LOOKING FOR BRIDGES: DOVETAILING CONSERVATION AND DEVELOPMENT IN A RURAL MEXICAN COMMUNITY

By

MIRAMANNI MARINGOLA MISHKIN

A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

UNIVERSITY OF FLORIDA

2008

To *Sr. Carlos Charlie* for imparting upon me the importance of thoroughness, the high cost of arrogance and the power of innocence

ACKNOWLEDGMENTS

There are a number of people without whom this thesis would not have been possible. I would like to extend my special thanks to the following long but un-editable list (and of course I have to write in linear order so order is absolutely not indicative of my level of gratitude):

Special thanks to *Dr. Kristina Ernest* and *Dr. Eugene Bozniak* for their recognition of what I needed to do with my life and their "gentle" nudging;

Special thanks to *Dr. Ignacio Porzecanski* for guiding me, teaching me to think more precisely, letting me vent and reviewing my work even though he wasn't even on my committee. I could not have done it without you. Special thanks to the *SNRE office*- without whom there are so many reasons I wouldn't be here- thank you *Meisha*, *Cathy* and *Dr. Humphrey*- I cannot thank you enough for all of your support.

I would also like to take this opportunity to thank *Ana Peterson* for taking a chance and extending me her hand, *Jon Dain* for being supportive and teaching me about diplomacy and the real value of the learning experience, the *TCD* program for being there and giving me a travel grant (especially to Hanna, Wanda and Patricia- but to all the TCD staff for all the hard work you do).

Of course, I want to specially thank my committee: *Hugh Popenoe* for being so impressively knowledgeable and keeping me on track, *Pete Hildebrand* for keeping me straight, being so patient and creating the model in the first place and to *Wagner* for knowing so much about orchids and being open minded, having a great outlook and sense of humor.

My gratitude also goes to *Carlos* for making the research possible and demonstrating true altruism and to *Candido* for making the research possible and teaching me about real intelligence and dedication.

I extend special thanks to *Dr. Alejandro Palacios* for working with me for a decade now and helping me coordinate research teams and generally collaborating…and being really patient. I would also like to thank *Dr. Alejandro Casas* for giving me personal classes in Ethnobotany. Special thanks also goes to *Diana* for everything (especially letting me crash the car) and being a great big sister, to *Julio* for being a good brother, a good lawyer and a true friend and to *Chacha* for being unconditionally supportive and motivating; And to all of them for reinforcing just how important family is.

My gratitude also to *Amy* for reminding me that my life is great and assuring motivation for the future- and teaching me the value of patience and steadfastness, to *Faith* for being hilarious and letting me know when I am not myself- and how to be a better me, to *Bob* and *Caanie* for supporting me for no other reason than because they are profoundly good people, to *Joe* for talking to me almost every day at points and helping me reason through a couple of tough parts, to *Brain* for great camping stories- without which I wouldn't be as happy to come back and write, to *Estelle* for being real and all the long venting sessions and to *Ondi* for inspiring me to appreciate my "temple" and my limits.

I am grateful to my dear *Polo* for undying love and support and watching from afar. Many thanks to my *parents* and my *Grandparents* for your support in this endeavor that was such a long time in coming, to my sister *Crystal* just for being there and sharing the same genes (not jeans); to my *Papá Luis and Mamá Yolanda* for keeping perspective and not letting me get caught up in the minutia and being great Godparents- for helping me to be the best version of myself.

And finally, my gratitude to *Salvador*, *Tzitziki*, *Sr. Carlos Charlie* and *Béto* for being the best roommates I could ask for.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abstract of Thesis Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Master of Science

LOOKING FOR BRIDGES: DOVETAILING CONSERVATION AND DEVELOPMENT IN A RURAL MEXICAN COMMUNITY

By

Miramanni Maringola Mishkin

August 2008

Chair: Hugh Popenoe
Major: Interdisciplinary Ecology

Orchids are a marketable non-timber forest product (NTFP) of cultural and economic value in the general study area, the Lake Pátzcuaro basin of Michoacán, Mexico. In the study community of Oponguio, and others, there is a need to improve the livelihood system (mainly production) to alleviate poverty, community fragmentation and ecological pressure. The Sondeo method was combined with Ethnographic Linear Programming modeling to perform an *ex-ante* analysis of the viability of an orchid culture activity. The results indicated that even while the orchid activity requires up to three years to generate cash, all households with available cash (including credit) and labor can participate without an adverse impact on the current livelihood system. The orchid activity acted as a significant supplemental activity even while the amount of cash generated was conservative. The general conclusion is that, with sufficient support, this sustainable management plan is a practical compromise and a significant step in bridging conservation and development.

Key words: *Natural product trade*, *orchids*, *Sondeo*, *ELP modeling*, *Michoacán, Mexico*

CHAPTER 1
INTRODUCTION

This thesis is about exploring the relationship, in a broad sense, between natural resource conservation, household livelihoods and economics and how these can be understood in order to reduce rural poverty and its ecological impact. The research delves into the very complex issue of resource conservation through livelihood diversification in a rural Mexican community using orchids as a vehicle.

Mexico is a country rich in cultural diversity, endemism and biodiversity. It is also home to some of the greatest social disparities in the Western Hemisphere (Faux 2003). The state of Michoacán, in south-central Mexico, is particularly interesting due to the long settlement history that the P'urhépecha people have there including more than 3,000 years of agriculture (particularly around Lake Pátzcuaro), high biodiversity and endemism, as well as some of the highest numbers of Mexicans that emigrate to the U.S. every year. External political and market pressures have perpetuated poverty, community fragmentation and environmental strain in the rural communities along the shore of Lake Pátzcuaro, and others.

The focus of this thesis was to look at the impact of an orchid cultivating activity on a rural community's livelihood system. The idea is to alleviate pressure on wild orchid populations and aid conservation efforts in the Pátzcuaro basin while seeking to alleviate rural poverty, promote sustainable resource management and support rural livelihood diversification.

One year (2006-2007) was spent collecting data in the community of San José Oponguio (Oponguio) in relation to the livelihood system and household interest in participation in an orchid cultivation project. A Sondeo (survey) was completed that resulted in general information related to the livelihood system and reproductive household activities. From there, various Ethnographic Linear Programming (ELP) models were created to simulate the household

livelihood strategies based on the greater livelihood system. Through these models, the impact of the addition of the orchid cultivation activity on the livelihood strategies of several households were analyzed, as well as the impact on the over all livelihood system. This information will be presented to the community and the University of Michoacán upon completion of the thesis.

