SOOT SAYERS: AN INTEGRATED APPROACH TO CHARCOAL PRODUCTION IN CALAKMUL, MEXICO

By

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A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
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To Don Eliseo Ek, a Calakmul institution unto himself

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Natural hazards have the potential to shock socio-ecological systems, the most vulnerable of which can be found in the rural developing world. Populations in these environments face obstacles in overcoming droughts, fires, hurricanes and other extreme events. In one of Mexico's poorest and most densely forested regions—Campeche's Calakmul Municipality—the effects of natural hazards are acutely felt. In addition, traditional swidden agriculture and attempts at wide scale access to the market have been flouted by a diverse set of actors. In August 2007, following a summer-long drought, category five Hurricane Dean made landfall on the southern Yucatán peninsula devastating subsistence agriculture, leaving many farmers without viable livelihood strategies. While charcoal production appeared in Calakmul prior to the storm, its importance after the storm seems to have increased due to policy changes in Mexican forest governance. The latter is due to a relaxation of post-hurricane timber harvesting permits. Interviews were carried out with households in peasant communities to determine the effects of the hurricane upon livelihood. Results indicate that while many respondents did not acknowledge the hurricane as a driver of their production, actions illustrate notable increases in production in the initial weeks and months following. This research links cultural and political ecology and hazards research in explaining how farmers have quickly shifted from reliance upon a hybrid of swidden and

intensive agriculture to alternative strategies, which may actually have less of an impact upon forest cover.

CHAPTER 1
INTRODUCTION

This research makes a contribution to the field of geography by linking natural hazards and cultural and political ecology (CAPE) in asking how environment and society interact to produce livelihood change. The questions investigated throughout this include: 1) How has climactic shock contributed to an alteration of landscape and livelihood in Calakmul, especially in the form of rapidly spreading charcoal production? 2) Is charcoal production an appropriate indicator for measuring this change as a result of Hurricane Dean? And, 3) what is the current state of the livelihood strategy and its prospects for the future?

CAPE is chosen to address these questions due to the complexity of human, particularly household, interactions within a problematic environmental setting. The setting involves a large protected tropical area, a frontier with demonstrable population flux, and indications of climate variability. The human-environment condition of Calakmul links human residents to the forest, to the currents of international conservation efforts, and to the political economy of Mexico in a globalized world. These relationships have undergone various stresses since the formation of the reserve, and then the municipality, only two decades ago. Demographic trends for the region, including periods of intense immigration and emigration, have also had profound effects on the conservation narrative largely constructed by government administrators and NGO officials (Haenn 2005). Yet while the interplay between these parties bears closer examination, the cumulative effect of human presence on a few thousand hectares of the municipality's millions is no less important. Careful observation of these patterns can only help further characterize the changes in decision-making of a household following an extreme event like a hurricane.

Natural hazards research and its relation to smallholder land use is an area ripe for research. As has been illustrated by Roy Chowdhury and Turner (2006), work on smallholder

agriculture and its ensuing permutations have been tied to developments in cultural and political ecology, hazards research, and to an extent land use/land cover change. Positioning land managers as actors and decision makers in a discussion of natural hazards, Burton, Kates, and White (1978) followed a path of geographic emphasis on the behavior of land managers as first articulated by Brookfield (1964), who himself maintained that the landscape could not be understood without attention to the primary modifiers of the landscape. Anthropological concepts of cultural adaptation, influenced by systems science, and peasant farmer decision-making by Chayanov (1966) and Boserup (1965) fed directly into these discourses. Soon Brookfield (1972), and later Turner and Brush (1987) and Netting (1993), applied agent-based theory, derived from economics, as an explanation for a host of human-environment conditions.

Within a decade a number of academics drew the broad outlines of what would be referred to as political ecology. Political ecologists challenged the emphasis on agency that cultural ecologists favored (Robbins 2004), contending that the latter gave flawed answers to human-environment questions (Watts 1983a, 1983b; Peet and Watts 1996). This school of thought asserted that a major refocusing was necessary to address the role of societal structures (Hewitt 1983), a theme that was carried into practice in cultural ecology at roughly the same time (Brookfield 1984; Bassett 1988). From this point a distinctive subcluster in vulnerability studies (Wisner et al. 2003) arose. For some initial practitioners, including Blaikie and Brookfield (1987), political ecology sought to establish a union of both agency and structure. This sentiment, in addition to a perceived lack of coherency, led Watts and Peet (1996) to fault the dominance of structuralist thought in vulnerability research. In turn, political ecology was challenged as lacking an understanding of either agency or events by others, notably Vayda and Walters (1999). In the interim, political ecology has been heavily weighted by the post-

structuralist school of thought, (e.g., Escobar 1996), which has been critiqued within the political community as overemphasizing the "social construction of nature" instead of the material setting for the social relations of production, the "natural construction of the social" as Peet and Watts (1996) called it.

A new tract was established as questions of global environmental change extended outside the confines of the geographic discipline (Turner and Robbins 2008). Land use/land-change, vulnerability and resilience, and sustainability sciences cropped up as little-explored intellectual territory (Cutter 2001; Kates et al. 2001; Lambin et al. 2001; Turner et al. 2003; Gutman et al. 2005; Turner, Geoghegan, and Foster 2004; Kasperson and Kasperson 2005; Lambin and Geist 2006). These researchers address both agency *and* structure in their design, a return to the exhortations of Brookfield in his original essay on the future of human geography (1964). Their post-positivistic explanatory nature, however, is not accepted by some political ecologists (Roy Chowdhury and Turner 2006). Scholars including Peet and Watts (1996), Forsyth (2003), and Robbins (2004) dispute any claims of objectivity and the modernist agenda as being insufficient in explaining human-environmental relations. Regardless, many of the above-mentioned researchers pursue a hybridization of ecologies, which acknowledge that attempts should be made to bridge dichotomies like agency and structure.

The difficulty in these hybrids as they apply to natural hazards research are manifold. Political economic conditions and the cultural and historical experiences that constrain agent-based decisions are now in the present realm of inquiry (Roy Chowdhury and Turner 2006). Using a socio-ecological discourse, cultural conditions and experiences shape household behavior, and together with natural events, they mediate the scope of decisions. As Chayanov (1966) observed in the early Soviet Union, the household, reinterprets and reforms its

circumstance and adjusts livelihood strategies accordingly. In the case of an external event, such as a hurricane, external forces can overwhelm the household and elevate the role of structure in complex modern systems that link non-human nature and people. Absent a decisive natural hazard, a household may make behavioral changes within a wide spectrum of possibilities (Lindell and Hwang 2008). Keys (2002), Turner, Geoghegan, and Foster (2004), and Roy Chowdhury and Turner (2006) have urged a comprehensive take on an agent-structure binary.

Human-environment geographers have typically left unexplored land use patterns as a response to natural hazards, except as part of an explanation for economic vulnerability. Kelly and Adger (2000) and Turner and others (2003) have conceived of frameworks from which this work might be done, but many of the attempted correlations between natural hazards, usually hurricanes, have been drawn by ecologists (Dale 1997; Foster, Fluet, and Boose 1999; Grau et al. 2003). A more elucidating link may be found in Lambin and Geist (2006) and Geist and McConnell (2006), which detail how deforestation, or transition, can best be understood as a combination of proximate and underlying causes, or synergies. Such frameworks are well placed in these multi-tiered categorizations. Another linkage is the use of social research methods, which are commonly put to use in both LUCC and vulnerability studies, often at the household level. (Turner and Robbins 2008)

Finally, the backdrop for this work cannot be considered without reference to an expanding body of research on innovation. The subject matter first came to prominence in economic geography with Rogers (1962) and then Feldman (1994), the crux of which recalls central place theory (Christaller and Baskin 1966). The core of this work explored how diffusion of cost and resource affects urban geographies. These urban discourses on innovation were not aided by research concerning rural innovation—in the developing world—until mention of

wood-burning fuels (Agarwal 1983; Feder, Just, and Zilberman 1985) emerged. This development was a departure from an agricultural extentionist emphasis on crop diversification, and has continued of late (Troncoso et al. 2007), though the emphasis has been on the mechanism for fuel wood conversion. Along parallel lines, Schumpeter's (1976) popularization of "creative destruction," or the process of transformation that accompanies radical innovation, has since been used to describe modification in an agricultural frontier as well, specifically in relation to intensification (Johnson and Lewis 2006; Keys 2004). Creatively destructive principles of rural production contrast with those of "destructive creation" in that they highlight sustainability, such as the amendment of manure in soil (Johnson and Lewis 2006, 108). These concepts have been used to interrogate rural economies and could provide opportunities for exploration outside of agricultural goods.

As CAPE has developed theoretically within geography, case examples such as the one explored in this thesis continue to suggest exploration in new domains of the field. Natural hazards serve as a focus pursuant to these larger schools of thought, as the shocks they represent add nuance to discussions of structural inequity—an interest of political ecology—and the alteration of forest use and coverage. But as the processes of decision-making vary, the added perspective of innovation helps to conceptualize how a change in livelihood strategy might produce an entirely different outcome.

CHAPTER 2
SOOT SAYERS: AN INTEGRATED APPROACH TO CHARCOAL PRODUCTION IN CALAKMUL, MEXICO

Introduction

This research links natural hazards and cultural and political ecology (CAPE) in asking how environment and society interact to produce livelihood change. The questions investigated throughout this thesis are made through the lens of charcoal production in two different communities in southeastern Mexico's Calakmul Municipality and include: 1) How has climactic shock contributed to an alteration of landscape and livelihood in Calakmul, especially in the form of rapidly spreading charcoal production? 2) Is charcoal production an appropriate indicator for measuring this change as a result of Hurricane Dean? And, 3) what is the current state of the livelihood strategy and its prospects for the future?

CAPE is chosen to address these questions due to the complexity of human, particularly household, interactions within a problematic environmental setting. There are also possible indicators for land use/land cover change (LUCC) in the study region, but these are mentioned only briefly given the shorter temporal scale under review. The setting involves a large protected tropical area, a frontier with demonstrable population flux, and indications of climate variability. The human-environment condition of Calakmul links human residents to the forest, to the currents of international conservation efforts, and to the political economy of Mexico in a globalized world. These relationships have undergone various stresses since the formation of the reserve, and then the municipality, only two decades ago. Demographic trends for the region, including periods of intense immigration and emigration, have also had profound effects on the conservation narrative largely constructed by government administrators and NGO officials (Haenn 2005). Yet while the interplay between these parties bears closer examination, the cumulative effect of human presence on a few thousand hectares of the municipality's millions is

no less important. Careful observation of these patterns can only help further characterize the changes in decision-making of a household following an extreme event like a hurricane.

The story of charcoal in the Calakmul is a contested one. According to some Mexican environmental agents, the timber product has existed in the area for more than four years as a response to receiving little payment from the market for crops. *Campesinos*—country people—latched onto something new, they say, because there were few other options. These campesinos, however, contend charcoal arrived on the backs (or trucks) of market intermediaries—locally known as *coyotes*—bent on their exploitation. Occasionally an argument is even tendered that the state government wanted to equalize the success of Mennonite agriculturalists, who had used the success of their kin in the northern states before the hardwoods extracted for charcoal there were largely deforested, to help consolidate a charcoal base in surrounding municipalities. This contention concludes that the federal government abused the permitting procedures to achieve its aims. Though it was not the goal of this research to judge the veracity of all these accounts, I believe that the truth includes elements of each. More to the point, the story of charcoal can be viewed as an expanding outpost in what has been referred to as a "problematic frontier," where the balance between the maintenance of a regional landscape includes the needs of farmers and the preservation of a valued ecosystem (Turner, Geoghegan, and Foster 2004, 1).

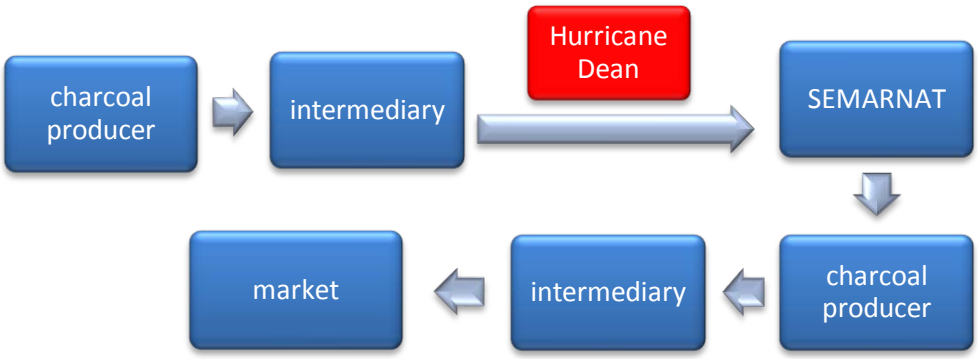


Figure 2-1. Chain of charcoal production in Calakmul

The production chain (Figure 2-1) provides a distilled explanation of charcoal's admittedly recent history in the area. Production done on a large scale in the northern Mexican states led to the deforestation of numerous hardwoods (Stoleson et al. 2005). The Mennonites of the northern states most likely transferred the information from their communities in the north to those in south, specifically in the Yucatán peninsula. Mennonite production before 2000 occurred primarily in the municipalities of Candelaria and Hopelchén, but after Campeche's environmental and forestry agencies provided extension demonstrations the idea of charcoal as a rural development strategy for forest communities spread anemically (Figure 2-4). A coyote began buying and selling finished charcoal in 2006 at which time 16 of the 68 interviewed charcoal producers were engaging in the practice. Shortly after Hurricane Dean in August 2007 the primary Mexican agency tasked with permitting relaxed collection and extraction of timber with the expressed purpose of preventing forest fires. The initial permitting period ended in April 2008, by which time virtually all the households in El Refugio were involved in charcoal production, as were a majority of those in Zoh-Laguna. By the time field work for this thesis was completed in August 2008, the coyote was also firmly planted as the connecting point between individual producers and the larger markets for the good in Mexico City and Puebla.

