markets is a common, perhaps dominating, theme in these works. Recent integrated land-change science approaches have paid less attention to the mechanisms that give rise to and operate the market in tropical frontier conditions (Klepeis and others 2004; Keys and McConnell 2005; McConnell and Keys 2005). This lack of understanding masks how markets influence the natural environment and vice versa.

Development-forest dynamics play a prominent role in the southeastern Mexican Municipality of

Calakmul (Figure 1), a tropical-forest landscape and development frontier in which the well-being of the Calakmul Biosphere Reserve (CBR), the creation of the international Mesoamerican Biological Corridor (MBC), and support for an increasing population of landholders have been linked to the goal of improved agriculture and archaeo-ecotourism (Acopa and Boege 1998; Primack and others 1998; Turner, Geoghegan, and Foster 2004). Whether various policy incentives and forest-use rules designed both to intensify cultivation and to promote sustainable cultivation — and thus protect the reserve and corridor while increasing household income — have succeeded is not clear (Klepeis and Vance 2003; Roy Chowdhury 2003; Abizaid and Coomes 2004). What has worked, at least in terms of its rapid adoption and spread across the landscape, is the production of jalapeño chili for the national market (Keys 2004b). This market penetration of the region was initiated by the smallholders — land-tenured farmers — themselves and was undertaken by inviting coyotes, as intermediaries are known locally, to serve as the market interface for and transporters of chili. This invitation and its "success" have locked in commercial crop production in ways that promise to affect cropping practices, household well-being, and the structure and function of the region's ecosystems.

This article addresses the way in which the coyotes operating in the southern Yucatan have set the conditions for and service of commercial cultivation, ultimately affecting cropping strategies, parcel-forest use, and the integrity of various state and private efforts to intensify cultivation in order to reduce pressures on forest lands and support the functioning of the CBR and the MBC. It outlines the roles, skills, economic considerations, and power of coyotes within the socioeconomic network of chili. The coyote may have enabled smallholder entry into commercial chili production, but this service has come at the price of coyote control of chili marketing in the region. This study illustrates how the social networks of the coyote reinforce themselves, controlling the development of the only proven commercial crop in the study region. The coyote has come to play an important role in the dynamics of the coupled human-environment system through influences on land use, from the structure and function of the landscape and the condition of the CBR and the MBC to the economic condition of the farm household.

INTERMEDIARIES AND THE CALAKMUL CASE STUDY

Smallholder farmers on the development frontier confront several significant obstacles to commercial production, foremost among which is a means of delivering their produce to markets (Bauer 1991). Intermediaries (also "middlemen" or "itinerant buyers") provide this important link, negotiating the farm-gate price and delivering the produce to regional and national buyers while reducing transportation costs for farmers (Netting, Stone, and Stone 1989; Plattner 1989). They constitute a "real face" in the otherwise "hidden hand" of the market. Their roles and power transcend these functions alone. They provide important technical information, capital stock, access to difficult-to-obtain items, and, in some cases, loans to smallholders (Finan 1988). In addition, they translate urban lifestyles and external worldviews to the farmer (Plattner 1989; Alvarez and Collier 1994).

These positive functions are countered by the intermediaries' often monopolistic power and willingness to use coercion to maintain their privileged position. Alice Littlefield (1978) suggested that the entry of intermediaries into areas previously dominated by subsistence activities represents the introduction of capitalist exploitation but ignores the important social functions that intermediaries serve. Timothy Finan (1988,694) noted that "intermediaries commonly employ strategies of a social content to achieve their economic intent." This means that the market-performance functions of intermediaries are conditioned not solely by the simple calculus of supply and demand but also by social relationships at the farm gate and at the point of sale (Smith 1975).

Beyond the smallholder, intermediaries serve the market by providing an efficient transportation and allocation function, especially for products that are available only during part of the year, are highly perishable, or both (Alvarez and Collier 1994). This function is warranted where the amount of production is relatively small and the delivery distance is great (Southworth, Jones, and Pearson 1979; Plattner 1989). To incur these costs and risks, the intermediary requires an acceptable level of assurances that the trip to the farm gate will be

rewarding far more often than not. This assurance is not left to happenstance on the smallholder side but is gained by power, trust, and, if necessary, force. This last option is taken with the risk of losing smallholder clients (Nwabughuogu 1982) and inviting retribution in kind (Southall 1978). Intermediaries have less power at the other end — that of relations with the regional, national, or international agrofood system (Whatmore and Thorne 1997; Eakin and Appendini 2005; O'Brien and Leichenko 2005). A successful intermediary understands that maintaining good connections in this system enhances his opportunities for profit (Whatmore 2002). Thus the intermediary must negotiate relationships with both farmers and commodity wholesalers (Silverman 1979).

The commodity network of which the intermediary is part has variously been described as a "commodity chain" (Gereffi and Korzeniewicz 1994), part of a wider world system (Wallerstein 1974), or an "actor network" (Latour 1993; Whatmore and Thorne 1997; Robbins 2001). These ideas locate market intermediaries as important actors in linked human-environment relationships. They attempt to transcend the persistent structure-agency debate in current cultural and political ecology discussions by recognizing that many influences on production systems — from individuals, institutions, the physical environment, and others — exert force on the shape those production systems take (Robbins 2001; Turner and others 2001).