Chapter Overviews: Chapter 1, the Literature Review, discusses the body of research related to rural poverty, livelihood diversification and natural product trade. Chapter 2, The **P'urhépecha**, explores the ecological background and physical characteristics of the *Zona P'urhépecha*, developing the ecological context of the study area. This chapter also discusses the elaborate knowledge of the P'urhépecha people of the area's ecology and a general introduction of cultural foundation of the P'urhépecha civilization. And finally, the development of the pre-Hispanic to the modern P'urhépecha will be discussed along with the implications that their development has for this research project as well as current social and ecological dynamics occurring in the *Zona P'urhépecha* and the state of Michoacán (in which it is found). A brief overview of orchid complexity as species in an ecological as well as commercial context will be discussed in Chapter 3, Orchids. Their historic importance as a commercial product as well as their importance in ecological composition is also discussed. Later, the physical characteristics of two species that are the focus of this research (*Euchile citrina* and *Laelia autumnalis*) will be detailed as well as their cultural significance. The different techniques that can be applied to orchid propagation and conservation are also briefly discussed as well as orchids' applicability to non-timber forest product trade and examples of their efficacy. Chapter 4, External Pressures, includes a general discussion of international market pressure and how it can cause a ripple effect with negative consequences for the rural impoverished. Specifically, NAFTA and its impact on Mexico are mentioned and how it has also been an influence on emigration from

Michoacán and subsequently the remittances that make up part of the economy. Sustainable livelihood analysis and development is approached as a means for resolving some of these issues in getting rural people reconnected with the natural environment in a mutually sustainable manner and as a solid and consistent foundation from which researchers can consider sustainable development programs in order to reconnect marginalized rural poor with the greater market system that they are disconnected from. Chapter 5, Methods, describes, in detail, the ELP modeling process along with the Sondeo method. The two scenarios that were tested are also briefly discussed. Chapter 6, The Community: Oponguio, explores the community itself. Local ecological details and census information will lay the foundation for the community overview. The general social dynamics and the community livelihood system is described as well as a bit of the community's history. The livelihood activities specific to the over all livelihood system are detailed. Marginalization is briefly discussed as it relates to this community as well as the political structure along with local infrastructure. The results of the model simulation of the overall livelihood system created through ELP is discussed in Chapter 7, Results and Discussion, along with the orchid activity's impact on the livelihood strategies specific to the households tested. Chapter 8, Conclusions and Recommendations, elaborates the conclusions drawn from the results obtained from the model and the conclusion of this thesis.

CHAPTER 2
LITERATURE REVIEW

According to an Institute of Development Studies (IDS) report in 2006, there is high spatial concurrence between the location of the world's rural poor and areas of high biodiversity. While this seems counterintuitive, the myriad of influences that ranges from a global scale to a national one, trickle down into the rural communities where many still maintain a tenuous, subsistence lifestyle.

This has distinct implications for livelihood studies and development programs in terms of being mindful of what is available and of value placed on activities (or resulting product) when developing a program. Activities that deplete the resource base are more costly in the long term in contrast to the initial cash return that results from them. However, in the absence of alternatives, these depleting activities must and will be chosen. This makes sense when economic pressures force market incorporation to acquire needed goods and services. Commercialization, however, is not an end in itself. While commercialization is interesting and theoretically viable, there is an immense need to ensure that a solid sustainable framework is applied to such development programs as this is transforming the way resources are used and therefore extracted.

Background

Communities with greater ecological diversity and a more conserved environment have greater productive diversity (Toledo et al. 1987). In contrast, the populations that have great specificity in trade or production activity are generally associated with ecological deterioration (due to over-exploitation of resources), which only serves to make subsistence more tenuous. Thus, if conservation efforts can be combined with diversification of household livelihood strategies based on local resources then there is a greater likelihood of long-term sustainable

resource management and livelihood success (Shackleton et al. 2007; Marshall et al. 2006; McSweeny 2004; Takasaki et al. 2004; Forsyth et al. 1998).

In many rural communities the need to further diversify their livelihood strategies (mainly through production) is due to environmental pressure, poverty and low standards of living. Diversification is one of the ways that rural communities achieve an adaptive economic stability (Shackleton et al. 2007; McSweeny 2004; Takasaki et al. 2004; Forsyth et al. 1998). Ashley and Maxwell (2001) discuss the need for sustainable development programs to ‘‘favor livelihood-strengthening diversification options that promote risk averse, multi-occupational households.” Therefore, alternatives that add to diversification of livelihood strategies are helpful for resilience and necessary for livelihood security as well as sustainable use of local resources. It is not a question of over estimating the potential of a given natural product to support a community so much as it is seeing natural products as a potential component of the greater livelihood system. In integrating natural products into livelihood strategies and with appropriate management, there is great potential to conserve natural product habitat in the process thus building a bridge between conservation and development. A practical way in which the actual system can be modified is through the determination of alternatives based on resource availability, historic success and traditional knowledge for commercial development.

The effort to comprehend poverty and its causes now focuses on income distribution, human capital, vulnerability, and an obligation to protect the poor (Ashley & Maxwell, 2001). Natural product trade has an important role in this process. A study done by Shackleton et al. (2007) demonstrated that natural products clearly make a difference in the welfare and development of the most marginalized sectors of communities. According to a review of non-timber forest product (NTFP) development projects in Mexico and Bolivia (Marshall et al.

2006), NTFPs are instrumental in satisfying subsistence needs and generating cash for rural communities. They assert that the current push towards a more global economy could be a benefit to natural product producers in rural, forested areas as it has potential to develop more trade linkages to the greater market system while acting to maintain forests as a resource base from which to draw. Even where the returns are not sizeable, in all cases involving natural product trade the benefits are socio-economically significant (Shackleton et al. 2007, Marshall et al. 2006).

Shackleton et al. (2007) developed a compelling discourse on the reasons for rural poverty, natural resource dependence and failed development programs. They argue that natural resource products in rural areas often yield "marginal returns" which has much to do with market access and production capacity. This creates a push towards focusing on activities with higher returns. When development programs concentrate on homogenizing livelihood strategies focusing on one potentially lucrative activity, a "poverty trap" is created as their dependence on one resource or few activities results in limited diversification making them less resilient in the event of market failure or changes in market demand.

In the Pátzcuaro basin, selling orchids has been a part of the livelihood system of the P'urhépecha people for centuries but many orchids (a number of them endemic like *L. autumnalis* and *E. citrina*) are becoming rarer as habitat is encroached upon by industry and urban sprawl. The P'urhépecha people's historic and current willingness to participate in general conservation efforts and development programs as well as ecological and ethnographic studies demonstrates that these people are willing to integrate sustainable, modern techniques with traditional ones in order to return to the level of ecological and economic equilibrium they had previously maintained for centuries (Toledo et al. 1987). Their successful use of natural

products in trade goes back to the pre-colonial period and was re-established during the Spanish occupation as local "poles of development." This concept is very much consistent with the sustainable livelihood philosophy that was dominant and successful in the area for several centuries, possibly millennia. Poles of development are referenced here as complementary clusters of production that rely on resources and skills specific to certain communities or localized areas that allow for market competition without competing with one another. All of the trades in this area are partially traditional and partially residual from a sustainable resource management plan developed by Vasco de Quiroga during the Colonial period. The plan developed by Vasco de Quiroga rested on the concept of poles of development. It has been considered a type of economic utopia as it was a successful barter system for local communities and developed refined artesian skills, many of which have persisted to the present day (Tuck 2002). Nowadays, in metal work, textile, ceramic and woodwork there are many success stories in terms of economic growth and participation in the modern, global market (Tuck 2002, State of Michoacán 2000). These examples demonstrate great potential for self-sufficiency through NTFP trade as well as long-term natural resource management if development programs are approached with sustainable development in mind. Orchids are a practical link between sustainable development and conservation due to their ecological interdependence, cultural significance and economic market value.