The Calakmul Biosphere Reserve (CBR) itself represents the largest tropical core protected area in Mexico and is a fitting locale from which to measure socio-ecological changes. Charcoal production sits at the intersection of human and environmental events which are highly dynamic. In five *ejidos*—villages with communally controlled land—in the north of the municipality (roughly equivalent to a United States county), campesinos have made a shift since the fall of 2007: from smallholder agriculture, or *milpa*, toward charcoal, a forest product that has no historical connection to the region. Four of these five communities lie within the bounds of the

reserve or its buffer zone, and exchanges between the campesinos and the reserve agents, not to mention its NGO and governmental partners, are often contentious (Haenn 1999). Hurricane Dean, which made landfall in the region on August 21, 2007, is identified as a strong underlying cause for this dynamism. Though classified as a category 5 storm, it left comparatively little structural damage in its wake, and even fewer human casualties *(El País* 2007). It did, however, devastate maize and other crops that were on the verge of being harvested.

In a rapid field assessment conducted by a team from the Universities of Florida,Virginia, and El Colegio de la Frontera Sur in September 2007, three weeks following the hurricane, many campesinos complained about crop loss. In some cases a whole season's worth of maize was extirpated, a more devastating turn of events for pobladores, or non-vested residents in an ejido, who have neither property nor representation in an ejidal assembly (Faust, Anderson, and Frazier 2004, 104). Many however also noted that SEMARNAT, the Mexican federal agency charged with the mission of conserving natural resources and providing environmental services, had begun issuing permits for the collection of downed timber for the expressed purpose of fire suppression but with the awareness that charcoal production would be an ancillary effect. Each head of household was given an allowance of 20 hectares toward charcoal production if they applied within a seven-month period. Afterwards they would have to pay hefty application fees. In Calakmul the five ejidos of Nuevo Bécal, Zoh-Laguna, Nueva Vida, El Refugio, and Xpujil had nascent production; in all the term carbonero (charcoal producer) was commonplace for both ejidatarios and pobladores involved in the livelihood strategy. Upon first glance charcoal production appeared to be another in a long line of rural production trends, but this cursory

observation was to be amended eight months later.

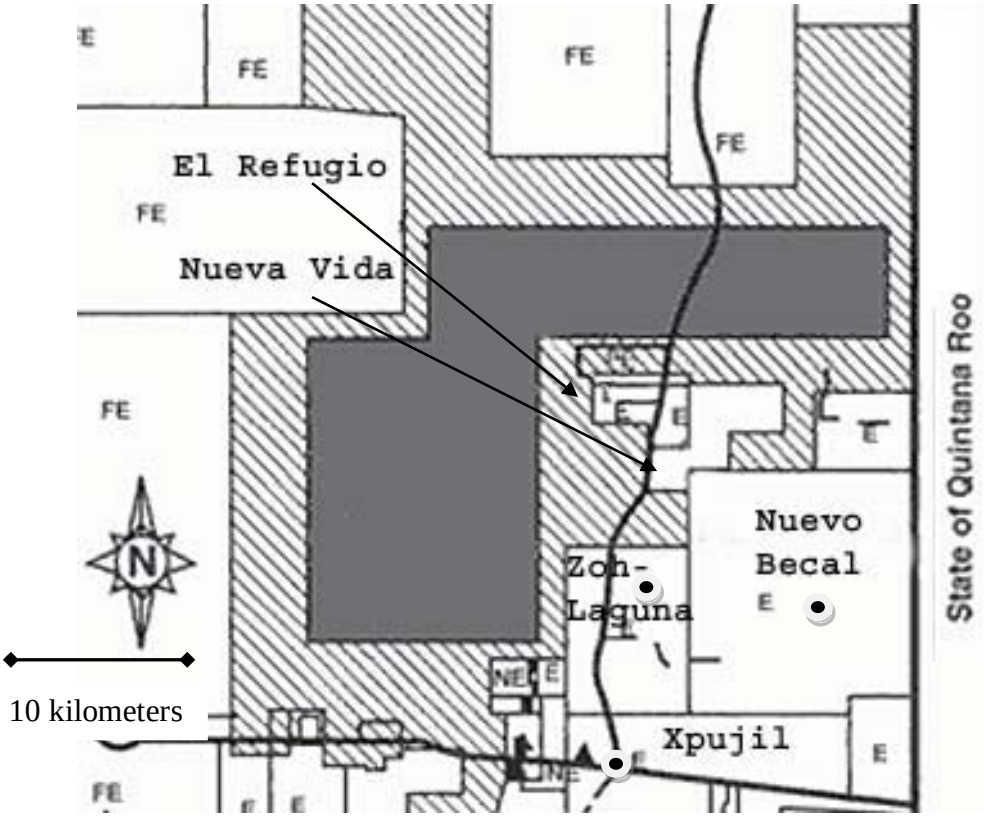


Figure 2-2. Map of the five charcoal producing ejidos in the Calakmul municipality (adapted from Ericson, Freudenberger, and Boege 1999)

Between May and August 2008, when fieldwork was carried out for this thesis, what was once an innovative livelihood strategy had become the subsistence base, a turn of events that can be observed in Figure 2-4. The constant refrain la única cosa [que tenemos] ("it's the only thing we have") was heard during research conducted in Zoh-Laguna and El Refugio. Hurricane Dean was cited by the sixty-eight carboneros interviewed as the force behind the downing of timber, but there was no consensus on the reason charcoal had become so widespread. It would not have been a stretch to conclude that charcoal was, as Ellis might call it, the primary "natural capital" of the northern ejidos (2000, 8). Few respondents hazarded guesses as to where their charcoal would arrive after leaving Xpujil in packed eighteen-wheel trailers. There was even less certainty on the part of the administration at CBR, which expressed that campesinos could not fathom the

impact these ovens dotting the landscape might have. Indeed, their view had it that if left unchecked the only hardwood species remaining "would be the ones in the far interior." It can be posited that the origins and effects of charcoal production are not adequately understood by any of the parties interviewed or otherwise mentioned in this thesis. Its newness would seem to assure it.

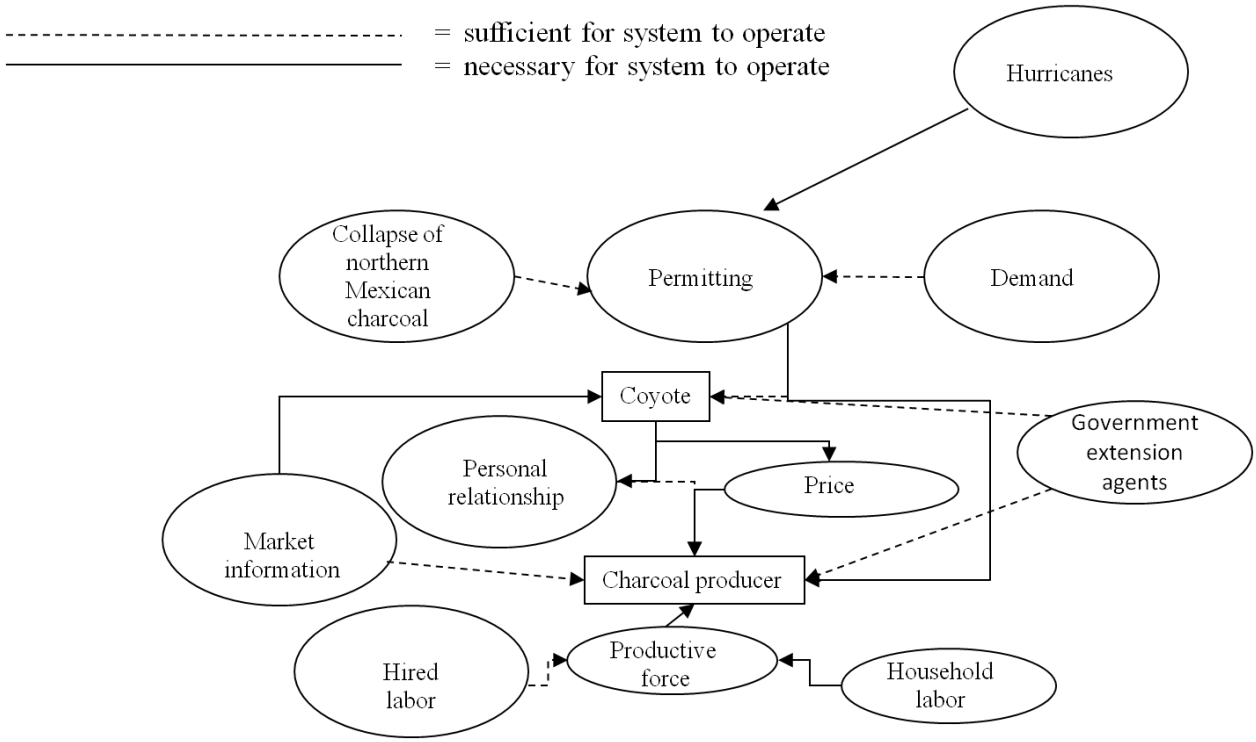


Figure 2-3. Diagram of charcoal production system in Calakmul.

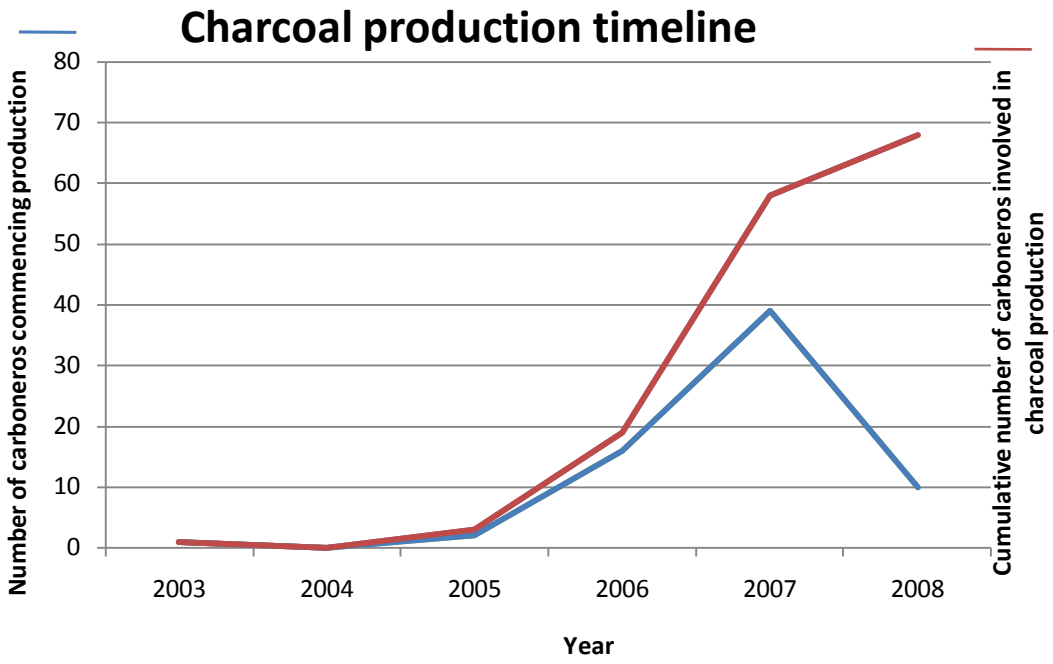
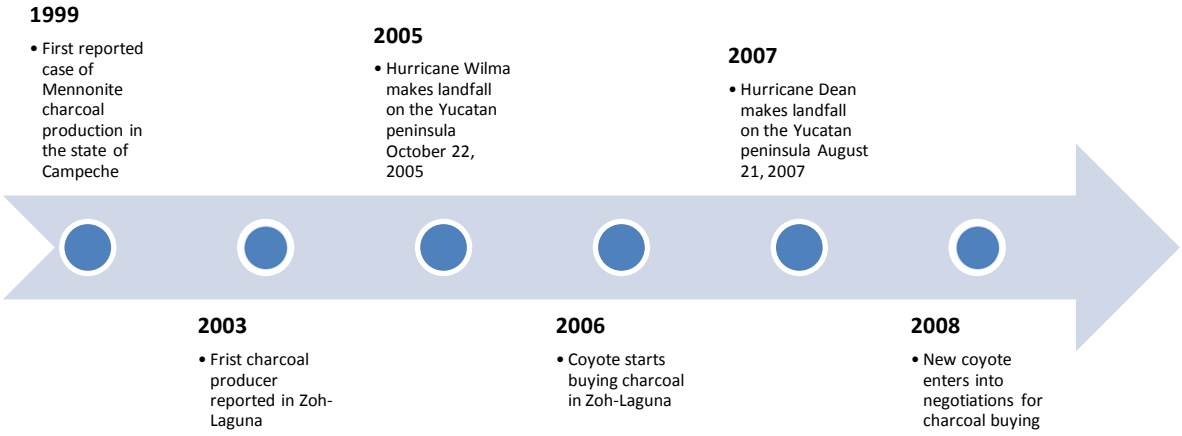