Actor-network theory has asserted that farm-to-market networks are constituted by "a wealth of other agents, technological and 'natural,' mobilized in the performance of social networks whose significance increases the longer and more intricate the network becomes" (Whatmore and Thorne 1997, 291). These actor networks are also socially constructed, and understanding how they are built is important, especially because these networks contribute to changes in land use and land cover. Sarah Whatmore and Lorraine Thorne (1997, 288) pointed out that, in actor-network theory, "economic institutions and practices are conceived of not as some separate, and still less determinant, 'sphere' of activity which articulates with other 'spheres' of civic society of governance but as socially embedded and contingent at every turn." Networks become resilient — within any broad political economic setting — as time passes and relationships between nodes solidify and form institutions. In this way, networks reinforce themselves through a process of increasing path dependency. When networks achieve this durability, the ability of actors to change the network is diminished. This case study reveals that intermediaries and the chili-to-market network within which they function have established considerable resilience, resisting challenges and change.

Volatile prices, uncertain growing conditions, and changing consumer tastes make commodity agriculture uncertain for smallholders even in the best years (Smith 1975). The functions of the market intermediaries ameliorate the risks inherent in smallholder market engagement (Converse 1926; Alvarez and Collier 1994). The relationships that intermediaries and producers develop help diffuse risk throughout the commodity-production chain, especially in high-risk production environments such as those experienced in Calakmul (Finan 1988). At the most basic level these relationships are, in part, based on some level of trust that the commodity-payment exchange will take place, and in some cases they have a deeper foundation in personal ties or other forms of social bonds (Davis 1973; Trager 1981).

Economic analysis suggests that intermediaries attempt to maximize profits in the short term after weighing the costs and benefits of participation in each market (Gertzel 1962; Rubenstein and Wolinsky 1987). This maximization strategy is difficult to follow perfectly in the real world of imperfect knowledge of market performance and crop production. Intermediaries translate market prices to farmers who otherwise are isolated. Coupled with their monopolistic power, they set the local farm-gate price. Intermediaries accept the high risks of shipment and sale that confront the smallholder, however, and incur the risk of poor quality or low levels of local production. This means that intermediaries and farmers must develop a functional level of cooperation and trust. The precise level of trust that can develop is determined, in part, by the intermediaries' options to obtain markets for the farmer's product. Intermediaries require high levels of trust or social capital if these options are few (Bebbington 2000), but, if multiple product markets exist, this requirement is diminished.

It is important to recognize that both intermediaries and farmers receive benefits, often indirect, for long-term relationships that may outweigh short-term gains. Intermediaries may, in fact, set a price less than optimal for themselves at the time in order to develop long-term relationships that promise future profits (Beals 1975). In this way they gain a measure of trust with smallholders and may affect cropping strategies — such as by encouraging farmers to devote more parcels to commercial crops or favored market cultivars — and land-use choices — for example, permanent parcel cropping versus shifting parcels (Galletti and Fernandez 1998). Finan (1988) noted that intermediaries in Northeast Brazil moved farmers from small-scale marketing of sugarcane and manioc to other commodities, once urban-market linkages were established. Robert Alvarez and George Collier (1994) further pointed out that intermediaries' ability to negotiate cultural and social norms makes them especially persuasive and effective at interacting with producers and markets.

Almost all of these characteristics and qualities of intermediaries are present in Calakmul and the southern Yucatán. The markets of the region are not open and competitive. Financial constraints on smallholder their recent entry into commercial cultivation, thin markets, distance to market, competition from other parts of Mexico, and environmental factors enable three intermediaries in the region to collude on prices and approaches to the purchase of jalapeño. But their ability to operate depends on the establishment of social and personal relationships with farmers, with some outcomes that are beneficial to the farmers relative to what they could do individually or in nascent cooperative arrangements. The coyote monopoly notwithstanding, these intermediaries provide an entry into markets for farmers otherwise incapable of doing so. They affect the very fabric of farming in the region and thus the condition of the landscape and its impacts on the CBR and the MBC.

CALAKMUL CHILI FARMERS

The Calakmul Municipality of Campeche, Mexico and adjacent parts of Quintana Roo (together, the southern Yucatan) constitutes both a development frontier and a "preserved" forest ecosystem that is reflected in the CBR and is central to the MBC (Primack and others 1998; Turner, Geoghegan, and Foster 2004; Vester and others forthcoming) (Figure 1). It is one of the poorest areas of Mexico despite at least twenty-five years of government programs and investment aimed at economic improvement. Farmers in the region often echo the sentiments: "We're damned," they lament. Despite modest successes involving programs promoting maize (corn), rice, cattle, and "sustainable" alternative cropping systems, the population of the larger region has grown substantially, increasing the number of smallholders, tenant farmers, and farm laborers, from 2,000 in 1970 to more than 24,000 in 2000 (Klepeis 2004). Landless and tenant farmers are difficult to separate as a group due to the absence of official reporting of these categories in my 1999-2000 sample survey. But workers characterized as "landless" or "tenants" constitute 21 percent of that sample.