Commercialization, however, is not an end in itself. While commercialization is interesting and theoretically viable, there is an immense need to ensure that a solid sustainable framework is applied to such development programs as this is transforming the way resources are used and therefore extracted. Production time is another a factor in conservation/ development programs as natural products are usually immediately profitable when they are

taken from natural populations as they are already developed and thus an immediately marketable product. This must be offset. Put another way, economic concerns for limited-resource households are immediately pressing even while the eventual return for the cultured orchid plants is significant for the households even at a conservative amount. This means that many producers face a real dilemma in terms of devoting labor that brings immediate economic benefits to an activity that will not have a return for up to two years in the future. For some households, this makes the labor more costly in the short-term. This is particularly true when there is little or no infrastructural or institutional support for such activities. The conundrum is that long-term sustainable development and conservation of natural products ensures livelihood diversity and subsequently security once such activities are established.

Socio-economic and even political marginalization is a huge obstacle to development programs as communities have limited access to market and market information, infrastructural supports for basic human services and law enforcement (Shackleton et al. 2007, IDS 2006, Marshall et al. 2006). These basic issues and how they act as potential barriers to development must be taken into consideration if a development program is to be successful over the long-term.

Previous Research

Because of the marked ecological deterioration that has been a result of the globalization (industrial revolution, modern agricultural practices), poor public works infrastructure, urban sprawl and subsequent concern by local communities, *Pátzcuaro 2000* was organized by a group of scientists in 1992. This project was supported by the government organization SEMARNAP (*Secretaria de Medio Ambiente y Recursos Naturales y Pesca*) and PNUD (*Programas de Naciones Unidas para el Desarrollo*). The goal was to research and subsequently publish a series of studies including prognostics and suggestions for natural resource management and

ecological conservation to organize efforts to understand the processes integral in the ecological deterioration of the Pátzcuaro valley and halt or reverse them. At the invitation of SEMARNAP and PNUD in 1997, a committee was formed (*Comité Técnico de Pátzcuaro,* established by the state of Michoacán), that integrated diverse municipal, state and federal institutions, as well as civil (*e.g., Instituto de Estudios Indígenas*) and academic groups (*e.g.,* UNAM, UMSNH). They were all brought together to coordinate the efforts to save Lake Pátzcuaro and the lake valley around it and disseminate the information generated by the effort. Initially, the research focused on ecological processes and how those processes have been impacted over the last several centuries.

These studies (some of which are still ongoing) took several years to complete and their goal was to have a solid, organized knowledge base by the year 2000 (including conservation and restoration plans). Some headway was made in terms of reforestation, sanitation (especially in the lake-shore communities), water treatment and creation of organizations like the *Fondo Mexicano para la Conservación de la Naturaleza* so that funding for research could continue (Pátzcuaro informe 2000).

Subsequently, the human influence was determined to have had the most impact and another round of studies was performed in reference to the impact of anthropogenic activities and their impact on the lake valley. Unfortunately, this second phase of research has not been as organized as the first phase was.

Here, it is especially important to mention that this progression of events has a great deal to do with how this Master's research plan came into being. In early 1999, Dr. Alejandro Martinez-Palacios (of the University of Michoacán, UMSNH) and I were collaborating on research that pertained to endangered and/or threatened orchids and their distribution around Lake Pátzcuaro.

The precise locations of populations were mapped with a GPS device and transects were established for long term monitoring. The goal was to determine their current distribution relative to their previous distribution and the reasons for their scarcity. Once this was accomplished, a plan for their conservation (although, admittedly, we were thinking in preservation terms) would be developed.

In the summer of 2000, after collecting ecological information about the orchids we began collecting information from the communities around Lake Pátzcuaro. Dr. Martinez-Palacios and I started by going into the communities where the orchids were historically proliferous with local guides who showed us scattered orchid populations in the forest from which orchids were collected. We were informed that community members rarely extracted orchids from overexploited populations although people from outside were not always as aware and respectful of these practices.

Next, families that sold orchids in the markets were interviewed (to expound on the information we were given by the guides). We were able to ascertain that, in general, the flowering season coincides with the time of year when the orchids were collected. If an orchid plant was collected, in general, just a portion of the entire plant (usually a section containing approximately two pseudobulbs) was taken. This is generally not to the detriment of the portion of the plant that stays in its habitat as each pseudobulb can grow on its own under appropriate conditions. Also, some were divided in home gardens and sold from there when possible.

Two of the families interviewed sell orchids in the two largest markets in Morelia, as part of a generational livelihood-- being one of several successive generations that participated in orchid collection. Both families informed us that selling plants, including various species of orchid was common. We were told of areas rich in orchids that have been more or less clear-cut

and that extraction, even of the orchids in the felled trees, was prohibited by the government. We were also told of areas where certain species once proliferated but are now rare. Orchids are also frequently sold along the highway between Morelia and Quiroga (two relatively large cities) and have been taken to market as far away as the states of Mexico, Jalisco and Puebla (more than 400km distance) where they receive a relatively high market price (as much as half a week's working wage per flower/pseudobulb depending on the species). We were also informed that several communities were interested in conserving well-established, second-growth forest (as virgin forest is almost nonexistent in the valley due to human presence over millennia). The State of Michoacán recognized several of these forest areas as protected areas between the years 2000 to 2006. Oponguio, the study community located in the heart of the *Zona P'urhépecha*, was one of them. They were chosen due to their willingness to participate, their interest in orchid propagation and conservation and the fact that both species of orchids were historically found within the forest that forms part of their community. The P'urhépecha people in general have been extremely receptive to conservation efforts and have been very involved in sustainable management programs. They have developed and, to a large degree, maintained complex methods of sustainable resource allocation and usage (Toledo et al. 1980, Caballero 1982). They have also developed a certain mistrust of development projects due to various past failures.

It became clear that certain specific endemic orchids have been part of the livelihood strategies of the Purhépecha people for centuries but they are becoming rarer as habitat is encroached upon by industry and urban sprawl. According to the previous research, these orchids are endangered due to the destruction of their habitat for industrial and subsistence purposes as well as their extraction from their habitat for cultural and commercial purposes.

Several years later in 2005 (as part of this Master's thesis), the next logical research phase was to deal with sustainable community development through conservation of the orchids as the rural communities' dependence on local natural resources had become evident. I determined that, in order to do this responsibly, it was imperative to understand the diversity in community livelihood activities and also the local natural resources in conjunction with the ecological dynamics that promote ecosystem health. Moreover, to assure long term sustainability, it was necessary to find ways to combine the two efforts. With such a diversity of natural resources and historic specificity of local production, this is an effort that has great potential to succeed. When it became apparent how integral a part of life the orchids were for the Mexican people (especially the P'urhépecha of this area) a plan of conservation through commercialization was discussed. The idea was to ensure that the people who relied on the orchids might continue to do so, but without such a detrimental impact on the wild populations and as a way to conserve them while extraction and unchecked industrialization encroaches on their habitat. In the case of *Laelia autumnalis* and *Euchile citrina*, and the people who live in the valley, there is an interesting dynamic that I believe lends itself to a mutually beneficial compromise.

CHAPTER 3
THE P'URHÉPECHA

Area Overview and Historic Progression

The state of Michoacán de Ocampo (as its boundaries are recognized today) was established as a State in 1824 (Fig. 2-1). It was not delineated with its many municipalities until 1918 and it's over all territory contained the majority of the P'urhépecha empire at its height (Secretaria de Educación, 2003). It is located in south-central México, within the tropic of Cancer, and extends from the Pacific coast east, into the heart of the Mexican territory. Its extension includes ocean, highland (dry tropical) and lowland valleys (tropical), sierras, volcanoes and various freshwater lakes and rivers. It covers a territory of 58,836.95 km^2 and is considered 5th in the nation in ecological diversity and biodiversity (SEMARNAP 2000).