Figure 2-4. Historic chart of charcoal production in Calakmul



Figue 2-5. Timeline of charcoal production in Calakmul

Research Context

At the intersection of natural hazards and smallholder land use studies a rich literature is accesible. As has been illustrated by Roy Chowdhury and Turner (2006), the study of smallholder land use, its origins, and ensuing permutations are tied to developments in cultural

and political ecology and to an extent hazards research. Positioning land managers as actors and decision makers in a discussion of natural hazards, Burton, Kates, and White (1978) followed a path of geographic emphasis on the behavior of land managers as first articulated by Brookfield (1964), who himself maintained that the landscape could not be understood without attention to the primary modifiers of the landscape. Anthropological concepts of cultural adaptation, influenced by systems science, and peasant farmer decision-making by Chayanov (1966) and Boserup (1965) fed directly into these discourses. Soon Brookfield (1972), and then Turner and Brush (1987) and Netting (1993), applied agent-based theory, rising out of economics, to explain human-environment conditions.

A corresponding development in what would soon be called political ecology challenged a culturally ecological focus on agency (Robbins 2004, 29). These researchers contended that cultural ecology gave flawed answers to human-environment questions (Watts 1983a, 1983b; Peet and Watts 1996), asserting that a major refocusing was necessary to address the role of societal structures (Hewitt 1983), a theme that was carried into practice in cultural ecology at roughly the same time (Brookfield 1984; Bassett 1988). From this point a distinctive subcluster in vulnerability studies (Wisner et al. 2003) arose. For some initial practitioners, including Blaikie and Brookfield (1987), political ecology sought to establish a union of both agency and structure. This sentiment, in addition to a perceived lack of coherency, led Watts and Peet (1996) to fault the dominance of structuralist thought in vulnerability research. In turn, political ecology was challenged as lacking an understanding of either agency or events by others, notably Vayda and Walters (1999). In the interim, political ecology has been heavily weighted by the post-structuralist school of thought, (e.g., Escobar 1996), which has been critiqued within the

politically ecological community as overemphasizing the "social construction of nature" (Peet and Watts 1996).

A complimentary but parallel approach of addressing human-environment dynamics has emerged alongside political ecology (Turner and Robbins 2008). Land use/land-change (or land change science—LCS), vulnerability and resilience, and sustainability sciences have begun to address both agency and structure in their design (Cutter 2001; Kates et al. 2001; Lambin et al. 2001; Turner et al. 2003; Gutman et al. 2005; Turner, Geoghegan, and Foster 2004; Kasperson and Kasperson 2005; Lambin and Geist 2006). These developments echo a return to the exhortations of Brookfield in his original essay on the future of human geography (1964). Their post-positivistic explanatory nature, however, is not accepted by some political ecologists (Roy Chowdhury and Turner 2006). Scholars including Peet and Watts (1996), Forsyth (2003), and Robbins (2004) dispute any claims of objectivity and the modernist agenda as being insufficient in explaining human-environmental relations. Regardless, many of the above-mentioned researchers pursue a hybridization of ecologies, which acknowledge that attempts should be made to bridge dichotomies like agency and structure. Human-environmental dichotomies work toward melding questions and approaches in political ecology and vulnerability studies; and of LUCC, vulnerability, and sustainability sciences (e.g., Batterbury and Bebbington 1999; Turner et al. 2003; Vasquez-Leon and Liverman 2004; Zimmerer 2004; Walker 2005; Turner and Robbins 2008).

These hybrids and their connections to natural hazards research are nevertheless problematic. Political economic conditions and the cultural and historical experiences that constrain agent-based decisions are now in the present realm of inquiry (Roy Chowdhury and Turner 2006). Using a socio-ecological discourse, cultural conditions and experiences shape

household behavior, and together with natural events, they mediate the scope of decisions. As Chayanov (1966) observed in the early Soviet Union, the household, reinterprets and reforms its circumstance and adjusts livelihood strategies accordingly. In the case of an external event, such as a hurricane, external forces can overwhelm the household and elevate the role of structure in complex modern systems that link non-human nature and people. Absent a decisive natural hazard, a household may make behavioral changes within a wide spectrum of possibilities (Lindell and Hwang 2008). A comprehensive take on an agent-structure binary by Keys (2002), Turner, Geoghegan, and Foster (2004), and Roy Chowdhury and Turner (2006) has been urged as a result.

Fewer works by human-environment geographers have explored land use patterns as a response to natural hazards, except as part of an explanation for economic vulnerability. Kelly and Adger (2000) and Turner and others (2003) have conceived of frameworks from which this work might be done, but many of the attempted correlations between natural hazards, usually hurricanes, have been drawn by ecologists (Dale 1997; Foster, Fluet, and Boose 1999; Grau et al. 2003). A more elucidating link may be found in Lambin and Geist (2006) and Geist and McConnell (2006), which detail how deforestation, or transition in landscape and livelihood, can best be understood as a combination of proximate and underlying causes, or synergies. Such frameworks are well placed in these multi-tiered categorizations. Another linkage is the use of social research methods, which are commonly put to use in both LUCC and vulnerability studies, often at the household level.

Innovation provides the last avenue for investigation. The subject matter first came to prominence in economic geography with Rogers (1962) and then Feldman (1994), the crux of which recalls central place theory (Christaller and Baskin 1966). The core of this work explored

how diffusion of cost and resource affects urban geographies. These urban discourses on innovation were not aided by research concerning rural innovation—in the developing world—until mention of wood-burning fuels (Agarwal 1983; Feder, Just, and Zilberman 1985) emerged. This development was a departure from an agricultural extentionist emphasis on crop diversification, and has continued of late (Troncoso et al. 2007), though the emphasis has been on the mechanism for fuel wood conversion. Along parallel lines, Schumpeter's (1976) popularization of "creative destruction," or the process of transformation that accompanies radical innovation, has since been used to describe modification in an agricultural frontier as well, specifically in relation to intensification (Johnson and Lewis 2006; Keys 2004). Creatively destructive principles of rural production contrast with those of "destructive creation" in that they highlight sustainability, such as the amendment of manure in soil (Johnson and Lewis 2006, 108). Largely used to explore the effects of agriculture on land degradation, these principles are useful for examining charcoal as well.

Turner and Robbins have argued that CAPE is entering new domains which could be collinear with LCS (2008). Charcoal production is one such area where this pattern might be observed. Natural hazards serve as a relevant focus pursuant to political ecology, as the shocks they represent add nuance to discussions of structural inequity, and the alteration of forest use and coverage are deeply culturally ecological. But as the processes of decision-making vary, an added perspective—innovation—helps to conceptualize how a change in livelihood strategy might produce an entirely different outcome. These strains are identified in this research: CAPE serves as the primary theoretical backdrop with natural hazards as the focus point, while the literature on innovation helps to more fully characterize production strategies in market terms. These theories inform the question of whether an extreme event can contribut to livelihood

change in the ejidos of Calakmul. They also point to using charcoal production as an indicator for measuring this change in Calakmul as a result of Hurricane Dean, and whether that production strategy is also a test of innovation in the ejidos of the municipality.

Study Site and Methodology

Study Site

Research took place in southeastern Campeche, which along with southwestern Quintana Roo makes up the southern Yucatán peninsular region (SYPR), home to the largest stretch of seasonal tropical forests remaining in Mexico and part of the largest forested area left in Mesoamerica (Turner, Foster, and Geoghegan 2004). It comprises an important north–south ecological gradient, which connects the northern most extension of humid Guatemalan forests with the dry forests to the north (Espadas Manríquez et al. 2003). CBR is 7225 km^2, which includes most of the land in the municipality and is situated within the Mesoamerican Biological Corridor (MBC). The reserve is segmented into a tropical core area and areas of forest extension, but ongoing conservation and preservation efforts are challenged due to disturbance and an increase in fragmentation of forests proximate to it (Lawrence et al. 2004).

Climatologically the SYPR is prone to hurricane activity, with extensive miles of coastline on both its shores. Annually, the hurricane season reaches its maximum activity in September for the Atlantic and Pacific coasts of the country (Longshore 2000). During the past 50 years six intense hurricanes (Category 5) have made landfall on the Gulf/Caribbean coasts, and when considering the frequency of landfalling tropical storms and hurricanes impacting on both littorals, their aggregate numbers have increased since the 1990s (Jáuregui 2003). Perhaps no hurricane has been more identified with SYPR than Hurricane Janet of 1955 (Redclift 2006, 155-156), which collapsed the region's *chicle*—natural gum derived from the sapodilla tree—industry and also managed to knock down large tracts of forest, which produced fodder for future

fires (Klepeis and Turner 2001). Tropical storms and hurricanes are mechanisms that provide a significant amount of the country's moisture, and active hurricane seasons usually translate into a prosperous year for agricultural activity in much of the rest of the country (Jáuregui 2003). They have in the past, however, had severe consequences for forests and their human inhabitants.

After the SYPR was opened to government engineered resettlement in the 1960s (Arizpe 1996), most of the colonists formed ejidos, the predominant form of land tenure in Calakmul, usually managed by a community of twenty or more farmers and granted lifetime rights to a percentage of the ejido (Keys 2002). Ejidatarios are those who are vested in the ejido and can take part in land use decisions among other privileges (Barnes 2009). Due to the failure of many larger scale works projects, most of the colonists began to adapt their land use toward the cultivation of cash and subsistence crops, a practice which continues to this day alongside the production of charcoal. These practices led to deforestation and raised concerns about threats to carbon stocks and habitats (Ericson, Freudenberger, and Boege 1999). Given the Mexican government's awareness of international conservation efforts, and a desire to draw upon their resources, the CBR was established in 1989 and registered with UNESCO in 1993. To this day it is divided by both core and buffer zones (forest extensions), the latter being predominantly agricultural.

Two of the northern ejidos surrounding CBR**,** Álvaro Obregón (locally known as Zoh-Laguna) and El Refugio, were chosen for this study because they provide comparable sites of study within the Southern Yucatán. Zoh-Laguna was settled in the 1940s largely as a lumber camp, built to support the extraction of hardwood tree species—specifically Mahogany (*Swietenia macrophylla* L.) and Spanish Cedar (*Cedrela odorata* L.) (Ericson, Freudenberger, and Boege 1999). Ethnically mixed it is today a hamlet providing services, education, and

clinical medical care to 250 households (INEGI), the majority of whom are ejidatarios. El Refugio did not become a recognized ejido for more than two decades after the formation of Zoh-Laguna, and did not have an existing resource base from which to draw upon. El Refugio is poorer, and smaller (43 households—INEGI), than Zoh-Laguna, as evidenced by a high number of pobladores with little historical connection to the community, their absentee landlords residing in either the US or other parts of the peninsula.

Both ejidos were identified with the help of local non-governmental organizations (NGOs) and staff members at the reserve who seek collaboration with academic researchers during the rapid assessment, but the final selection of comparable ejidos took into account the differences in production through empirical observation and accounts from both campesinos and the charcoal intermediaries for the area, one who in particular became a key informant throughout the duration of research. Intermediaries are part of the movement of a farmer's goods from initial collection to final shipment. It is commonly posited that farmers in poorer countries are not free to choose amongst intermediaries for the sale of goods because they are tied to traders to whom they must sell goods at a depressed price (Bauer 2004, 10). In the ejidos of Calakmul, like other parts of the developing world (Bauer 2004, 11), there is no clear distinction between the producer, in this case a carbonero, and the intermediary, the coyote (Keys 2005). This reflects a model wherein a more enterprising carbonero, or at least one who benefits from greater initial capital and political connections, can make a transition very easily from farmer to trader while still being anchored in the rural community where they ply their trade. This was apparent in Zoh-Laguna, where the charcoal intermediary for all of Calakmul lives and was at one time an ejidal political leader.