Until 1975 most farmers were engaged largely in subsistence cultivation, with some normal surplus of maize sold at government regulated prices. That year, three migrant farmers from Veracruz, with experience in chili (chile jalapeño: *Capsicum annuum* L.) cultivation, arrived to homestead a new ejido with the aim of growing the crop commercially. Their initial economic success far exceeded that achieved by state agencies and by nongovernmental organizations (NGOS) and rapidly led to widened chili production through the area, especially along the southeastern edge of the CBR (Lawrence and others 2004). A 1999 survey of 160 farmers in the southeast revealed that 85 percent of the smallholders there regularly cropped chili and that another 6 percent occasionally did so (Keys 2004a).

This self-initiated, smallholder effort established a development trajectory that still has momentum, aided in part by changes in the larger political economy of Mexico (De Janvry, Gordillo, and Sadoulet 1997; Keys 2004a, 2004b; Vance and others 2004). The initial use of coyotes, perhaps the only reasonable option at the time, extended the architecture of a coyote social network into the fabric of local production, shaping many facets of the coupled human-environment system of Calakmul. Interestingly, these developments ultimately coincided with Mexico's commitment to a neoliberal economy, complete with new expectations for the ejido. The nation's foremost communal land-tenure institution, the ejido was

reinterpreted as a problem, one that locked rural folks into an economically marginal and subsidized existence (Liverman 1992; Randall 1996; De Janvry, Gordillo, and Sadoulet 1997). The "chili experiment" of Calakmul, therefore, should be seen as a self-designed experiment consistent with changes in Mexican visions of the ejido, but one in which coyotes have played a significant role. [2]

COYOTES AND CHILI IN CALAKMUL

Research for this study was carried out during 1999-2000 in conjunction with the Southern Yucatán Peninsular Region project (Turner and others 2001; Turner, Geoghegan, and Foster 2004). The role of coyotes in the regional economy was the focus of the first phase. [3] More than seventy interviews with different types of stakeholders — coyotes, farmers, business owners, and governmental and NGO agents — were carried out to gain an overview of the history, production, and marketing of chili. Convenience of sampling dictated selecting coyotes to interview. Three main coyotes were operating in the region, and numerous subcoyotes were available at various times. I interviewed six coyotes (two were lead coyotes). These interviews included travels with them to observe their activities and relationships with farmers, as well as discussions to understand their organizational structure and to determine their operating costs. Farmers who also operated as coyotes at the grassroots level of coyote organization were interviewed during the course of interviews with farmers. In addition, I conducted interviews in Mexico City and the State of Mexico with executives at chili wholesale and packing companies to gain insights about the marketing end of the coyote system.

In 1975 three farmers loaded their experimental chili harvests on horses and donkeys and transported their product over unimproved logging roads for 30 kilometers in order to reach Xpujil (now the administrative center of the Municipality of Calakmul), located on the paved, east-west Highway 186 that crosses the southern Yucatán. From there, they hired trucks to carry their dried chili — chipotle — to a buyer in Escárcega, 115 kilometers west of Xpujil at the junction with the only highway connecting the Yucatán with the rest of Mexico. They earned a negligible profit and determined that the mechanism by which to improve profits was to find a coyote who was willing to travel to them.

Before the second planting began, a group of farmers traveled to their former communities in Chiapas, Tabasco, and Veracruz to convince a previously known coyote to serve the Calakmul region the following year. He urged the growers to encourage others to take on chili production, correctly calculating that an expansion of chili in Calakmul was required to make his investment in the region worth-while. The farmers understood the need for an enlarged production base to entice more coyotes to come to Calakmul. Following the lead of the original farmers, others began to farm chili with borrowed or purchased seed. Subsequently, in 1978, a warehouse from Mexico City sent a buyer to Calakmul to encourage chili cultivation by providing seed and money for production, and one coyote provided money to first-time chili farmers as well. These investments and the word-of-mouth encouragement were successful.

The original coyote came from Puebla, the origin of coyotes in central and southern Mexico owing to the presence in that city of La Merced, one of the nation's largest and most important markets for agricultural produce, which is served by a large group of intermediaries who specialize in the transportation of lowland crops to Mexico City (Laborde and Pozo 1984; Long-Solis 1998; SAGAR 1998). As production grew in Calakmul, other coyotes from Puebla entered the southern Yucatán, eventually supplanting the initial coyote. Buoyed by the improved roadways, the second phase of coyotes to arrive were able to purchase green — fresh or nondried — chili, which fetches a higher market and farm-gate price per kilogram than does chipotle. Over time, coyotes established stronger links with individuals in the area, thus embedding themselves in the Calakmul region. Their role in agriculture there has developed beyond chili, for they purchase secondary crops such as chigua (a cucurbit), provide agricultural information to farmers, and occasionally supply difficult-to-find consumer goods to farmers.