Michoacán is not a culturally homogenous entity. There have always been several ethnic groups present in the same territorial area: the Nahuas along the coast, Mazahuas and Otomies to the east, and the Purhépecha in the central part- the *meseta* and the lakes areas. The term Michoacán comes from the Náhuatl, *Michihuacan*- place where the people have the fish (*michi: pescado, huac: possessive pronoun, an: place*). This is a direct reference to the freshwater, high altitude lakes in the heart of the empire, which are also in the heart of the current state (Correa-Perez 1997). The cultural resistance of these groups in the face of the Spanish Conquest and resulting *mestizaje* has left in its path their languages and other manifestations (although fragmented, subordinate and in many ways separated from their original roots) that to this day give each area its own flavor, personality and authority that defines it even in the face of dominant modern westernization.

Zona P'urhépecha

Evidence exists of human civilization dating back approximately 5,500 years and evidence of agriculture dating back 3,500 years in the current "Zona P'urhépecha" located in the north-central portion of the state of Michoacán (Caballero 1982). This area is considered the capital of the P'urhépecha Empire, as Pátzcuaro is located there (Fig. 2-2). Tzintzuntzan, only a few kilometers away is believed to be the religious center. The people who currently inhabit the area are believed to be one of the few and, in some cases relatively insolated survivors from the prehispanic era. Their actual territory has been documented to have extended from Michoacán, Jalisco, Nayarit, extreme north of Colima, the southern portion of the state of Guanajuato, southeastern portion of the state of México, southwest of Querétaro, and western Guerrero occupying approximately 100,000km^2. The P'urhépecha language has been compared (in terms of complexity) with classic Latin and Greek (Durán Carmona and Sevilla Palacios (ed.) 2003). Their most notable contributions in terms of skills are their ceramic techniques, medical practices, social organization, and complex political and religious practices (Duran Carmona and Sevilla Palacios (ed.) 2003).

What makes them different than the vast majority of native North American cultures is that, while they showed patterns of decadence and splendor, their decline was not part of natural process inasmuch as it was due to human intervention- the invasion of the Europeans. In spite of this (as in many regions of México), the P'urhépecha people demonstrated a passive but tenacious resistance that is evident today. It is reflected in the complex mixtures of symbols and significance that can be clearly seen in religious festivals, combinations of the traditional with the European in their foods, music, clothing and art and *artesanía*. The P'urhépecha developed and, to a large degree, have maintained complex methods of resource allocation and usage

(Caballero 1982). This will be elaborated a bit later on in this chapter's "Prehispanic to Colonial Purhépecha" section.

Many factors make the particular area of study ideal for this thesis, not the least of which are available natural resources and the historic development of the Purhépecha civilization and culture. The natural environment in the Zona Purhépecha is very diverse along with the communities found there. The diversity of natural resources lends itself to community development and livelihood diversity.

The total extension of their territory includes considerable variation in topography (*e.g.,* mountains, rivers, valleys, lacustrine areas), micro-climates and soil types. This creates diverse ecological systems as well as considerable diversity in flora and fauna. They also have been touted as having maintained and even augmented the biodiversity found in their territory (Toledo et al. 1997, Correa Perez 1997).

Three main lakes are found in the Purhépecha region: Chapala, Cuintzeo and Pátzcuaro. The lake ecosystems are varied and represented by species composition that indicates modification by humans (direct or indirect). The highlands are represented mostly by oak and oak-pine forests which, depending on their location within the area, have very notable differences in distribution, composition and structure.

Physical Characteristics of the Study Area

Situated in the heart of the Zona Purhépecha is the Pátzcuaro valley. The Pátzcuaro valley lies around 101° 26' N and 101° 54 W longitude and 19° 25' N latitude and sits at an altitude of approximately 2369m. The lake-river valley, approximately 1000 km^2 (93,430 ha), is a closed valley (meaning that the water is stored in lakes from rain, not river-fed) with marked gradients and abrupt topography. The altitude can vary from 2,035 m to 3,300m above sea level. This is a consequence of the complex geological history responsible for the formation of the neo-volcanic

mountain chain (as part of the Eje Neovolcánico Transversal) and the results of which are the large number of sierras and the 150 small volcanoes in the area (Duran Carmona and Sevilla Palacios (ed.) 2003).

Complex geo-history is also responsible for high ecological diversity- micro-climates and micro-ecology. In spite of the relatively small extension of the valley (approximately 1000km^2), impressive geographical and ecological diversity is present. This is evident in the six distinct altitude gradients (steps), eight vegetation types, five distinctly different climate types, and at least eighteen different soil types (SEMARNAP 2000).

Since the valley is closed, the area is afforded a sort of continental insularity. This means that it is isolated enough as to experience a certain independence in development with respect to the surrounding areas. This also means that the process of development established a delicate balance based specifically on this insularity and on its components- particularly its forests and lakes. This has enormous implications for resource use and management.

The most influential factor in the balance of the area (as determined by the same study done by SEMARNAP 2000), is the hydrologic balance and particularly, Lake Pátzcuaro (Fig. 2-3). Therefore, the quantity of water that is provided by rains, evaporation rates, runoff, filtering and accumulation rates are extremely important. It is estimated that the region receives 10 x 10^{12}m^3 of rainwater (an average between 900 and 1000mm annually) of which 7 x 10^{12} are lost to evapo-transpiration. Of the 3 x 10^{12} m^3 that remain, one third is lost to runoff and the rest is leached through the soil. The lakes (especially Lake Pátzcuaro) are receptors for this rainfall. With a total area of 130km^2 and a depth of approximately 5-8 meters, Lake Pátzcuaro maintains a relatively constant temperature between the surface and its depths (Platt Bradbury, 2000).

The forest that surrounds the lake aids in water and gas cycling and filtration. Evidence of a great deal of species rich, secondary growth forest is present, which is considered a sign of human activity over an extended period of time (Toledo et al. 1987). According to a study compiled by the Secretaria de Educación del Estado (revised 2003), the forest composition directly around the lake is very distinct from the rest of the oak-pine forest that inhabits the majority of the interior of the state of Michoacán. Just around Lake Pátzcuaro the forest is dry tropical forest (which boasts very fertile soils and species richness). The dry tropical forest here is considered dense to moderately dense with a canopy being between 6 to 12 meters. In general, it is found at altitudes of 2000m or higher where light freezes occur each year. This forest type previously made up more than 45% of the forest cover in Michoacán but now makes up barely five percent (Duran Carmona and Sevilla Palacios (ed.) 2003). Much of the territory is now oak-pine forest, grassland or parceled into agricultural plots.

Cognitive Base Knowledge of the Natural Environment

The Purhépecha developed a complex system of species classification and nomenclature which has largely been conserved to the modern day. For example, of a list of 506 documented species of wild plants found in the area, those people who were consulted were able to name at least 244 in Purhépecha and/or Spanish (Toledo, et al. 1980). Of a list of 136 collected fungi in the region, 64 had indigenous names, as well.