Though ejidos were cited in the original drafting of the project, in time it became clear that comparing between the two would prove instructive. El Refugio was assessed to be more removed from the fulcrum of the intermediary's power, and in turn a location where less pressure could be exerted upon it by informed producers, while Zoh-Laguna was recognized as being more active in its production and more able to influence the intermediary as a result. This as well as population size and resource base are the main discrepancies.

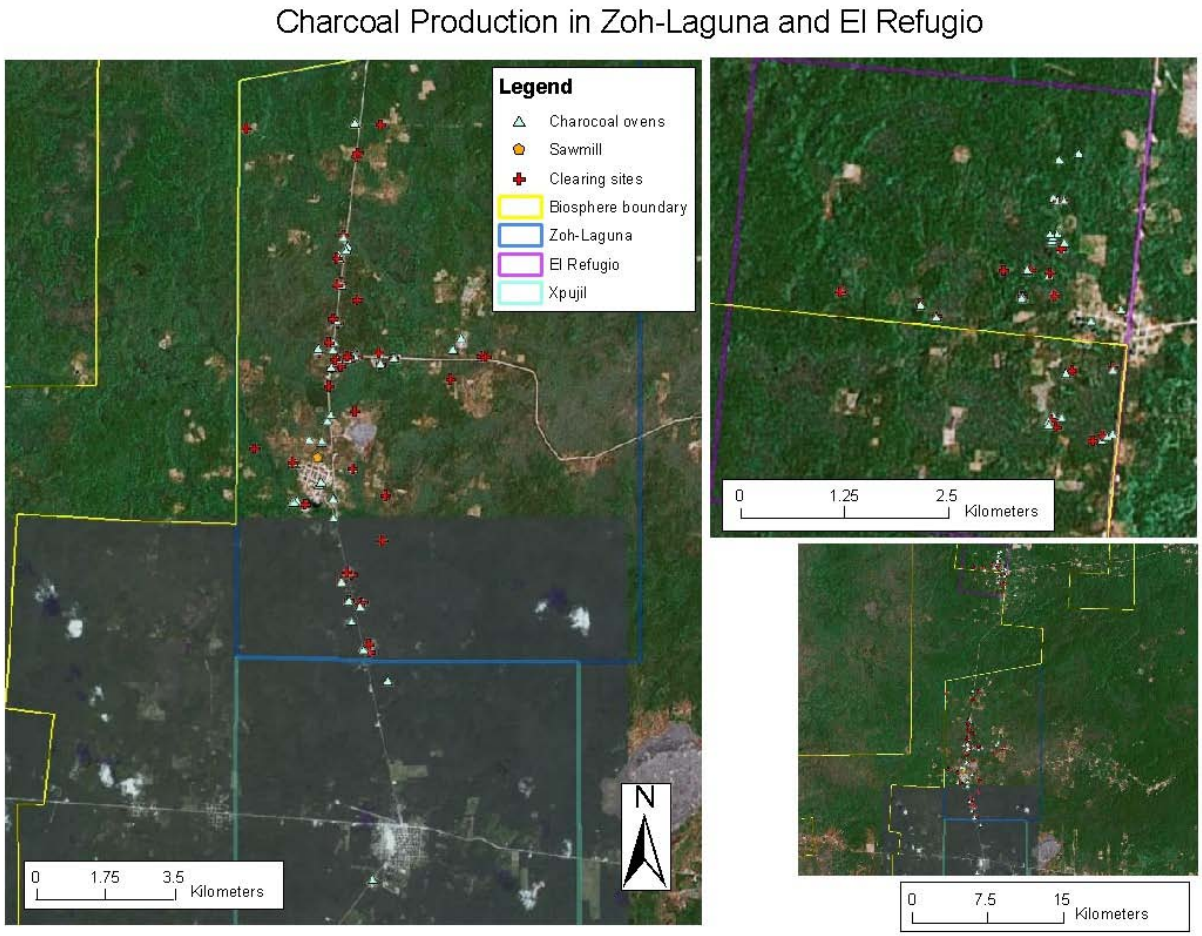


Figure 2-6. Map of charcoal ovens and clearing sites in El Refugio and Zoh-Laguna.

Methods

This research investigates whether a natural hazard contributed to the introduction of a new livelihood in the ejidos of Calakmul. Complementary attempts are made to posit whether

charcoal production is an appropriate indicator for measuring this change in Calakmul as a result of Hurricane Dean, and whether it also a test of innovation in the ejidos located within the municipality and reserve. Changes in land use and land cover are also pointed to. My research question explores elements of cultural and political ecology, with close attention paid towards natural hazards; research topics that require not only great consideration, but also an integration of methodologies. Mine is an attempt to incorporate social methods in a research design that leaves room for future work by landscape ecologists and others.

Table 2-1. Historic land entitlement and current charcoal production coverage in the SYPR

Historic land entitlement in the SYPR (Ha.)	Mean	Standard deviation
Keys and Roy Chowdhury 2006	59.31	13.61
Klepeis and Vance 2003	95.7	64.2
Schmook 2008, 139	71.1	41.71
Vance et al. 2004, 173	88.23	50.45
Total hectares used for charcoal production per year (El Refugio and Zoh-Laguna)	0.83	0.49

Surveys

Sixty-eight household surveys were conducted over the course of two and a half months. This included the full population size of carboneros in El Refugio (N=25) and a large sample size of those in Zoh-Laguna (n=43 out of a population of 70). Other data were collected using semi-structured interviews with staff at CBR, ejidal and municipal administrators and political leaders, representatives from Mexican federal agencies, and regional marketers of the product. Additionally field visits were used to document the GPS coordinates of agricultural and forested parcels where charcoal is produced, culminating with a map of the field sites (Figure 2-6).

The surveys were conducted at less than two hours each in the household or charcoal production site, often in a campesino's milpa. The instruments included information concerning (1) land tenure, (2) livelihood strategy, (3) climate, and (4) ongoing charcoal production.

Governance was briefly mentioned but the results are patchy given the clear desire by some carboneros not to involve themselves in ejidal political matters. With the exceptions of data sets related to the quantity of charcoal production, land size, and income the levels of measurement for the results were either nominal or ordinal. Interval data were probed (Bailey 2007, 144) with respondents in the event that the individual was unable to immediately come up with a numeric response, usually monetary amounts. If surveys were conducted within the household, field visits were requested and consented to in all but one case, in recognition of the dynamic links between household and land use in rural landscapes (Rindfuss et al. 2003). Field visits were often conducted while charcoal was being produced, or when the raw material was being extracted for the purposes of carbonization at a later date. These visits provided ample opportunity for a discussion of the process, and questionnaire centered around (1) effects of climate and natural hazards, (2) the permitting process, (3) the extraction of timber, (4) oven operation, and (3) the chain of productivity. The construct validity (Bernard 2000) of the survey was ensured through multiple queries used to confront similar indicators, but an understanding of ejidal land tenure, the permitting process, and the productivity could not be reached through these means alone.

Figure 2-7. Typical field visit of a traditional oven site in El Refugio

Interviews

Both open-ended and semi-structured interviews were conducted with carboneros, ejidal administrators, reserve and governmental officials, and to a lesser degree *asadors* (meat roasters)[1] and intermediaries. Open-ended interviews are versatile, and often used in studies that require both textual and numerical data (Carey, Morgan and Oxtoby 1996). Semi-structured interviews are designed to have a number of interviewer questions prepared in advance but such questions are designed to be sufficiently open such that they cannot be subsequently preplanned (Wengraf 2001, 5). The interviews were conducted with individuals, but at times a group format was required as in the case of an *asador* and his employees responding while occupied. *Pollo asaderos* (chicken roasting eateries) are commonplace throughout Mexico, and grilling over charcoal is the preferred method. Thus they represent a significant portion of end point charcoal users (Lee 1999; Watson and Chow 2001). These interviews allowed for the acquisition of detailed information about the perceptions and activities of charcoal production. The intermediaries provided detailed information about their trade, but given the complications of their practices and the possibility of losing leverage over carboneros, they generally declined to answer questions concerning their revenues from the forest product. Interviews conducted with reserve officials were carried out within Zoh-Laguna or the municipal seat, Xpujil, but informal reserve information was derived from discussions that often did not take place with top administrators, a practice made easy because CBR staff live in Zoh-Laguna during the workweek. Governmental officials who volunteered for interviews were typically circumspect, but details on the permitting process and the productivity chain were gleaned from these discussions.

Results

The data analyses for this research are largely descriptive given the categorical nature of the data. Questions concerning the hurricane and production elicited responses of significance, as did self-reports of income. These answers were used to depict production, household, and the commodity chain. Attempts to depict household economy inferentially, as well as the putative influence of charcoal production since its inception in Calakmul, were made using linear correlations and analysis of variance (ANOVA). Such results prove less revealing where the research questions are concerned, however.

Income and Costs

As Table 2-3 illustrates, charcoal production makes between 70% (Zoh-Laguna) and 90% (El Refugio) of the aggregate household income in the ejidos as reported by carboneros. These numbers include federal entitlement and subsidy programs, many of which were meant for rural communities such as Progresa, DICONSA, DIF, PROCAMPO and PROARBOL. The median income derived from charcoal far outpaces that which is derived from other sources, a difference of $24,400.00 ($2,440.00 US) and 26,500.00 ($2,650.00 US) pesos in Zoh-Laguna and El Refugio respectively (Table 2-2). Moreover 64% (28) and 79% (19) of the respondents received income from no other source, including subsidies, other than what was yielded from charcoal production. Extrapolated to the full population of carboneros in Zoh-Laguna this would mean that fewer than 40% have participated in another livelihood activity since Dean (El Refugio represents the full population). Postulating how these numbers fit into the household economic base is a more difficult task given the diversity of strategies employed at various scales (including that which the definition of “household” itself occupies), but it was uncommon to encounter a household where at least one member was not engaged in charcoal production if only as a *jornalero* (day laborer).

Most ovens, both traditional and laminate, operate on a weekly cycle for timber extraction, construction, burning, cooling and packing for finished charcoal. The timber extraction, construction, and packing stages are most commonly carried out with family members, jornaleros, or associates who may be in agreement over an exchange of labor. The inputs for both Zoh-Laguna and El Refugio ovens show little variability (Table 2-5), and this also holds true for the oven types as well with the exception of the laminate tops, which come at a cost of $5000 pesos ($500 US), and last on average 1-2 years. The construction of traditional ovens requires no additional technology other than soil, grass (or leaves), and the wood itself. Occasionally foil and tarps will be utilized, but more often than not inclement weather will force a carbonero to keep watch over his or her oven regardless of the preparations made. This is the main advantage of a laminate oven; they also do not require constant attention during rains, and in fact require little to no attention at all other than during the filling of the oven and packing of the end product. Additionally the intermediary and all but a few carboneros concur that charcoal burns more evenly, and thus will produce a more sellable product in a laminate oven. This is the intermediary's explanation for purchasing charcoal for $1.80 pesos from El Refugio and $1.90 pesos/kilogram from Zoh-Laguna, though there were 13 traditional carboneros in Zoh-Laguna who received the same price per kilogram. The laminate tops are generally bought from the intermediary, often on credit or until the balance is paid from the charcoal produced, which would take approximately 4-5 weeks at charcoal's present buying rate.

The mean kilograms produced in a single cycle of a laminated oven comes to 1,049.14, or 45 *costales* (sacks). Acknowledging little difference between the yields from traditional ovens in Zoh-Laguna and El Refugio, an oven's cycle will yield 969.26 kilograms or 39 costales. The

difference in the median number of kilograms is negligible, though the number of costales is 5 less in El Refugio.