Depending on intonation and modifier, "coyote" is a mildly derogatory term that implies illegal activities and is used throughout Mexico to describe a person who engages in the movement of

people or products. In the case of chili, coyotes do not engage in illegal transport. But, in the opinion of many farmers, the way in which coyotes operate and the prices they pay are unfair. More often than not, smallholders believe that they are not given just returns for their labor and investment. Only eight farmers (5 percent) interviewed in 1999-2000 thought that the price coyotes paid them for chili was fair. According to smallholders' calculations, coyotes should pay nearly U.S.\$0.10 per kilogram more than that season's price. On average, farmers reported that they need a price of U.S.\$0.33 per kilogram to make chili production profitable. Despite this perception, smallholders continue to grow chili because it is the most proven commercial crop available to them, and they continue to rely on intermediaries with whom a measure of trust is maintained despite the "coyote" label.

COYOTE BUSINESS EXPENSES AND RETURNS

Although farmers bemoan price-fixing, a coyote's expenses are significant, for he must draw on hard-earned capital or on loans (Table I). Buying and maintaining the pickups or midsized trucks he needs are expensive relative to coyote income. A lead coyote and his subcoyotes own as many as twelve trucks as well as three or four semitrailers for shipment to Mexico City. In peak season, if all of his large trucks are engaged in delivery to the capital, a coyote hires independent haulers to deliver the purchased chili at a cost ranging from U.S.\$938 to U.S.\$1,146 per truckload. Included in this cost are driver payments, gasoline, permits, bribes, and miscellaneous other costs, such as repairs and replacement tires. If the coyote has the trust of a packing company or warehouse, these entities generally pay up front for the cost of the driver and deduct this amount from the sum paid to the coyote.

A coyote's costs involve much more than the transportation and driver costs, of course. He purchases mesh bags used to transport the harvest. Once they are given to a farmer, the bags constitute an informal contract between the two about pickup times and places, the approximate amount of chili involved, and the price to be paid (Figure 2). Each semitrailer carries 35 metric tons of chili. At the 1999 average price of U.S.\$0.23 per kilogram, a semitrailer load of chili cost the coyote U.S.\$8,021. To fill the truck, the coyote pays loaders between U.S.\$6 and U.S.\$10 per day, or an average of U.S.\$167 per truckload.

The coyote also rents a building — typically in Nicolas Bravo, an ejido in neighboring Quintana Roo — that serves two purposes: to store locally collected chili until it is transferred to a semitrailer and to house his workers. He rents telephone lines and pays for electricity and up to seven auxiliary workers: two cooks at U.S.\$6 per day, two bookkeepers at U.S.\$21 per day, and three cleaners at U.S.\$4 per day, for an additional U.S.\$80 per day for labor.

Green chili carried in open-back semi-trailers must be transported quickly to market in Mexico City — twenty-four hours away by truck — in order to avoid shrinkage and rot problems. A truckload of chili loses between 2 and 5 percent of its weight due to rot. Assuming an average spoilage of 3.5 percent, 1.2 metric tons are lost, costing the coyote U.S.\$0.23 per kilogram, or approximately U.S.\$275 per trailer, the farm-gate price that the coyote originally paid for the now-spoiled chilis. In addition, Calakmul chili is perceived to be of low quality, relative to chili from elsewhere in Mexico, and thus commonly fetches the lower range in price at the central market. The warehouse or market price for chili in 1999 was between U.S.\$0.31 and U.S.\$0.42 per kilogram. The coyote also experiences an additional "cost," the reduction in profit of U.S.\$598 that disappears with spoilage during shipment.

The coyote also encounters other, variable costs: for example, bribes, emergencies, and even the theft of shipments. Bribery of police and other government officials during the transportation of chili seems rampant, at least according to coyotes. An informant in Calakmul reported that these costs amount to anywhere between 5 and 15 percent of a chili load. Coyotes tend to calculate these costs at an average of 7.5 percent. With a premarket value of U.S.\$8,021, a chili load costs an additional U.S.\$604 for these incidental expenses.

In short, the gross income from a single truck in 1999 totals between U.S.\$12,760 (at U.S.\$0.36 per kilogram) and U.S.\$14,583 (at U.S.\$0.42 per kilogram), and the coyote has invested U.S.\$11,998. His net income, therefore, ranges from U.S.\$763 to U.S.\$2,585,

depending on the price he receives for the chili. Chili prices vary daily in the national market, and that variation greatly increases or reduces the profitability of a day's shipments (Laborde and Pozo 1984; SAGAR 1998) (Figure 3). Coyotes and national companies both report that the national companies protect regular coyotes somewhat from price fluctuations in the market.

The amount that coyotes spend to transport chili does not account for capital investment and should not be taken as real net income. Because coyotes are not willing to divulge capital investments, their full budget cannot be calculated accurately. Nonetheless, the other expenses demonstrate the considerable cost incurred. It is precisely these high, up-front costs that inhibit individuals or groups of small-holders from paying for chili shipments or undertaking them themselves, given the considerable risks involved.