The classification system for plants and fungi found in the area expresses utility (or lack thereof) of a given species, whether it is terrestrial or aquatic, wild or cultivated, indicative of reproductive season, etc. There is an uncanny parallel between the P'urhépecha and the Linnaean system of classification (Toledo et al. 1987). The fungi are classified in groups of edibles and hallucinogenic or they are grouped by time of year that they appear or germinate. The names given to fungi species usually refer to the color of the cap or surface, stipe, type of

reproductive structure (or possible absence of these) as well as phenology and habitat. They are considered "*Flores de la Tierra*" (flowers of the earth. Currently 25 species are still considered a regular part of the Purhépecha diet.

A even more complex taxonomic classification system for plants is broken down into five taxa that are significant of biological criteria defined by life form or habit; one of which is for plants with anomalous habits- a sort of "miscellaneous" category. Notably, there are also many terms that refer to distinct parts of plants (some are allegorical) as well as a direct correlation to the importance of a given species and the number of terms associated with it (Toledo et al. 1980).

It is also interesting to note the P'urhépecha's extensive understanding of successional stages and species composition in ecological communities both after disturbance such as forest fires and in areas of cultivation that are fallowed. A classification of different ecosystem types that are related to human modification was also developed as part of their knowledge base. For example, the communities around Lake Pátzcuaro would be considered an altered or "transformed" environment, where the lake itself and the forests surrounding it are considered "natural" or unaltered (as they are forests and lakes by nature) (Toledo et al. 1980). The transformed environment refers to the areas where horticulture, arboriculture, agriculture, livestock and the cultivation and management of certain aquatic plants occurs (or occurred and modified the ecosystem over the long-term). This has strong, positive implications for modern management and conservation.

It is well documented that there were many species collected for medicinal purposes. The Purhépecha even developed a system very akin to institutionalized medicine that is referenced in the colonial literature-- numerous doctors in the service of the P'urhépecha ruler that received

patients from surrounding areas (Ruiz 1978). In the colonial literature there is direct mention of trade and possible commerce of medicinal plants (Caballero 1982). To the present day, many homes have a small medicinal home garden.

The P'urhépecha classification system is extensive (ex. Table 2-1). A large portion of their vocabulary is dedicated to the classification of different soil types (there are ten according to the Purhépecha and 6 designated by pedologists), seasonal cycles of winds that occur in the basin, clouds (in terms of signals), types of rain, constellations and their location for navigation, and season classification as well as moon phases and how they affect fishing activity, i.e. fertility (Toledo et al. 1980). Also noteworthy is that the words related to the annual cycles of the seasons incorporate the cardinal direction from which they originate. The determination of soil classification describes texture, color, productive potential and general phenomena associated with each of the ten designated soil types (i.e. parent material, sediment size, fertility, etc.). Based on their classification, they were even able to construct an accurate area map based on soil type described in a study done by Barrera Brassols (2003).

A study conducted by Toledo (et al. 1987) showed a base of 160 named and classified species of mammals, amphibians, reptiles, birds and fish. Animal classification and nomenclature is also determined by biological characteristics and distribution in their habitat, especially in the case of fish.

Aquaculture and fishing were a large part of Purhépecha life. Many of these traditions were carried on until well into the XX century and some even into the XXI (although many are now restricted by scarcity and governmental restrictions).

The literature also refers to a highly developed system of sustainable forestry (for which the exact techniques are unfortunately unknown), which is demonstrated in the diversity and

composition as documented by Fray Alonzo de la Rea in 1643 (Caballero 1982). According to Ruiz (1978), the forests were documented as being impenetrable and only a certain group of high priests, while in charge of keeping their use and integrity under observation, were permitted to freely enter. As mentioned previously, the secondary growth forest is common in the region and is considered a sign of human intercession.

It is important to note that, according to historic accounts, the Purhépecha also received tributes from groups surrounding their territory. It is also believed (based on documented biodiversity and forest density) that their management and consumption practices were sustainable over an indefinite, extended time period (Barrera-Bassols & Zinck 2003). This is largely based on colonial writings that describe the area's diverse ecological composition which appears consistent with the composition as recently as 50 years ago. For all of the modifications and alterations over the last five centuries, it was apparent that, until approximately 50 years ago, there were no major changes or shifts in ecological structure (Toledo et al. 1980).

Another example of resource management is directly mentioned in the colonial literature was a wild-life park in which various species of animal were maintained. It is believed that this park existed mainly for bird conservation since that feather art was central to the region and culture (Caballero 1982). Feather art was very prominent and multicolored feathers were used like mosaics in geometrical patterns or in the likeness of animals. These designs were worn on ceremonial capes, fans, pins and wall hangings (Correa Pérez 1997) and involved the use of a process involving orchid pseudobulbs called *Pasta de Caña de Maíz.*

Prehispanic to Colonial Purhépecha

Fortunately, history of the Purhépecha people is well documented since the XVI century-including ten works that document traditional knowledge and use of natural resources (Alvarez-Icaza et al. 1990). During the height of the Purhépecha civilization in the XVI century, the

estimated population was 80-100 thousand inhabitants and was distributed in 90-95 settlements across their territory (Alvarez-Icaza et al. 1990). They were primarily hunters, farmers and fishermen. Agriculture and fish were the base of their economy (Correa Perez 1997). They grew a variety of crops- from food crops (like *chía*, maize and beans) to crops like cotton and tobacco. It is asserted that they were able to flourish and maintain biodiversity due to the high variation in resources that is naturally available there (SEMARNAP 2000). They used wood for construction and firewood for cooking and heating.

Evidence has been found that shows the use of bronze tools as early as the XIV century (Fig. 2-4). The P'urhépecha are considered to have some of the most prolific and advanced techniques for metalwork (copper in particular) in Mesoamerica (Correa Pérez 1997). They used metallurgy to construct tools (for example hoes and planting tools), weapons, and for artistic applications like inlay and filigree. They worked in copper, bronze, silver and gold utilizing techniques like firing, soldering and molds. They are documented as also having very developed techniques in stonework (*e.g.*, construction, statues, obsidian weapons and tools), woodwork (*e.g.,* statues, furniture and construction) and *barro* (terracotta) which was used for domestic, commercial and ceremonial purposes (Correa Pérez 1997).

Agriculture was considered a collective practice (although there were also plots of land that were devoted to the political figures and priests). Four distinct forms of agriculture were found in the area: highland farming, lowland farming, riparian farming and terrace farming. The agricultural procedures were determined specifically by ecological conditions and they appeared to have utilized methods that were considered minimally manipulative of the natural environment; in other words, with a minimum of external inputs.

Terrace agriculture was practiced mainly in the peninsular area in the eastern portion of Lake Pátzcuaro, due to rocky soil and steep topography and was maintained by manual labor. Terracing both for building and agriculture was prevalent. In fact, many of these terraces are still used in area agriculture today. They were/are used to prevent erosion and run-off into the lake. Irrigation systems were also developed that utilized wells, lake water and rainwater (Toledo et al. 1989).

Home gardens were also commonly used for fruits and vegetables like tomatoes and chiles that are common in daily use (Caballero 1982). The vertical space was maximized in the gardens to make the best practical use of the smaller space.