Table 2-2. Comparison of income sources in Zoh-Laguna and El Refugio

$ pesos per year ($ US)	Zoh-Laguna (n=43) Mean	Zoh-Laguna (n=43) Median	El Refugio (N=25) Mean	El Refugio (N=25) Median
Income outside of charcoal	13,879 (1,387.90)	2,600.00 (260.00)	6,384.00 (638.40)	2,500.00 (250.00)
Income from charcoal	27,220 (2,722.00)	27,000.00 (2,700.00)	21,720.00 (2,172.00)	20,900.00 (2,090.00)
Total income	41,099 (4,109.90)	29,600.00 (2,960.00)	28,104.00 (2,810.40)	23,400.00 (2,340.00)

Table 2-3. Income breakdown for charcoal production by ejido and by oven type

		Zoh-Laguna (n=43)	El Refugio (N=25)
Age		43.47	40.64
	SD	12.25	11.74
	Median	45.00	39
Household members		4.61	4.68
	SD	2.41	1.53
	Median	4.00	4
Year arrived		1973	1988
	SD	10.80	12.46
	Median	1977	1988
Charcoal as source of household income		70%	90%

Table 2-4. Average income from charcoal per year by ejido and oven type

$ pesos per year ($ US)	Zoh-Laguna (n=43)	El Refugio (N=25)	$ pesos per year	Traditional oven (n=44)	Laminate oven (n=24)
Avg. charcoal income	21,717.00 (2171.70)	27,216.00 (2,721.60)	Avg. charcoal income per year	21,530.00 (2,153.00)	24,940.00 (2,494.00)
Median charcoal income	20,900.00 (2,090.00)	27,000.00 (2,700.00)	Median charcoal income	20,900.00 (2,090.00)	24,700.00 (2,470.00)
Total charcoal income	93,385.00 (9,338.50)	68,040.00 (6,804.00)	Total charcoal income	109,745.00 (10,974.50)	51,680.00 (5,168.00)

Table 2-5. Expenditures by ejido

Costs per burning cycle	Traditional oven (n=44)		Laminate oven (n=24)	
$ Pesos ($US)	Mean	Median	Mean	Median
Tools and equipment[1]	5963.27 (596.33)	6252.50 (625.25)	6635.00 (663.50)	6045.00 (604.50)
Paid day labor	52.27 (5.23)	106.72 (10.67)	180.42 (18.04)	187.30 (18.73)
Transportation	112.89 (11.29)	76.37 (7.64)	121.54 (12.15)	87.33 (8.73)
Total cost	6128.43 (612.84)	6435.60 (643.56)	6936.96 (693.70)	6319.63 (631.70)
Days per burning cycle	10.04	10	10.66	10

Effects on Charcoal Production

A large portion of the survey and related interviews were devoted to gauging the impact of Hurricane Dean and other climatic events upon charcoal production. This effort to measure indicators of production vulnerability provided inconsistent results, speaking to both the differences between revealed and stated preferences (Turner and Martin 1984). It is important to situate the lifting of the permits as proximate cause of charcoal production just as Hurricane Dean was more underlying. Or using the conditionals of necessary versus sufficient (Woods, Wiggins, and Edgington 1997), Hurricane Dean can be positioned as a sufficient catalyst of larger scale charcoal production and the permitting process as necessary one. As drivers, both natural hazards and the effects of permit lifting elicit comparable responses. Of the 68 respondents in the survey, 20 (29%) in both ejidos suggested their production increased due to the lifting of permits, which along with wildfire prevention was one of the primary motives SEMARNAT had in relaxing the permitting process to begin with, according to officials in that agency. The plurality reported no change in production was evident. A secondary prompt asked

[1] Many tools and equipment are included as an initial investment. Some tools are reported to last for infinite period of time, but for others durability was only roughly estimated. It would not be possible to extrapolate the costs of rakes or machetes for one oven, for example.

about actual tonnage, but oftentimes the respondent either declined to submit an answer or provided amounts with little care.

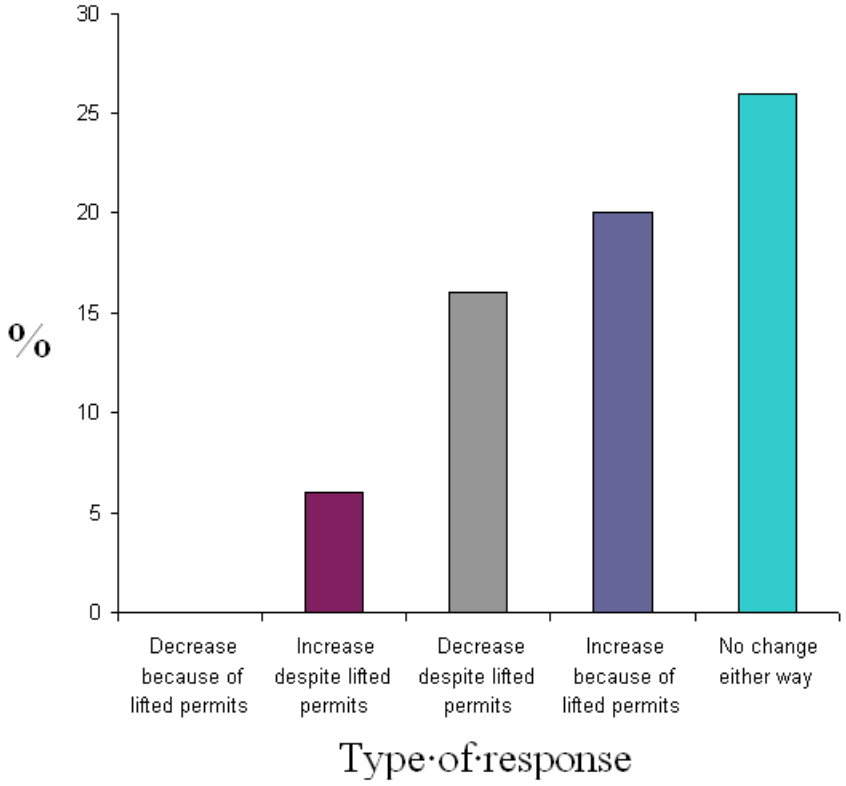


Figure 2-8. Effect of permitting on total weight of charcoal produced in both ejidos (n=68, "yes" response=1 unit)

Similarly, when asked about various natural hazards and the potential effects upon production that might be evidenced, respondents overwhelmingly reported that hurricanes did not affect the total weight of their charcoal. Again, metric tonnage had to be dispensed with as an indicator because of the inexactness (or lack) of responses in some cases. In both ejidos only 8 (12%) respondents indicated that hurricanes, as a general phenomenon, affect charcoal production. Though more respondents reported an increase in charcoal production as a result of the hurricane in El Refugio (5=20.83%) than in Zoh-Laguna (3=6.82%), in both communities respondents clearly indicated that hurricanes decrease charcoal production rather than increase it.

In the particular case of Hurricane Dean, as will be shown below, the majority of producers initiated production only after the storm made landfall in August 2007.

Every single carbonero who reported that droughts increase total charcoal production (8—11.76%) observed that prolonged aridity facilitated the drying of hardwood timber, and that when burned would take less time. Nevertheless, the majority of respondents (77.94%) indicated that droughts had no effect upon charcoal production. Tropical storms and general (seasonal) rain received high numbers of "decrease" responses, understandable given the cooling of active traditional ovens during precipitation, and the inaccessibility of roads following a storm in the region. Wildfires, which as one carbonero observed "pre-burn" timber, were also cited as increasing production, but the majority of respondents in both ejidos (69.12%) noted little change. These "decrease" responses combined with the apparent lack of change as a result of hurricanes highlight precipitation's role as a deterrent of charcoal production.

Table 2-6. Effects of natural hazards on charcoal production in both ejidos

Events in both ejidos (n=68)	Decrease	Increase	No change
Droughts	7	8	53
Wildfires	7	14	47
Hurricanes	43	8	17
Tropical storms	48	7	13
Seasonal rain	47	9	12

McNemar's Test Results

McNemar's Test, typically carried out to compare dependent proportions primarily in medical research (Agresti and Finlay 1997), was used to evaluate data of reported charcoal production in Zoh-Laguna subsequent to Hurricane Dean making landfall on the Yucatán peninsula. The survey queried the full population of producers in El Refugio, and because responses indicated real increase in that ejido's production after Dean a paired test was not necessary for analysis. McNemar's was judged to have greater validity than a linear regression of

data using indicator variables given its nominal character and its demonstrated use in testing cause and effect (Robins and Wish 1977; Whitney et al. 2002; Winner 2006). The majority of carboneros did not report a significant increase in their production after the hurricane struck

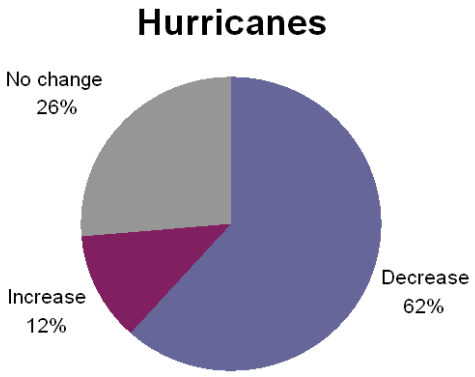


Figure 2-9. Chart of responses in both ejidos to preceding question (n=68, “yes” response=1 unit)

when probed, though interviews and reports from Mexican environmental officials stated otherwise. Permits were increased to collect downed wood from ejido lands between the end of August and the beginning of April 2007, specifically the thick vegetation that tends to grow on fallow land. That the majority of carboneros do not cite the permitting process as sufficient grounds for determining whether or not reported production began around the time of the hurricane is notable. The equation was established using the related samples or categories of carboneros who engaged in charcoal production before the hurricane and immediately after it, before the hurricane and not afterwards, only afterwards, and neither before nor afterwards, following the model established by Flynn (1986). The second category could be filled by carboneros who did not continue to produce charcoal at any time between the hurricane and field work. The last category included those carboneros who neither produced before nor after the hurricane. The results indicate that the hurricane was a statistically significant driver, or

treatment (Agresti and Finlay 1997), upon respondents' motives to engage in charcoal production in Zoh-Laguna.

Table 2-7. McNemar's paired sample test
H0: Hurricane Dean had no impact on when carboneros began charcoal production in Zoh-Laguna
Ha: The proportion of carboneros producing charcoal after Hurricane Dean increased.

Effect of Hurricane Dean (n=43)			
		After	
		Charcoal use	Non-charcoal use
Before	Charcoal use	n_{cc}	n_{cn}
	Non-charcoal use	n_{nc}	n_{nn}

Exact P-values	
Zoh-Laguna	0.000977

The New Livelihood and Land

The impacts of charcoal are an ongoing concern for conservation authorities and could potentially shift land use patterns in the region for the future. As Tables 2-8 and 2-9 show, the average number of hectares extracted and utilized for charcoal on an oven parcel are similar between Zoh-Laguna and El Refugio, and between traditional oven carboneros and laminated oven users. Correlations between town and extraction size, town and oven parcel size, oven type and extraction size, and oven type and oven parcel size revealed little. It should be noted, however, that the median extraction size for both laminated and traditional oven carboneros are nearly identical (.50 hectares), reflecting the fact that all carboneros in El Refugio use traditional ovens. These apparatuses are much smaller than the standard dimensions of a laminated oven (reported as 2.5x1.5x4m), but traditional ovens often do have a greater capacity than the laminated type.

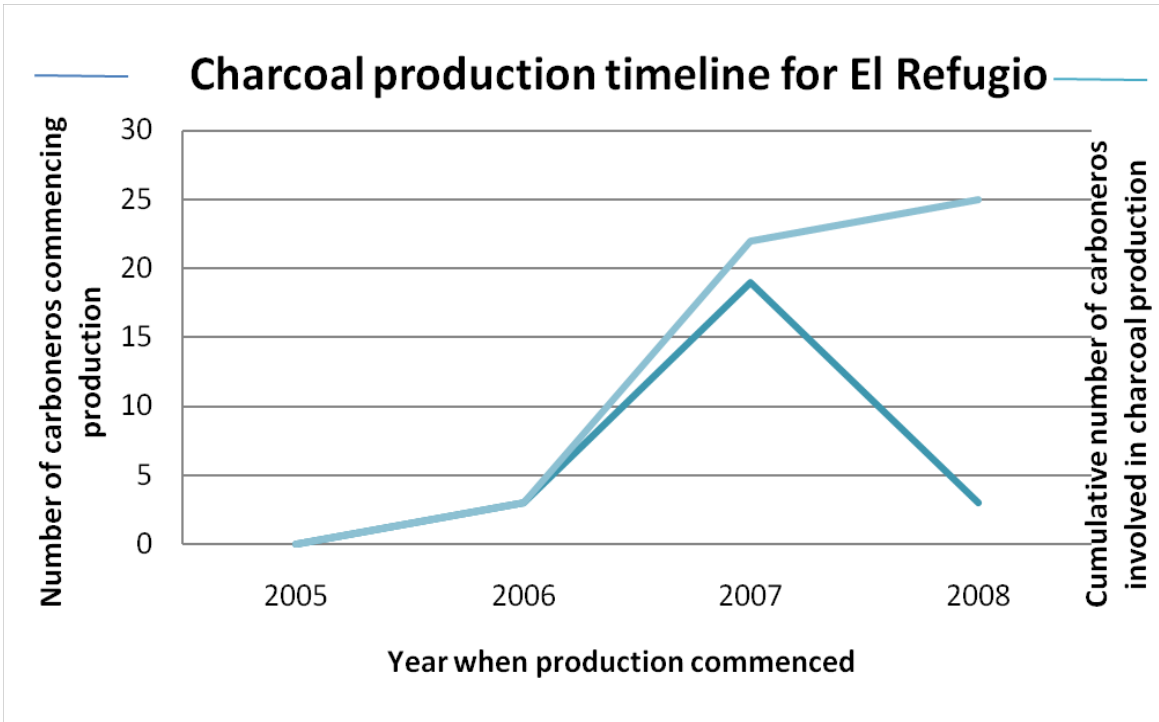


Figure 2-11. Chart of the commencement of charcoal production in El Refugio by year

Traditional carboneros rotate their ovens routinely around their parcels, and can at times have more than one oven burning at the same time. These oven parcels vary in size depending on if they are located at a site of timber extraction or in a separate location. Slag leftover from past cycles of a traditional oven burning deters construction of an oven in the same location (Figure 12), and in extreme cases ovens may be continually constructed near the next closest area of timber extraction. In all charcoal sites smallholder agriculture is also practiced, generally through a staple of corn, beans, chili, and squash. No carbonero reported extracting more than 2.5 hectares per year for charcoal production and this was verified by field visits. All carboneros, when solicited, maintained that a traditional milpa (that which is reserved solely for agriculture) leads to at least 3 hectares or more per year of deforestation due to slash and burn practices, although this number should take into account crop rotation and fallowing and may in fact be more like 1.5 hectares per year (Uitz et al. 2006; Schmook 2008).