Farmers cannot afford to undertake chili shipping and marketing in addition to their cultivation costs (Keys 2004a, 2004b). Those farmers engaged in mechanized cultivation earns on average slightly more than U.S.\$1,042 per hectare each year; those practicing swidden chili farming earns less than U.S.\$729 per hectare in a year. Few farmers cultivate more than 2 hectares of chili. A full year's production of chili cannot pay for the costs associated with shipping alone, and attempts to organize chili shipment among groups of farmers is difficult in the region. Farmers could combine in cooperatives and share the costs of transportation, but, lacking the connections of a coyote, the chances of success — either reaching Mexico City on time or being able to sell the chili there — are slim. Thus, absent substantial external support to develop their own transportation, farmers are tied to coyotes.

THE COYOTE BUSINESS MODEL

All three coyotes — including two brothers — operating in Calakmul and the southern Yucatán in 1999 inherited their "social" or transaction networks outside the study region from their fathers, grandfathers, or fathers-in-law. Especially valuable are the connections their family members have developed with warehouse and processing-plant managerial personnel. One coyote's family had been doing business with the same company for years, establishing a reservoir of trust that was emphasized by the company's chief purchasing agent: "I'd give anything to [this coyote]; he's been with us for years." Such ties empower the coyote by establishing exclusive contracts with warehouses and packers that cover quality, quantity, and the timing of delivery. Such contracts can be met only by coyotes, so potential smallholder cooperatives and unions cannot make direct sales.

The three principal coyotes employ subcoyotes, usually family members, to work as purchasers. These subcoyotes often call on coyotitos (lieutenants) to assist them. The coyotitos generally are wealthier farmers with access to trucks, established trust in their home ejido and in neighboring ones, and long-term personal relationships with the principal coyotes. This hierarchy allows some movement; in some cases, these farmers-turned-coyotitos have risen to the subcoyote level and established themselves as regionwide buyers. The basic structure of the hierarchy remains the same, however.

In order to maintain their dominance in the region, the principal coyotes strive to appear to outsiders as a monolithic unit, capable of unified, swift action. They do collude to set farm-gate prices and stave off internal competition that would bypass them. Beyond this, disagreements among the three principal coyotes have led to the threat of violence, and the internal discord within each of the three organizations can be large. Subcoyotes at times steal from their leader through various deceptive practices. Coyotes attempt to gain a measure of control over this by recruiting subcoyotes from among their family members: cousins, in-laws, and children they believe they can trust. A measure of trust is established among the remainder of the coyote's crew of accountants, cooks, loaders, and others through long-term employment. Such auxiliary positions, though not demanding as much trust as do subcoyotes, enable a smoother working organization.

Subcoyotes are assigned to work a portion of the coyote's region. In some cases, these working territories overlap those of subcoyotes working for another lead coyote. During peak harvest times, however, subcoyotes of the same lead coyote also may range into each other's

territories. They are paid a commission per kilogram of chili loaded for the trip to Mexico City, and the lead coyote asks few questions about how or from where they have assembled their quota for shipment. The going rate of payment to farmers, according to former coyote employees, is approximately U.S. \$0.05 per kilogram.

The subcoyotes and coyotitos who actually pick up the cut-and-bagged chili from field locations pay the farmers directly, and the lead coyote repays his subcoyotes. This last payment occurs in two ways: When trust is great, the lead coyote lends money to the subcoyote for immediate payment to farmers; but, more commonly, the subcoyote is paid after the day's delivery and the second weighing of the chili. The subcoyote must then return to pay the farmer. When the subcoyote has sufficient money, he generally pays the farmer after he loads the product in order to avoid the return trip.

Unlike the early years, when coyotes were trying to expand the cultivation of chili, providing smallholders with money for future chili harvests is now rare. Production levels generally exceed demand, and farmers often violate understood contracts, a claim supported by both coyotes and farmers. Generally, negotiations take place with, and farmers sell to, whichever subcoyote arrives in the village as crops mature. Only 16 percent of chili farmers (25 out of 152) reported that they sell to the same subcoyote every year.

The exception to these payment relationships involves periods of projected nationwide shortfalls in chili production. Both coyotes and farmers claim that, under these circumstances, contracts — verbal, informal, and insecure — are established with growers. Cash or agricultural chemicals are supplied to the smallholder with the understanding that the lender handles the farmer's chili harvest. Despite these claims, such contracts may be rare: During a nationwide, massive chili shortfall in 1999, no expanded contracts were negotiated in Calakmul.