According to historic accounts, the Purhépecha were still using (up until the late XX century- and even today in some cases) the same species of maize (*blanco*, *amarillo*, *colorado*, *pinto* y *azul*) and several species of chile. Beans, however, are species that are commercially available today (commonly Navy bean, Flor de Junio and Flor de Mayo). They also cultivated amaranth, a grain commonly used in many Prehispanic/ Mesoamerican cultures, and is still part of the Purhépecha diet, usually in conjunction with wheat or corn. Unfortunately, past references to other food plants are vague and unspecific but there are many references to wild species frequently collected for food. This is still done today especially as a way to supplement what they grow and/or to save money (*e.g.*, nopal--which is a staple in the Mexican diet and is sold in the more urban areas) (Refer to Oponguio chapter).

The area surrounding Lake Pátzcuaro housed the administrative centers of the P'urhépecha. As was previously mentioned Pátzcuaro itself and Tzintzuntzan housed the political and religious centers, respectively. The local resources were traded between and among communities due to the specialization of services and products that were available through the

local resources in each area (local natural resources could be specialized by the local flora and fauna- medicinal herbs, feathers, specific wood, etc.). There was also artisanal production like embroidery, metal work, wood work, painting, carpentry, stone cutting, etc. Clay, semi-precious stones like turquoise, gold, silver, and copper, were resources that were used but were not found in the lake area although they existed inside the P'urhépecha territory. The presence of these resources is indicative of trade which occurred also outside of the P'urhépecha communities with other groups (Ruiz 1978).

The colonial period (XVI century) brought a major change in the lifestyle of the P'urhépecha people as well as a major shift in resource management. The territory was broken into parcels that were called *encomiendas* and were under the control of a European land owner. This change meant that, as soon as the Spaniards came in to rule, there was no longer a system of communal land and the power structure of the P'urhépecha civilization was effectively dismantled. Epidemics like measles and others decimated the indigenous population. In fact, between the XVI and XVIII centuries, entire populations disappeared (CESE 2000). To make matters worse, the European farming practices and crops were impractical as they were non-native and required a great deal of external inputs in order to produce. They were also frequently devastated by plagues, pests and drought due to limited defenses to environmental conditions. The result of such radical social and ecological changes was that the social organization of the settlements was drastically altered, population became disperse as well as accelerated "hydrologic deficits" of Lake Pátzcuaro that had begun pre-colonialization (Platt Bradbury 2000; O'Hara et al. 1993; Toledo et al. 1989) among other environmental problems (CESE 2000). Socioeconomic disparity became rampant exacerbating cruelty and labor abuse while natural resources were irrationally exploited for export to Europe.

Schmal (2004) writes,

"Professor Verástique writes that "three factors contributed to the loss of life in Michoacán: warfare, ecological collapse, and the loss of life resulting from forced labor in the *encomienda* system." Between 1520 and 1565, the population of Michoacán had declined by about thirty percent, with a loss of some 600,000 people. For the rest of the colonial period - the better part of three centuries - Michoacán would retain its predominantly agrarian economy."

A little later in the XVI century, in order to facilitate the conversion of the indigenous people to Christianity, the Franciscans and the Augustines formed towns around their churches and convents. This gave rise to a new form of organization which allowed for a return to communal farming, which was shared, as well as somewhat improved access to resources like health care and water.

At the end of the XVI century, land tenure was dictated by a new legislation that one could purchase land and resources (i.e. water and forest) and *haciendas* were formed, once again displacing indigenous communities. Frequent structuring and restructuring occurred continually during the XVII and XVIII centuries and caused further social instability except for some exceptions in very rural, insulated areas. During this time, the lakes in the region and particularly Lake Pátzcuaro lost a great deal of their extension (more than one third of its surface area) due to drainage (*e.g.*, for building and farming), eutrophication and water usage (irrigation, drinking, etc.) (Platt Bradbury 2000) as the focus of settlements and resource exploitation occurred largely in the lake areas.

In the XIX century, the social and political issues reached crisis proportions and many towns and farms were abandoned due to the war of independence (1810-1821) as their inhabitants sought greater stability, security and safety (not to mention those that left to

participate). After the war, a new government was established and people returned to the abandoned homes and farms and emigration diminished considerably. The post war XIX century brought about more resource exploitation and land tenure disputes as the system of governance and land tenure did not change considerably.

However, in 1786 the process to establish municipalities and the political boundaries of the state of Michoacán began in earnest with the idea of emulating Spain's organization in order to create a more "modern" state (Duran Carmona and Sevilla Palacios (ed.) 2003). Territories were divided among the politically powerful. Michoacán then became one of the 19 founding states of the New Mexican Republic in 1824. Mexico went through a great deal of political turmoil and change over that century and resulted in a more traditional European system of organization and governance by the end of it resulting in the delineation of Michoacán more or less as it is known today.

Modern Purhépecha

The most recent demographic research done by the *Secretaría del Medio Ambiente, Recursos Naturales y Pesca* (SEMARNAP) (1990), found that there are approximately 112,000 people in 92 communities- a density of approximately 112 people per km^2 in the state of Michoacán (compared to 53 people per km^2 in the country). Of these, 33% of the rural population is considered indigenous and living in the Zona P'urhépecha. Although the conquest saw the disappearance of many of their traditions, there are pockets of communities that have conserved much of their cultural and traditional knowledge. The vast majority of people in this area consider themselves P'urhépecha, retaining many of the same customs. A census done in 2000 (CESE 2000) showed 121,409 persons were registered as speaking P'urhépecha; while the majority (85%) spoke Spanish, 15% spoke P'urhépecha alone or P'urhépecha and a language other than Spanish.

Excluding Lake Pátzcuaro, there are approximately 77,516 ha of land resources allotted for indigenous use. Of this area, about two-thirds is natural ecosystem (considered not modified: forest, grassland, and other vegetative areas) and the other one-third is used for agriculture, horticulture, arboriculture and cultivated meadowland (modified ecosystems). According to a study done by Toledo et al. (1980), land use categories can be broken down into percentages: forests 41.8%, agriculture 34.8% (24.3% seasonal agriculture, 8.6 % humid agriculture and 1.9% irrigated land), livestock 0.5%, and horticulture and arboriculture 0.4% respectively.

Horticulture tends to be practiced around the lake and agriculture is practiced in the highlands (*mesomontaña*) and lowlands. There is distinct seasonality (dry and wet season- the dry season seeing potential frost in the highlands). Irrigation is utilized for horticulture and in some cases for lowland agriculture. The staple crops are maize, beans and wheat. There is a variable fallow period of one to three years.

Aquaculture is still practiced today, in some cases even as it was before colonization. However, dependence on wild fish for subsistence and commerce still exists. According to some studies, there are approximately 14 species of fish extracted through fishing (10 native and 4 introduced) as well as a few species of amphibians and turtles (Alvarez-Icaza et al. 1990). However, according to the data collected by this study, the fish populations have declined drastically in the last decade and fishing is no longer a viable economic activity and barely sufficient for subsistence. Where once it was a common activity, it is now limited to only a few communities and the number of fishermen has dropped by more than two thirds (Martinez-Palacios personal communication, Durán Carmona and Sevilla Palacios (ed.) 2003). A common example is the Whitefish (*pescado blanco*: *Chriostoma sp.*), a fish endemic to Lake Pátzcuaro that is now considered extremely endangered. Efforts are being made to farm and reestablish

this fish into its habitat but the results are inconclusive (Martinez-Palacios 2002). Fish are now being brought in from other states.