Table 2-8. Comparison of extraction between El Refugio and Zoh Laguna

Hectares per year	Zoh-Laguna (n=43)				El Refugio (N=25)			
	Mean	Median	Standard deviation	Variance	Mean	Median	Standard deviation	Variance
Timber extracted	0.834	1.000	0.451	0.204	0.815	0.500	0.554	0.306
Approximate size of ovens	0.004	0.003	0.002	0.000	0.007	0.006	0.539	0.290
Total area	0.838	1.003			0.821	0.506		

Table 2-9. Comparison of extraction between traditional and laminated oven users

Hectares per year	Traditional oven (n=45)				Laminated oven (n=23)			
	Mean	Median	Standard deviation	Variance	Mean	Median	Standard deviation	Variance
Timber extracted	0.813	0.500	0.510643	0.260756	0.847	1.000	0.451	0.203
Approximate size of ovens	0.006	0.005	0.004	0.000	0.003	0.003	0.002	0.000
Total area	0.824	0.510			0.854	1.006		
Total finished kilograms per cycle	969.26	39 sacks	1,049.14	45 sacks				

Figure 2-12. Recently completed traditional charcoal burning with leftover slag and ash

Discussion

In attempting to address essential questions of human-environmental relationships, this thesis has embarked upon two separate journeys. The original research question that asks whether climactic shock contributes to livelihood change in the ejidos of Calakmul is corroborated by a body of evidence collected in two different communities linked by actors and processes in the production of a new good. That good, charcoal, did not arrive in the region by happenstance, and has been documented by numerous parties to have originated here as a result of the lifting of timber collection permits (a proximate cause) and more generally as a result of Hurricane Dean and the collapse of the charcoal industry in the northern states of Mexico (underlying cause). Or in other words, permitting was necessary for charcoal production to be widely adopted, but the hurricane was a sufficient driver of this event. The results have lent weight to this hypothesis as a result of a paired samples test and methodical documentation as to when carboneros began their production. With a few exceptions that might lead to an assumption of the null, the majority of carboneros in both ejidos began their production after Hurricane Dean made landfall. The relaxation of collection permits facilitated this process, as prohibition did not officially come back into effect until April 2008.

The complimentary question, which sought to answer whether charcoal production has a future, is fleeting and immediate conclusions cannot be easily made. In the two ejidos under observation, it would appear to have as much of a future as swidden agriculture at present. While it is true that campesinos throughout Calakmul still practice shifting, swidden agriculture in much the same way as they have dating back to the influx of migration here in the 1960s, and that since the sudden rise in charcoal production livelihood strategies are still diverse, results from survey research demonstrate that these communities are forging a strong identity in the manufacturing of charcoal. This can be summed up best by the income tables, and by local

municipal officials who refer to the region as *la zona carbonera* (charcoal zone), echoing the *zona chilera* (chili) to the south that has been tied to the crop for the past decade (Keys 2002). As the literature on rural innovation has explored, timber used for fuelwood is not anomalous, yet interviews and the limited data available indicate charcoal production arrived in this part of Mexico by virtue of the numerous hardwood species—and due to the large-scale deforestation of genera such as *Acacia, Celtis, Condalia, Haematoxylum, Pithecellobium, Prosopis*, and *Quercus* further north (Stoleson et al. 2005).

Data was assayed through surveys, interviews, photographic documentation, and GPS, leaving substantial room for future work in landscape ecology. Survey responses do point to a land use practice that requires the cutting of fewer forested hectares per year. As has been noted in contemporary research in the region (Mercer, Haggar, Snook and Sosa 2005; Schneider 2006; Uitz *et al*. 2006), the average household milpa parcel ranges between three and five hectares of forest cut per year. This has been slightly modified by Schmook (2008), who found in her study that the actual number of new hectares cut per year is more like 1.5 hectares (or 1-1.5 hectares per plot, one plot per year), though she too found households engaging in greater extensification (2-9 ha in some cases). The largest timber extraction site in my survey, however, was reported to be 2.5 hectares on an ejidal parcel, the average less than half of that number. Without comparing satellite imagery and aerial photography, or without the records of forest managers or on-the-ground measurements, there is no accurate way to test these claims. It is notable, however, to state that carboneros report cutting down less forest per year than dedicated *milperos*, factoring in crop rotation and fallow time. Moreover, as Figure 5-1 illustrates, timber extraction and charcoal oven sites provide sufficient soil in which to plant a traditional rotation of corns, beans, squash, and chili peppers. While land use patterns have switched as a response to economic

necessity and natural hazards, the changes in land cover may be less than what has been evidenced by traditional milpa.

A strong current throughout the results indicates respondents' apprehension towards questions pertaining to the onset of the hurricane, motives for production, and relation to the perceived governance of timber extraction. The questionnaire was designed to obtain inter-rater reliability using the responses of differently worded questions (Imle and Atwood 1988), but this may be the result of informant inaccuracy, as later responses to questions regarding motivation yield little statistical significance (Bernard et al. 1984; Romney, Weller, and Batchelder 1986). Just as likely the social desirability of responses could be considered a reflection of respondents' desire to dissimulate in the presence of an outside researcher or to otherwise project a stronger conservation ethic to an interviewer with an expressed interest in questions pertaining to forest use.

Figure 2-13. Mixed-use parcel with evidence of timber extraction, oven construction, and maize cultivation.

Figure 2-14. Fulgenico Canché Keb filling his oven before a charcoal burning

Conclusions

Climactic shock as manifested by Hurricane Dean has catalyzed not only a change to livelihood, but possibly to the landscape in the ejidos of Calakmul. The pathway to this change is, however, dependent on events preceding and succeeding the storm, notably the permitting process initiated by SEMARNAT. Importantly, its effects could run counter to the criticisms leveled by the CBR and others within the conservation community, but longer term studies would need to be carried out to establish this. Without including the cases of Nuevo Bécal, Nueva Vida, and Xpujil (all part of the zona carbonera), the household economies of El Refugio and Zoh-Laguna are unquestionably the domain of charcoal production in the municipality at the present time. The product has changed livelihoods entirely in some cases and minimally in others, and it has even gone so far as to establish individuals and their households as leaders in

the trade; there are carboneros who produce more charcoal than others, and then there are those who manipulate its sale.

The surrounding forest of the CBR has also been impacted by charcoal production, with more land being used for extraction and construction. More ejidal land, and that which is rented to pobladores, is being used primarily for charcoal production and secondarily for milpa. The amount of land used for charcoal production, however, is less than that which has been historically used for smallholder agriculture in the SYPR. This poses the distinct possibility that in the short term the conversion of forested land cover, or the extent of cut timber, will be less in and around these ejidos. Moreover land use in parcels and house lots (*solares*) is diverse, as households tend to farm subsistence crops, or in some cases produce enough surplus for market as a result of intercropping. While conservation authorities express concern about growing pressures on a critical ecosystem, sheer numbers do not benefit their argument against charcoal relative to traditional swidden agriculture. Migratory patterns have had varied effects on the landscape in Calakmul (de Sherbinen and Freudenberger 1998; Ericson et al. 1999; Ericson 2004; Radel and Schmook 2008), but long term growth from natural increase is a reality. Either as ejidatarios or pobladores, these households will cut down fewer hectares of forest unless there is a dramatic development in either the technology or oven capacity for charcoal production.

SEMARNAT's permitting process facilitated the collection of timber through April 2008—and for many years to come if the rate of production proceeds at 1.5 hectares or less each year, advancing into most common use and ejidal land. Interviews with officials often pointed out that it was not the hurricane that brought the livelihood into being, but rather the presence of Mennonites who were closely linked to their brethren in the northern states where deforestation of hardwood genera for the purposes of charcoal production was first observed. In the surveys

with carboneros themselves few had any idea where the idea for charcoal came from other then at a demonstration at a sawmill by federal extension agents, and in some cases concerted attempts at making more efficient fuelwood for stoves. The hurricane was an underlying cause along with Mennonite and extentionist presence, just as the disbursement of extraction permits was proximate. Its force also serves as a possible case example of creative destruction, however, allowing campesinos to switch livelihood from swidden agriculture to charcoal production and thus exert less pressure on forested land cover.

Close attention will have to be paid to the changes in the northern ejidos of Calakmul, but the spread of charcoal seems imminent given the generally uniform social and ecological conditions of the Calakmul municipality; some ejidos may not have access to the densest parcels of timber, but charcoal can be produced regardless of a tree's diameter at breast height. Not all ejidos are as comparatively affluent as Zoh-Laguna, but if El Refugio is any indication, poverty could spur greater production not less. The current status of permitting restrictions placed on some ejidos and not others appears to be agency politicking, not because of a lack of interest in production throughout the parts of Calakmul encountered. Indeed, given the fluctuations in price and patterns of trade exhibited by intermediaries in the region (Keys 2005), charcoal will be spread by buyers and sellers, which will in turn lead to others with mercantile interests. This has recently been shown in Zoh-Laguna itself with the short-lived attempt by a Guadalajara-based charcoal intermediary to dilute the power of its current primate.

A natural hazard triggered the rapid expansion of this livelihood, but two things are important to keep in mind: 1) hurricanes will not necessarily expand the reach of charcoal in the future, and 2) it is a drought, and perhaps even ancillary wildfires, that could ultimately be responsible for greater yields. Respondents put little stock in storms or droughts as drivers of

output, instead focusing on access to permits. This crystallizes why the drivers of the trade should be understood synergistically. Nevertheless commentary always revealed that the hardwood species that were driest before the burning cycle were the most ideal. Persistent drought, like seasonal rain, can be prepared for, and charcoal producing strategies are likely to adapt. Capricious events, like another Hurricane Dean, may pose new opportunities—destructively creative or creatively destructive—altogether.

Future Directions

Calakmul, encompassing both the municipality and the reserve, continues to be an intricate landscape. The addition of a non-agricultural good on the frontier poses dilemmas for researchers: Are households more forest dependent now that slash-and-burn cultivation is a secondary activity in many ejidos? Are campesinos now more cognizant of a forest's diverse offerings (this would especially be the case for recent migrants, many *mestizo*,[2] who have little historical connection with the Mayan selva)? Along these lines, do campesino households adapt to climatological and political pressures even if they do not recognize them as radical changes in their livelihood?

Further research in cultural and political ecology can provide answers to these and other questions involving adaptation in response to prevailing conditions, and more importantly shocks, as they arise. Particular attention should also be given to understanding the power relations that exist inter- and intra-ejido as well, drawing upon a rich human geographic tradition of exploring ethnicity and status as symbols for the composition of forest communities in the developing world. Closer attention should be paid toward Zoh-Laguna for many of these studies given its central importance in the current charcoal production strategy, but the ejido should not

[2] Persons of mixed European and indigenous ancestry. Mestizos in Calakmul are mainly migrants from Mexico's states of Veracruz and Tabasco (Haenn 2002).

take the place of research throughout the larger region, fraught as it is with multiple divisions in environmental quality, wealth, ethnicity and land tenure.

CAPE will continue to provide leads for an understanding of the composition of the reserve, and if charcoal production is a model, the buffer zones of the reserve will be fruitful geographies to observe. Landscape ecology will go a long way toward elucidating the long-term seasonal changes, including persistent drought, and potential linkages with charcoal production and other livelihood strategies that though based in the forest, may have more difficult signatures to mark than a milpa or other agricultural parcel. Correlations and analyses of additional natural events, if discovered, will help evoke an understanding at a larger scale.

CHAPTER 3
CONCLUSION

This thesis has sought to establish the linkages between CAPE and natural hazards in a novel way in assessing a developing household livelihood strategy, specifically charcoal production. This integrated approach was chosen in large part because while CAPE approaches have been used to couch research in Calakmul, work on natural hazards in the region is exiguous. Research on the region with an eye to the effects of hurricanes on local populations is lacking, despite the increasing contributions of post-hazard ecological (Vester et al. 2007) and paleoecological (Gill et al. 2007) research. As noted in the introduction, smallholder charcoal production draws upon a number of recent advances within geography but can be acceptably situated in less contemporary scholarship as well.