DECEPTION AT ALL LEVELS BUT ADVANTAGE TO COYOTES

Trust within the coyote organization and in the coyote-farmer relationship is of paramount importance because the potential for cheating is so significant. A subcoyotes may renegotiate the leaders set price with the farmer or simply refuse to pay the farmer fully, claiming nonpayment or insufficient payment by the lead coyote, robbery, or misquoted prices. Either way, the subcoyote pockets the difference between the set price and the paid price. The subcoyote can also sell his chili to another coyote who needs to fill a semitrailer shipment and is willing to pay a higher price in order to move the shipment to Mexico City promptly. This "cross" sale is rare, however, due to the time involved in transferring chili from smaller, subcoyote trucks to Mexico City-bound semitrailers: Too many "eyes" might witness the transaction and report it to the boss. Information travels quickly in Calakmul because taxis and buses frequently ply the roads, taking people to school, market, and work from dawn until nightfall.

Cheated farmers have little recourse, for they rarely gain an audience with the lead coyote and possess little credibility when they do meet with him. Moreover, once the harvest is bagged (Figure 4), it is more vulnerable to rot, and its value is controlled by how quickly it can be delivered to Mexico City. Because it is nearly impossible to arrange for another subcoyote to arrive at the field site in time, the farmer must take the reduced price or potentially lose his investment. The best recourse that a smallholder has is to cease doing business with subcoyotes in whom he loses trust. Indeed, at least one subcoyote was driven out of business in this way when most farmers stopped selling to him after years of abuse.

Occasionally, farmers violate the implicit contract signified by acceptance of the delivery of shipping bags to them by the coyote or his minions. While farmers wait for the harvest to be picked up, other subcoyotes may pass by and offer a higher price. Farmers may also load the bags with rocks, leaves, or other debris to increase their weight. Because the bags are not unpacked until they reach the packing plant in Mexico City, this deception occurs frequently and may represent a significant and unreported loss to the coyotes. Coyotes commonly counter this type of cheating by refusing to deal with the farmer in question. Armed with this knowledge, other coyotes may offer the known "cheater" a lower price. The farmer, in turn, may attempt to

pass his chili to another farmer on a consignment basis or may drop out of chili production altogether.

Deceptive practices are prevalent, although each transgression tends not to be excessive, and appear to be tolerated by all parties to a degree, even though the smallholder may have little choice in the matter. Coyotes do not tolerate attempts to circumvent their place in the chili system, such as when they are threatened by the formation of farmer unions and cooperatives. In 1998 two agricultural extension agents sought to build support for a nascent chili-growers' union in Calakmul that promised to circumvent coyote control. The agents disappeared during the process, and their dead bodies were later found at a southern roadside. No one was prosecuted, but farmers and others in the region suspected that one or all of the coyotes had ordered an execution. Proof was less important than the suspicion, reflecting the power that smallholders' believe the coyotes have. Although murder is extreme, violence and the threat of violence helps coyotes maintain control over the region. At times the violence is internecine, especially in cases of subcoyotes cheating each other. One coyote, for example, is rumored to have murdered two of his subcoyotes in Quintana Roo because they sold chili directly in Mexico City that he considered within his domain. Whether or not the rumor is true, fear of such acts reduces the amount of cheating by smallholders.

Coyotes use other forms of violence, actual or implied. In 1999 a chili cooperative, the Union of Ecological Chili Growers of Calakmul, was formed. Because the federal government sponsored the cooperative, the coyotes were reluctant to suppress it visibly. To ensure that the cooperative's chili did not reach the market, unidentified people stopped the delivery truck at Puebla, kidnapped the driver, and held him and his cargo for four days — or so the driver claimed. After four days, shrinkage and rot spoiled the entire shipment. Coyotes may have bribed the driver of the truck so that he arrived late, but the message was clear. Simultaneously, the coyotes set their prices above that offered by the cooperative, raising them from U.S.\$0.19 to more than U.S.\$0.29 per kilogram. They thus collected most of the farmers' product in Calakmul, reducing the cooperative's supply to such an extent that the co-op could not repay the government's initial investment. Such price fixing effectively ruined the cooperative, and the price for chili fell back to U.S.\$0.19 per kilogram.

Geography and competition from elsewhere further empower the coyote. Campeche and Quintana Roo are secondary, perhaps tertiary, supply centers of chili for Mexico. In most years, coyotes fulfill their contracts with packers and warehouses by adding chili grown elsewhere in Mexico well before they reach Calakmul. Thus they can bargain in Calakmul from a position of strength, in that their income needs have already been largely met. Because transportation from the region is expensive and its chili is of lower quality than is that from other regions, farmers receive the lowest return on their investment of time and money. So, when a farmer pushes for higher prices, the coyote can refuse with small loss to his yearly profits. In years when production in other parts of the country is high, as in 1998, coyotes arrived with a price below the marginal return for farmers and left before the last harvest. Farmers watched their crop rot in the fields.