Agricultural practices have changed due to mechanization, land tenure laws, removal of subsidies and market pressures. However, some traditional techniques have remained prevalent in small scale, modern farming. Terracing is still practiced- even simply through maintaining old terraces- as well as home gardens, in some cases. Draft animals are employed to help with farming in the highlands, lowlands and riparian areas where mechanism is unaffordable, unavailable or not possible due to rocky soils. The use of oxen occurs but horses are generally favored due to their multiple use potential and relative cost-effectiveness (Toledo et al. 1990; Martínez, personal communication).

According to Toledo et al. (1990), quite a bit of diversity exists in agricultural crops. Documented, are nine varieties of corn, two of wheat, fourteen varieties of bean, five of squash, twenty fruits, fifteen plants used for tea, eleven leafy greens, and more than fifteen other vegetables (carrot, radish, beet, potato, tomato, tomatillo, onion, cauliflower, etc.). The staple crops are maize, beans and squash which are alternated with wheat and barley. Maize and beans are often intercropped. In areas close to the lake's edge, the lake water is used for garden irrigation. In general, these gardens are tended by the women and have a great diversity of both domestic and semi-domestic plants (Toledo et al. 1990). They also utilize a vertical technique in gardening (i.e vertical multi-cropping), making greater productive use of a smaller space (Alvarez-Icaza et al. 1990).

There are five common irrigation techniques that originate in P'urhépecha traditional knowledge. In the gardens near Lake Pátzcuaro, they employ a method that is believed to be of pre-Hispanic origin. It is designed with a lever with a cup-like attachment that pushed water

from the lake into the gardens through stone lined canals (Toledo et al. 1990). Water is also transported by hand from the lake areas where there is greater poverty and smaller plots. Another method is to dig into the water table (generally 100-200 meters from the lake) approximately 2-4 m into the ground creating a well and possibly canals that lead to the gardens (Toledo et al. 1987). Some use is also made of animal-run chain pumps, which are generally utilized in riparian areas. And finally, some electric pumps are used to pull water directly from the lake or previously constructed wells.

A complex system of subsistence based on the multiple-use of ecosystems is common-- home gardens, aquaculture, etc. (Toledo et al. 1980). There are several main activities that have always been a part of the P'urhépecha livelihood system. For the people inland but around the lake, agriculture is a main activity while island communities focus on fishing activities. A growing industry for ecotourism for some communities with direct access to the lake waters is emerging (personal communication and observation). A number of minor activities are also part of the livelihood systems of different communities. These activities will be detailed further in the chapter on Oponguio, the community specific to this study.

The majority of the communities in the Zona Purhépecha have some area of specialization as far as community livelihood-- generally agricultural products or artesania. It is notable that as recently as 1980 of the 24 communities studied by Toledo et al., 16 of them had a specialized trade that involved some direct use of the natural environment. Around the lake, many of the trades that were prevalent at the height of the P'urhépecha empire are still prevalent today: clay (Capula), metalwork (Sta. Clara del Cobre), woodwork (Patzcuaro), Reed weaving (throughout the lake region), textiles (Erongarícuaro), fishing and aquaculture, etc. These trades are, however, (in many cases) less localized and due to external pressures (see External Pressures

chapter) are limited by over-exploitation of resources and limited market access. Limited employment that requires certain skill (i.e. educators, nurses and political leaders) and which supplies labor to industry (i.e. railroad, construction, etc) is also available.

All of the trades that are prevalent in the Zona are partially traditional and partially residual from a plan of self sufficiency developed by Fray Don Vasco de Quiroga during the colonial period (Tuck 2002). The plan was successfully designed to provide religious instruction, training in marketable trades (some of which were traditional and simply maintained) and education in the fundamentals of governance as deemed appropriate by the European system. In the later XX century, the Mexican government stepped in to subsidize private, foreign initiatives at the expense of the people of the Zona Purhépecha. In metal work, textiles, ceramic and woodworking (especially furniture) there are many success stories in terms of profitability in the local and even, in some cases, the global market are formed.

These examples (alongside historic development) demonstrate a high likelihood of self-sufficiency, adaptive management and sustainability. However, the socio-economic disparity which was not present in historic accounts of the prehispanic P'urhépecha culture and was not apparent at the peak of Vasco de Quiroga's sustainable development plan, is very evident today.

Currently, it has been observed that the communities with greater ecological diversity and more conserved environment have greater productive diversity and greater economic success (Toledo et al. 1990). In contrast, the populations that have great specificity in trade or production activity are generally associated with ecological deterioration and social fragmentation, which only serves to make subsistence more tenuous (Davis et al. 2007, Barret et al. 2001, Bebbington 1999).

With the encroachment of urban sprawl, poverty and impractical land use and land tenure laws, in the XX and XXI century it has become evident that their traditions and the environmental integrity of what once was an ecologically rich and healthy area are suffering greatly. A marked ecological deterioration exists in the Zona Purhépecha and particularly the Lake Pátzcuaro region which has increased with frightening rapidity. This has been directly correlated with industry, poverty and land use restrictions (Alvarez-Icaza et al. 1990, Toledo et al. 1980).

From 1963-1990 the forest cover diminished from 33,000 ha to 18,000 ha- a disappearance of 45% of the total forest cover (Alvarez-Icaza et al. 1990). This and other types of disturbance (forest fires, resin extraction, deforestation) are believed to have left remaining forests vulnerable to disease and blight. This has grave implications not only for the forests and the ecosystems that they sustain, but also the people and livelihoods that depend on them.

Livelihoods were affected by resource exploitation (in particular the forests) that occurred in the XX century. Particularly in the 1970s, there was an irrational exploitation of the forests in the *Zona P'urhépecha* not only by the residents but also by outside interests and industry. Many of the natural forest resources presently end up in development centers outside of the area even today (Morelia, Quiroga, etc). The most common uses for the trees are pine resin (for paint and solvents), material for construction, heating for metal processing, and paper. This leaves local communities with limited forest resources, water scarcity and few alternatives to exploitation as the products have high industrial value. According to a study done by SEMARNAP (2000), it was determined that between the years of 1963 to 1991 some 45% of the forest in the Lake Pátzcuaro valley was removed.

Where erosion and vegetative debris have always been an issue (especially in the lake areas) they have had graver impacts in the last few decades due to removal of forest cover, according to the same study. This is causing eutrophication in the lakes that is resulting in seriously declining fish populations, poor water quality and sedimentation (Alvarez Icaza et al. 1999). Unfortunately, conservation efforts have lagged exploitation and have not been sufficient to balance out the quantity of extraction and continued consequences of previous damage at this time.

In terms of the lake areas, a full 50% of Lake Pátzcuaro (a wealth of resources for the entire lake river valley) is considered in a serious state of degradation and high continued risk having low chlorophyll-a values, high phosphorus concentrations, severe erosion causing high ppm of suspended solids, and the direct influence of agricultural and human wastes-- all accelerating eutrophication at an alarming rate (Alvarez-Icaza et al. 1990). According to the study done by SEMARNAP (2000), the principal causes of the Lake's contamination are due to insufficient and underutilized public works infrastructure, agrochemicals and poor solid waste treatment in adjacent communities. Due to many of the same causes, severe contamination of the rivers and streams in the valley continues.