The International Social Science Council, and the United Nations University, under the banner of the International Human Dimensions Programme on Global Environmental Change. (International Human Dimensions Programme on Global Environmental Change 2005) is the largest framework under which this thesis is situated. Calakmul's setting includes a large protected tropical area, a frontier with demonstrable population flux, and indications of climate variability. Human-environmentally, Calakmul links human residents to the forest, to the currents of international conservation efforts, and to the political economy of Mexico in a globalized world. These relationships have undergone various stresses since the formation of the reserve, and then the municipality, only two decades ago. Demographic trends for the region, including periods of intense immigration and emigration, have also had profound effects on the conservation narrative largely constructed by government administrators and NGO officials (Haenn 2005).

Natural hazards research and its relation to smallholder land use is an entryway for much of my specific analyses. Roy Chowdhury and Turner (2006) have illustrated how work on smallholder agriculture and its ensuing permutations have been increasingly tied to developments in hazards research. Positioning land managers as actors and decision makers in a discussion of natural hazards, Burton, Kates, and White (1978) followed a path of geographic emphasis on the behavior of land managers as first articulated by Brookfield (1964), who himself maintained that the landscape could not be understood without attention to the primary modifiers of the landscape. Anthropological concepts of cultural adaptation, influenced by systems science, and peasant farmer decision-making by Chayanov (1966) and Boserup (1965) fed directly into these discourses. Soon Brookfield (1972) and Turner and Brush (1987) and Netting (1993), applied agent-based theory, rising out of economics, as an explanation for a host of human-environment conditions entertained. Chayanov's work is central to the conceptualization of charcoal production as a smallholder activity in this thesis allows for a closer review of agent-based phenomenon in the face of an extreme event.

Agency which is questioned at certain points throughout discussion, including at what point does a hurricane or an institutional directive induce behavioral change, has been fruitful for cultural ecologists dating back to the 1960s. Political ecologists challenged the emphasis on agency that cultural ecologists favored (Robbins 2004), contending that the latter gave flawed answers to human-environment questions (Watts 1983a, 1983b; Peet and Watts 1996). This school of thought asserted that a major refocusing was necessary to address the role of societal structures (Hewitt 1983), a theme that was carried into practice in cultural ecology at roughly the same time (Brookfield 1984; Bassett 1988). From this point a distinctive subcluster in vulnerability studies (Wisner et al. 2003) arose. For some initial practitioners, including Blaikie

and Brookfield (1987), political ecology sought to establish a union of both agency and structure. This sentiment, in addition to a perceived lack of coherency, led Watts and Peet (1996) to fault the dominance of structuralist thought in vulnerability research. In turn, political ecology was challenged as lacking an understanding of either agency or events by others, notably Vayda, and Walters (1999). In the interim, political ecology has been heavily weighted by the post-structuralist school of thought, (e.g., Escobar 1996), which has been critiqued within the political community as overemphasizing the "social construction of nature" instead of the material setting for the social relations of production, the "natural construction of the social" as Peet and Watts (1996) called it. This last point remains unresolved in the findings of this thesis, but while conservation authorities continually question the impacts of charcoal production on the biosphere's forest, the current set of facts do not strongly support their claims and instead point to more likely vulnerability amongst the human population.

A theoretical bridge was sought after in the research, and Kelly and Adger (2000) and Turner and others (2003) have conceived of frameworks from which this work might be done, but many of the attempted correlations between natural hazards, usually hurricanes, have not always been clear. This thesis argues that the rationale used by Lambin and Geist (2006) and Geist and McConnell (2006) have much to offer in indentifying causality. These works detail how deforestation, or transition, can best be understood as a combination of proximate and underlying causes, or synergies. Figure 2-3 illustrates this complexity, noting that the collapse of northern Mexican charcoal and demand were instrumental in establishing the permitting process, but that Hurricane Dean proved an effective catalyst.

Innovation is not dwelled upon in the previous chapter, but it is nonetheless important to consider given its credence in geography. The subject matter first came to prominence in

economic geography with Rogers (1962) and then Feldman (1994), the crux of which recalls central place theory (Christaller and Baskin 1966). The core of this work explored how diffusion of cost and resource affects urban geographies. These urban discourses on innovation were not aided by research concerning rural innovation—in the developing world—until mention of wood-burning fuels (Agarwal 1983; Feder, Just, and Zilberman 1985) emerged. Such a development was a departure from an agricultural extentionist emphasis on crop diversification, and has continued of late (Troncoso et al. 2007), though the emphasis has been on the mechanism for fuel wood conversion. Along parallel lines, Schumpeter's (1976) popularization of "creative destruction," or the process of transformation that accompanies radical innovation, has since been used to describe modification in an agricultural frontier in non-urban discussions, specifically in relation to intensification (Johnson and Lewis 2006; Keys 2004). Creatively destructive principles of rural production contrast with those of "destructive creation" in that they highlight sustainability, such as the amendment of manure in soil (Johnson and Lewis 2006, 108). The thesis argues that charcoal production is creatively destructive in the ejidos under review, as smallholder agriculture no longer provides the economic base or identity that it has even in the recent past.

The contributions to geography contained within this volume are meant to articulate a shock by new terms and its spatial consequences. The relevance of this work speaks to material production in a forested landscape carried out by household actors, a theme not unfamiliar to researchers. The effort to establish heretofore unarticulated linkages has been the intent, and hopefully the success, of this work.

APPENDIX A
SURVEY QUESTIONNAIRE

CUESTIONARIO Y PROTOCOLO DE LA ENTREVISTA PARA PRODUCTORES DE CARBÓN

CHARCOAL PRODUCTION IN CALAKMUL

COMUNIDAD: **MUNICIPIO:** **CODIGO:**

FECHA: **INFORMANTE:** **ENCUESTADOR:**

ANOS:

I. TENENCIA DE TIERRA

1.1 ¿En qué año llegó a_____?_____

1.2 ¿Es Ud. ejidatario?_____

1.3 ¿Cuál es su ocupación?_____

1.4 ¿Ha trabajado en otras areas del ejido?_____

1.5 Ejidatario: ¿Cuantas hectáreas de derecho ejidal le corresponden? _____

Poblador: ¿Cuantas hectareas le prestaron en el ejido para trabajar?_____

1.6 ¿Hace algun uso de las tierras comunes? Si___, No____, Cuantas hectareas?_____

1.7 ¿Hace algun uso de las ampliaciones del ejido? Si___, No____, Cuantas hectareas?_____

1.8 De ese numero de hectareas, ¿Cuántas hectáreas tiene Ud. en:

Uso	Hectareas				Cuanto tiempo se dedicado a la				Usos futuros			
	T C	A	E	P								
Agricultura												

Pastizal												
Mecanizada												
Monte alto												
Bosque secundario												
Helhecho												
Tajonal												
Acahual												
Bajo												
Otro												

II. HISTORIA/ECONOMIA FAMILIAR

2.1 ¿De dónde viene?
Estado_____Comunidad_____

2.2 ¿A que actividades se dedicó en su lugar de origen?

2.3 ¿Cómo es que llegó aquí?

2.4 ¿Le ayuda monetaria que recíbe para cubrir sus necessidades?

PROGRAMA	PESOS	AÑOS	INTENTO	USO
PROGRESA				
PROARBOL				
PRODERS				
PROCAMPO				
PROGANADO				
Otro				

2.5 ¿Cuantos membros viven en su hogar?

○ **= male**

☐ **= female**

2.6 ¿A que otras actividadedes se dedica su familia durante el año? (Incluyendo su esposa(o) u otras miembros del hogar)

ACTIVIDAD	INGRESO	PERIODO DEL ANO	CUANTOS ANOS	QUIENES	COMENTARIOS
TRABAJO EN CARRETERA					
TRABAJO EN RANCHO					
ASERRADERO					
OBRA PUBLICA					
BIOCOMUSTIBLE					
NEGOCIO					
APICULTURA					
GANADERIA					
EMPLEO PUBLICO					
Otro					

III. HISTORIA PERSONAL CON LA PRODUCCIÓN DE CARBÓN

3.1 ¿Se dedicaba la gente de su lugar de origen a la producción del carbón?

3.2 ¿Como aprendio a producir carbon?

3.3 ¿En qué año empezó a producir al carbon en _____? ¿Por cuánto tiempo ha producido carbón?

IV. PRODUCCION EN REALIDAD

4.1 ¿Por qué produce carbón?

DECISION DE CULTIVAR, SI=1, NO=0	COMENTARIOS
Ha visto a otros produciendo_____	
Le quitaron los permisos para extraccion de madera_____	
Motivado por alguien (quién)_____	
A causa de un desastre natural (el clima)___	
Crédito u otro apoyo del gobierno_____	
Experimento_____	
Tradición_____	
Mejorar sus condiciones económicas_____	
Aumentar su posición ascender_____	
Otro	

4.2 ¿Qué tipo de madera utiliza para crear carbón?

Probe**: Que especies?**

4.3 ¿Que diametro de arboles es el minimo que se puede aprovechar para carbon?

4.4 ¿Que tipo de madera no es bueno para hacer carbon, o que usted evita usar para su carbon?

4.5 De qué clase de los lugares recoge su materia prima para la producción de carbón?

TIERRA	HA USADO	VENTAJAS	DESVENTAJAS
ACAHUAL			
MONTE ALTO			
BOSQUE SECUNDARIO			
BAJO			
OTRO			

4.4 ¿Dónde prefiere producir su carbon (Dónde prefiere construir sus hornos)?

TERRANO	HA USADO	VENTAJAS	DESVENTEJAS	CERCE DE UN CAMINO (Si=1, no=0)
ALTO				
SECO				
ACAHUAL				
BAJO				
Otro				

4.5 Por favor, ayúdenos a completar como se hizo los hornos

Tip de	Cuanto	Tomaño	Costalillas

horno	hornos tiene	(approximado volumen)	(capacidad)
HORNOS CON TAPAS			
HORNOS TRADICIONAL			
HORNOS TABIQUE			
OTRA			

V. DESASTRES NATURALES Y OTRA PROBLEMAS

5.1 ¿De qué forma han afectado las problemas del clima en esta comunidad?

TYPO	DISMINUIR	AMINUIR	NADA	YEAR
Huracanes				
Tormentas tropical				
Lluvia en general				
Incendios				
Sequias				
Nada				
Otro				

5.2 Cómo le afectó a su produccion de carbon el huracan Dean?

REPUESTAS	Si= 1, No= 0	Cuantas kilogramas o tonneladas
Mas porque le quitaron los permisos		
Mas a pesar de los permisos		
Menos porque le quitaron los		

permisos		
Menos a pesar de los permisos		
Nada cambiar		

VI. El COMERCIO DE CARBON

6.1 ¿A quién vender carbón?¿Vende carbón siempre a mismo comprador?

6.2 Por favor, completa la tabla: Que tiempo se lleva?

Cortar madera		Construccion	Incendiar	Enfriado	Empacado
Un horno					

Adi.: Que mano de obra usa? Propia familia=P, contrato=C…Cuantos trabajado?

6.3 Por favor, completa la tabla: Que es su costo de mano de obra en:

Cortar madera		Construccion	Incendiar	Enfriado	Empacado
Un horno					

6.4 Cuantos se gasta en:

HERRAMIENTAS?MAQ.	CUANTO CUESTA	CUANTO DURA
Motosierra		
Cadena		
Aceite de modo		
Aceite para gasolina		
Palas		
Carretillas		
Azadon		
Costalilla		
Rastrillo		
Transportacion		

Otro		

6.5 Cuanto gasta Ud. por un horno?

	Un horno
Ingresos (no beneficios)	
Costalillas	

6.6 Por favor, ayudenos acompletar como fue la produccion en otros anos:

Ano	Cuantos tonneladas produje	Que tan seguido sacaba horno este ano	Cuanto ingreso por un kilo (o cuantos kilos por costalillo)	De donde trajo su madera	Donde tenia su horno	Ha por ext. de los arboles	Ha por hornos	Tomano tipo de horno
05								
06								
07								
08								

6.7 ¿En su opinión, son los precios que ofrecen los compradores?

6.8 ¿Cómo consiguió la maquinaria? O <u>Donde</u> consiguió la maquinaria?

6.9 ¿Ha recibido algún crédito del gobierno para la producción de carbón?

VII. PLANES PARA EL FUTURO/ABIERTOS

7.1 ¿De que forma beneficia la producción de carbón en _____?

Probe**: En Calakmul?**

7.2 ¿Cuáles son los problemas más graves con respecto a producción de carbón?

Probe**: En Calakmul**

7.3 Sino no hiciera carbón, como se ganaría la vida?

ACTIVIDAD	Si=1, No=0	INGRESO
PROGRAMA DEL GOBIERNO		
FAMILIARES		
TRABAJO EN OTRAS PARTES DE MEXICO		
TRABAJO EN EEUU O CANADA		
AGRICULTURA		
GANADERIA		
Otro		

7.4 ¿Cree usted producir carbón en el futuro? Probe**: Por que si o no?**

7.6 ¿Va a aumentar o disminuir la producción de carbón en sus terrenos en este momento?