SOCIAL NETWORKS OF COYOTES

Perhaps the most important facet of coyote skill, and the most difficult to demonstrate empirically, is the coyote's ability to serve not only as an intermediary of a product but also as a social and cultural agent between two distinct parts of a society. When buying, the coyote looks and sounds like a smallholder. He drives a pickup truck, wears a cowboy hat, speaks in vulgar and vernacular Spanish, and offers informal or understood contracts. Negotiating with a purchasing company, however, requires a change of face. Now the coyote wears a business suit and negotiates a formal contract in proper Spanish. Reminding the company or warehouse of his long-term connections, he understands what extras he can request from the company and knows how to look for other outlets should the negotiations fail. Farmers and farmer cooperatives do not possess these skills or the other connections and capital needed in order to sustain a flow of chili to Mexico City, a fact understood by companies and warehouses. Thus the coyote employs social, political, and economic skills, along with an element of ruthlessness, to move seamlessly between two cultures (Putnam 1993; Alvarez and Collier 1994; Bebbington

2000).

Moreover, coyotes can provide items that are otherwise difficult to obtain on the frontier, serve as sources of information about new technology, and constitute a relay connection to expert sources of information about cultivation problems. When an outbreak of whiteflies occurred in the region, local farmers had no experience with the pest. They turned to a coyote who, based on contacts and experiences elsewhere in Mexico, not only diagnosed the problem but also directed farmers to the appropriate agrochemical to combat the whiteflies (Keys 2004a).

The coyote uses these skills shrewdly and, from the smallholders' perspective, gains too much power relative to the marginal, frontier farmers of Calakmul — marginalized by their distance from and recent entry into the market as well as by their low-input farming systems. This power, as monopolistic and coercive as it may be at times, also brings some positive benefits to farmers beyond market access alone. Entering commercial cultivation ties the farmer to the vagaries of the market as much as to those of nature; it has the potential to improve household income but axiomatically increases risks. The coyote, like many market intermediaries elsewhere (Planner 1989), helps to buffer the smallholder from market swings by accepting lower profits in bad years, offsetting the losses by shaving the price paid for chili in good years. He keeps marginal farmers in the "game," a role that obviously benefits the coyote and helps the farmer as well.

The coyote resides at the center of an elaborate social network "whose significance increase[s] the longer and more intricate the network becomes" (Whatmore and Thorne 1997, 291), especially because the network ties socially and geographically distant smallholders more closely to the market over time. The social network of chili is embedded and contingent, involving relationships among farmers, intermediaries, and warehouse packers as well as various federal institutions and offices. Coyotes must master relationships among each of these players in the network to be successful. But having done so, they lock in control over a principal resource, and the only commercially viable product grown in the region at the moment is chili. This control is amplified in locales like Calakmul — distant, rural, poor, possessing limited local market demand, and presenting few alternatives for commercial production — and holds wide-ranging implications for agrarian reform to affect meaningful economic change in the region.

Individuals and firms constitute the chili agrofood system from Calakmul farmers to the consumer. The ability of intermediaries to move between the informal social world of the farmer and the more formal world of chili-purchasing firms makes their role increasingly necessary to the chili agrofood system. Furthermore, they do not represent simple market functionaries; they represent known people with established relationships at both ends of the chili-to-market system. This circumstance may explain, in part, the difficulty of developing alternative marketing strategies for chili in the region as well as the coyotes' obviously successful resistance to such alternatives. Coyotes also perform both economic and social functions for smallholders, enhancing their ability to dominate the intermediary function. Coyotes are embedded in the economy of Calakmul and the southern Yucatán through the multiple functions they fulfill beyond a mere transportation role.

FARMERS, COYOTES, AND THE EMERGING LANDSCAPE

To enhance their chances in commercial cultivation, Calakmul farmers voluntarily sought the assistance of intermediaries — coyotes. The coyotes soon became powerful and dominant players in chili farming in the region. With the advantages of capital and social networks, they control the access of Calakmul's chili to the national market and thus determine the viability of the region's only proven marketable product and the rewards that accrue to the smallholder engaged in chili cultivation. Understanding commercial farming dynamics in the region requires an understanding of the multiple roles of coyotes and their impacts on household decision making, farming practices, and income.

These impacts include a myriad of factors that determine the health of the coupled human and natural environments in Calakmul and the southern Yucatán. They significantly affect land-use

decisions — amount of land cultivated, cropping frequency, and time in fallow — that affect land-cover change — forest fragmentation, nutrient cycling, and composition and abundance of species. Landscape-level changes, in turn, affect pest vectors and, possibly, local rainfall and the efficacy of the CBR and the MBO — two critical components of the other economic dimension of the region, archaeo-ecotourism. These changes and feedbacks increase capital inputs required of marginal farmers, highlighting the importance of understanding how their profit margins are determined by coyotes.

Coyotes and higher-level buyers in Mexico City resist attempts to find alternative marketing strategies. But buyer resistance is insufficient to explain why coyotes are able to maintain dominance in Calakmul. It is their ability to travel along farm-to-market paths, both materially and culturally, that enables them to maintain their economic control over the chili farmers of Calakmul.