7.7 ¿Cree la calidad de la madera es adecuada en el futuro?

7.8 ¿Cree la cantidad de la madera es adecuada en el futuro?

VI. Informacion Adicional

Esta seccion puede contener las preguntas que hace los informants, observaciones, que hace el encuestador, o notas sobre el cuestionario en si.

APPENDIX B
SEMARNAT PERMITS

SEMARNAT 03-003-D

SEMARNAT 03-003-D

AUTORIZACIÓN DE APROVECHAMIENTO DE RECURSOS FORESTALES MADERABLES EN TERRENOS FORESTALES O PREFERENTEMENTE FORESTALES.

MODALIDAD D

APROVECHAMIENTOS FORESTALES EN SELVAS TROPICALES MAYORES A 250 HECTÁREAS, APROVECHAMIENTO DE ESPECIES FORESTALES DE DIFÍCIL REGENERACIÓN Y EN ÁREAS NATURALES PROTEGIDAS

REQUISITOS:

I. El nombre, denominación o razón social y domicilio del propietario o poseedor del predio, o de quien tenga el derecho a realizar el aprovechamiento en términos de las disposiciones legales;

II. Copia certificada del título que acredite el derecho de propiedad o posesión respecto del terreno o terrenos objeto de la solicitud;

III. Tratándose de ejidos y comunidades, deberán presentar acta de asamblea de conformidad con la Ley Agraria, en la que se contenga el acuerdo para llevar a cabo el aprovechamiento, así como copia certificada del Reglamento interno en el cual se definan las obligaciones y formas de participación en las labores de cultivo, protección y fomento de sus recursos;

IV. Plano georeferenciado indicando ubicación, superficie y colindancias del predio;

V. El programa de manejo forestal, y

VI. Una manifestación, bajo protesta de decir verdad, de la situación legal del predio o predios y, en su caso, sobre conflictos agrarios.

Artículo 75
La Secretaría deberá solicitar al Consejo Estatal de que se trate, opiniones y observaciones técnicas respecto de las solicitudes de autorización de aprovechamiento de recursos forestales maderables o de forestación, previamente a que sean resueltas. El Consejo correspondiente contará con diez días hábiles para emitir su opinión. Transcurrido dicho término, se entenderá que no hay objeción alguna para expedir o negar la autorización.

Artículo 76
Los siguientes aprovechamientos forestales requieren la presentación de una manifestación de impacto ambiental, en los términos de la Ley General del Equilibrio Ecológico y la Protección al Ambiente:

I. En selvas tropicales mayores a 20 hectáreas;

II. En aprovechamientos de especies forestales de difícil regeneración, y

III. En áreas naturales protegidas.

La manifestación de impacto ambiental se integrará al programa de manejo forestal para seguir un solo trámite administrativo y se realizará de conformidad con las guías y normas que se emitan en la materia.

En las autorizaciones de las manifestaciones de impacto ambiental a que se refiere este artículo, la autoridad deberá dar respuesta debidamente fundada y motivada a las propuestas y observaciones planteadas por los interesados en el proceso de consulta pública al que se refiere la Ley General del Equilibrio Ecológico y la Protección al Ambiente.

Authorization for the use of timber resources in forests or classified forests.

Mode D

Logging in tropical forests more than 250 hectares in size, logging of timber species that have difficulty in regenerating, and [logging] in protected natural areas.

Artículo 37. RLGDFS

Los programas de manejo para el aprovechamiento de recursos forestales maderables, deberán contener:

I. Para el nivel avanzado:

a) Objetivos generales y específicos;

b) Ciclo de corta y el turno;

c) Análisis de la respuesta del recurso a los tratamientos aplicados anteriormente, con datos dasométricos comparativos;

d) Clasificación y cuantificación de las superficies del predio o conjuntos de predios, de acuerdo con lo establecido en el artículo 28 del presente Reglamento;

e) Diagnóstico general de las características físicas y biológicas de las superficies, que deberá incluir clima, suelo, topografía, hidrología, tipos y estructura de la vegetación y especies dominantes de flora y fauna silvestres;

f) Estudio dasométrico, que deberá contener la descripción de la metodología del inventario en el predio, cuya confiabilidad mínima deberá ser del noventa y cinco por ciento y un error de muestreo máximo del diez por ciento; las existencias volumétricas, densidades promedio, incrementos, edad y turno de aprovechamiento y diámetro de corta, así como las densidades residuales. Esta información deberá presentarse en totales, por unidad mínima de manejo y por especie, anexando la memoria de cálculo;

g) Justificación del sistema silvícola, que incluya los tratamientos complementarios;

h) Posibilidad anual y descripción del procedimiento para su obtención, plan de cortas por unidad mínima de manejo, tratamientos silvícolas a aplicar y la propuesta de distribución de productos;

i) Descripción y, en su caso, la planeación de la infraestructura necesaria para la ejecución del programa de manejo forestal y el transporte de las materias primas forestales;

j) Los compromisos de reforestación cuando no se presente la regeneración natural;

k) Medidas necesarias para prevenir, controlar y combatir incendios, plagas y enfermedades forestales, así como el calendario para su ejecución;

l) Descripción y programación de las medidas de prevención y mitigación de los impactos ambientales durante las distintas etapas de manejo, así como las que se deberán realizar aun cuando el predio se encuentre en receso o termine la vigencia de la autorización. Cuando existan especies de flora y fauna silvestres en riesgo, se especificarán las medidas de conservación y protección de su hábitat. Cuando exista autorización favorable en materia de impacto ambiental para el aprovechamiento solicitado, se exceptuará la presentación de lo indicado en el presente inciso;

m) Las acciones encaminadas para la rehabilitación de las áreas de restauración y su programación;

n) Método para la identificación del arbolado por aprovechar, el cual deberá ser personalizado, indeleble y notable a simple vista;

ñ) Nombre, denominación o razón social y datos de inscripción en el Registro del prestador de servicios técnicos forestales que haya formulado el programa y, en su caso, del responsable de dirigir su ejecución y evaluación, y

o) Planos en los que se indiquen áreas de corta, clasificación de superficies, infraestructura y diseño de muestreo.

II. Para el nivel intermedio: Los señalados en los incisos a), b), c), f), g), h), i), j), k), l), m), n), ñ) y o) de la fracción I del presente artículo, así como la cuantificación de superficies y la identificación del tipo de vegetación y especies dominantes, y

III. Para el nivel simplificado: Los señalados en los incisos b), f), h), i), j), n), ñ) y o) de la fracción I del presente artículo, así como la cuantificación de superficies y la identificación del tipo de vegetación y especies dominantes. Cuando se trate de conjunto de predios, además, deberá incluirse lo señalado en los incisos c), k), l) y m) de la misma fracción.

SEMARNAT 03-050 TERRENOS DIVERSOS A LOS FORESTALES

SEMARNAT 03-050 BZ

APROVECHAMIENTO DE RECURSOS FORESTALES EN TERRENOS DIVERSOS A LOS FORESTALES

REQUISITOS:

RLGDFS

Artículo 109. Para realizar el aprovechamiento de recursos forestales que provengan de terrenos diversos a los forestales, los interesados podrán solicitar a la Secretaría que verifique que el aprovechamiento proviene de dichos predios y emita la constancia respectiva, la cual amparará la legal procedencia del recurso. La constancia deberá solicitarse mediante el formato que expida la Secretaría, el cual contendrá:

I. Nombre, denominación o razón social y domicilio del propietario o poseedor del predio;

II. Ubicación y denominación del predio;

III. Cuantificación de los recursos forestales por aprovechar y transportar, indicando la especie y superficie, y

IV. Destino de los recursos forestales.

DOCUMENTACIÓN

- Solicitud
- Documento legal de propiedad (original y copia)
- Plano del Predio
- Identificación del Promovente

Logging of timber resources in mixed forest land types.

SEMARNAT 03-004

AUTORIZACIÓN DEL PROGRAMA DE MANEJO SIMPLIFICADO EN SUPERFICIES MENORES O IGUALES A 20 HECTÁREAS O PARA LA REMOCIÓN DE ARBOLADO MUERTO POR PLAGAS, ENFERMEDADES, INCENDIOS O FENÓMENOS METEOROLÓGICOS, O BIEN, PARA EXTRAER ARBOLADO POR UNA SOLA VEZ, PARA PROYECTOS DE RECREACIÓN O DE INVESTIGACIÓN.

REQUISITOS:

ARTICULO: 74 LGDFS

I. El nombre, denominación o razón social y domicilio del propietario o poseedor del predio, o de quien tenga el derecho a realizar el aprovechamiento en términos de las disposiciones legales;

II. Copia certificada del título que acredite el derecho de propiedad o posesión respecto del terreno o terrenos objeto de la solicitud;

III. Tratándose de ejidos y comunidades, deberán presentar acta de asamblea de conformidad con la Ley Agraria, en la que se contenga el acuerdo para llevar a cabo el aprovechamiento, así como copia certificada del Reglamento interno en el cual se definan las obligaciones y formas de participación en las labores de cultivo, protección y fomento de sus recursos;

IV. Plano georeferenciado indicando ubicación, superficie y colindancias del predio;

V. El programa de manejo forestal, y

VI. Una manifestación, bajo protesta de decir verdad, de la situación legal del predio o predios y, en su caso, sobre conflictos agrarios.

Artículo 76 LGDFS

Los siguientes aprovechamientos forestales requieren la presentación de una manifestación de impacto ambiental, en los términos de la Ley General del Equilibrio Ecológico y la Protección al Ambiente:

I. En selvas tropicales mayores a 20 hectáreas;

II. En aprovechamientos de especies forestales de difícil regeneración, y

III. En áreas naturales protegidas.

La manifestación de impacto ambiental se integrará al programa de manejo forestal para seguir un solo trámite administrativo y se realizará de conformidad con las guías y normas que se emitan en la materia.

En las autorizaciones de las manifestaciones de impacto ambiental a que se refiere este artículo, la autoridad deberá dar respuesta debidamente fundada y motivada a las propuestas y observaciones planteadas por los interesados en el proceso de consulta pública al que se refiere la Ley General del Equilibrio Ecológico y la Protección al Ambiente.

Artículo 37. RLGDFS

Los programas de manejo para el aprovechamiento de recursos forestales maderables, deberán contener:

III. Para el nivel simplificado: Los señalados en los incisos b), f), h), i), j), n), ñ) y o) de la fracción I del presente artículo, así como la cuantificación de superficies y la identificación del tipo de vegetación y especies dominantes. Cuando se trate de conjunto de predios, además, deberá incluirse lo señalado en los incisos c), k), l) y m) de la misma fracción.

Approval of the management program for simplified use of trees under or equal to 20 hectares in order to remove dead trees suffering from pests, diseases, or fire and weather phenomena, or to remove trees for one-time research projects.

I. Para el nivel SIMPLIFICADO:

b) Ciclo de corta y el turno;

f) Estudio dasométrico, que deberá contener la descripción de la metodología del inventario en el predio, cuya confiabilidad mínima deberá ser del noventa y cinco por ciento y un error de muestreo máximo del diez por ciento; las existencias volumétricas, densidades promedio, incrementos, edad y turno de aprovechamiento y diámetro de corta, así como las densidades residuales. Esta información deberá presentarse en totales, por unidad mínima de manejo y por especie, anexando la memoria de cálculo;

h) Posibilidad anual y descripción del procedimiento para su obtención, plan de cortas por unidad mínima de manejo, tratamientos silvícolas a aplicar y la propuesta de distribución de productos;

i) Descripción y, en su caso, la planeación de la infraestructura necesaria para la ejecución del programa de manejo forestal y el transporte de las materias primas forestales;

j) Los compromisos de reforestación cuando no se presente la regeneración natural;

n) Método para la identificación del arbolado por aprovechar, el cual deberá ser personalizado, indeleble y notable a simple vista;

ñ) Nombre, denominación o razón social y datos de inscripción en el Registro del prestador de servicios técnicos forestales que haya formulado el programa y, en su caso, del responsable de dirigir su ejecución y evaluación, y

o) Planos en los que se indiquen áreas de corta, clasificación de superficies, infraestructura y diseño de muestreo.

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BIOGRAPHICAL SKETCH

Sam Schramski was born in the Arizona desert and his hide has yet to recover.

There have been times when he could of have, as when he moved to San Diego, California for high school and then Berkeley for his undergraduate years, but all too often those salves failed. Even the mesic environs of Washington, DC provided him with little solace. Gainesville and the University of Florida have proved accommodating, but there are few large mammals with a natural distribution along the Sun Belt.

His MA experience has been a formative one, and one day he too hopes to have a publication receive 500 hits on Google Scholar.