Nonetheless, the control that the coyotes maintain reflects long histories of marketing the uncertain products of marginal zones. By sharing the risk of transportation and sale among multiple parties, the farmer-coyote-national company commodity chain enables the continued economic gain, albeit muted for farmers, derived from chili cultivation. Because of the high risk associated with agricultural production, the intermediary coyotes enable production, though at the cost of the farmer's autonomy. In these actions the coyotes in Calakmul can also be seen as important in maintaining the current land-use strategies of traditional slash-andburn agriculture and the growing mechanization of cultivation — both of which are important land-cover alterations in this zone of rapid deforestation. Intermediaries play a central role in market production in remote zones, often of most concern for global environmental change. This complex and nuanced role needs explanation to assess and alter adverse environmental change in parts of the world deemed to be hot spots of such change.

The face of the market — the coyote — and the market itself should not receive blanket condemnation. In some ways the long and somewhat stable coyote-farmer relationships, even if confrontational at times, represent more security than does the history of mercurial, even if fleeting support by government and NCOS in the region. Without the coyotes' work, farmers in Calakmul would not grow chili; nor would they participate in the market to the extent that they currently do. Coyotes, therefore, are intimately tied to household economic and landscape conditions.

The Calakmul Municipality is both a development frontier and a preservation landscape. The CBR and the MBC represent expensive investments by state and international organizations to preserve the forest ecosystem — biotic flows and carbon stocks — and to shift much of the regional economy to archaeo-ecotourism. This shift is expected to help relieve land pressures in and around the CBR, but, in the meantime, various efforts are under way to make cultivation sedentary, focusing agriculture on currently used parcels, reducing shifting cultivation, and permitting significant forest regeneration (Abizaid and Coomes 2004; Lawrence and others 2004; Vester and others forthcoming). Few intensive agricultural experiments offer unequivocal win-win solutions; that is, reduce pressures on the CBR-MBC and improve the livelihoods of local farmers. Chili cultivation promises to at least partly meet the intensification vision and reduce shifting cultivation while increasing household income. Inasmuch as commercial chili cultivation becomes the favored option for farmers, coyotes become increasingly important components for understanding farming practices and, hence, landscape consequences. By 1999, indicators of increasing successional growth in the chili-farming zones hinted that chili and sedentary practices might be working. Subsequently, a new explosion in recutting successional growth seems to have taken place (Schneider 2004; Vester and others forthcoming). Not surprisingly, some of this deforestation appears to be a product of expanding "permanent" chili cultivation made possible by the farm-to-market linkages provided by the region's coyotes.

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NOTES

1. "Certified production status" refers to tropical-forest harvesting that is guaranteed by a certifying body (usually an international conservation organization) to satisfy concerns about sustainable use of the basic forest resource.
2. Various consequences of commercial chili production, in tandem with efforts to sedentarize and intensify cultivation on the premise that focused cultivation will reduce deforestation, are reported in detail elsewhere (Turner, Geoghegan, and Poster 2004). Some of the more important findings for tropical-forest and land-change themes, which can also be found elsewhere, include: threats to the structure and function of the forest ecosystem and the biodiversity function of the CUR and the MBC; possible land-change-induced decreases in precipitation; apparent declines in the nutrient stocks of parcels more frequently cultivated; and household winners and losers in chili cultivation regarding smallholder households and attempts to reduce deforestation in the CBR and the MBC (Keys 2004b; Lawrence and others 2004; Vester and others forthcoming).
3. The second stage of the research involved 160 farming households in five ejidos. Standardized surveys that elicited information about cultivation practices, marketing behavior, and household history with chili cultivation were administered in each household. One village was selected specifically because it was the first community to engage in chili cultivation. The other villages were selected at random from the main chili-growing region of Calakmul, along the road that skirts the southeastern side of the CUR (Figure 1). The respondents were selected at random from each community's official roster of residents both with and without guaranteed land rights. The results of these interviews and analysis of cropping systems and household economics are reported elsewhere (Keys 2004a, 2004b). The survey provided additional information about the coyote-smallholder relationship reported in this study.

TABLE I — COYOTES' COSTS, IN U.S. DOLLARS, ASSOCIATED WITH TRANSPORTING A LOAD OF CHILI FROM CALAKMUL TO THE CENTRAL MARKET IN MEXICO CITY, 1999 (IN U.S. DOLLARS)

ITEM	COST
Driver/truck payment	\$1,042
35 tons of chilis	8,021
Commission to subcoyotes	1,823
Loaders and other labor	233
Spoilage loss	275
Miscellaneous costs	604
Total \$11,	998

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MAP: FIG. 1 — The study area in the Yucatan Peninsula, Mexico. The study villages lie south of Xpujil on Highway 186. (Cartography by Anne Gibson, Clark Labs for Cartographic Technology & Geographic Analysis)

GRAPH: FIG. 3 — Wholesale prices per kilogram of chili in Mexico City, November 2000. The

fluctuations in daily prices challenge the profitability of chili for farmer and coyote alike. Source: CEDA 2000.

PHOTO (BLACK & WHITE): FIG. 2 — A coyote weighs bags of chili in Calakmul, Mexico, before they are loaded onto a truck.

PHOTO (BLACK & WHITE): FIG. 4 — Bags of chili stacked at a roadside in Calakmul, Mexico, awaiting pickup by a coyote.

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