A great effort is being made to increase awareness of the plight of this area along with others made by local residents (*e.g.,* establishing forest as protected area in Oponguio), government organizations (*e.g.,* SEMARNAP), and NGOs (*e.g.,* EcoMorelia) since the early 1990s. It is my hope that the dissemination of the information in this thesis will help to support this effort along with practical development programs that take conservation into account when creating development plans.

Figure 3-1. Map of Michoacán de Ocampo; Courtesy of Enciclopedia Británica, Inc©.

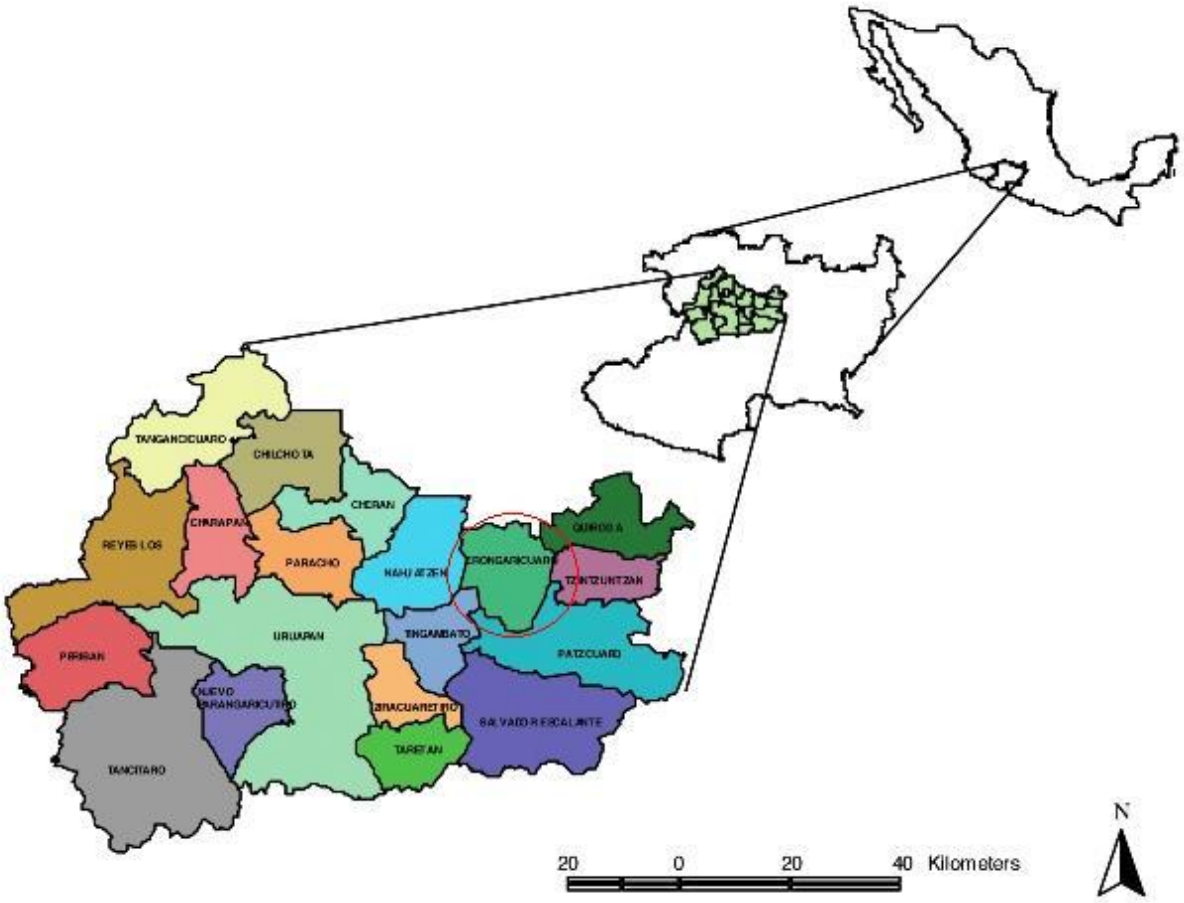

Figure 3-2. Map of the Zona P'urhépecha courtesy of Carlos Villaseñor. A) The study area lies within the municipality, Erongaricuaro, outlined by the red circle.

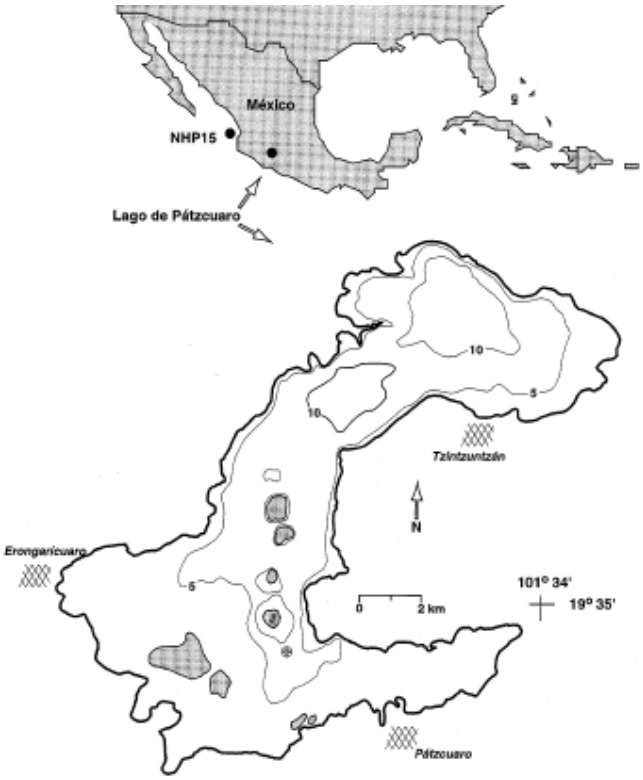

Figure 3- 3. An Index map showing location of Lago de Pátzcuaro. A) 5 and 10 m bathymetric contours are shown; Adapted from Chacón-Torres (1993) and taken from Platt Bradbury (2000).

Figure 3-4. P'urhépecha tools from post-classic to classic periods courtesy of Carlos Villaseñor.

Table 3-1. Examples of P'urhépecha classification nomenclature modified from Barrera Brassols (2003).

Earth or hard matter		
P'urhépecha	*Spanish*	*English*
Echeri	Tierra	Earth
Tzacapu uiramu	Canto	Boulder
Zacapurhu	Piedra	Stone
Tzacapu pupurash	Piedra deleznable	Brittle stone
Charaki	Grava	Gravel
Poksinda	Terrón	Ped (sic.)
Echeri kuatapiti	Tierra suelta	Loose earth
Echeri choperi	Tierra dura	Hard earth
Echeri ietakata	Tierra mixta	Mixed earth
Substances or soft matter		
P'urhépecha	*Spanish*	*English*
Itsi	Agua	Water
Itsírhuky	Jugo	Juice
Tariat	Aire	Air
Terendani	Materia orgánica	Organic matter
Iorhejpiti	Fuerza vitamina	Vitamin nutrient (sic.)
Tsipitícha	Organismo viviente	Living organism
Plants and roots		
P'urhépecha	*Spanish*	*English*
Plantáecha	Planta	Plant
Siringua	Raíz	Root
Siringua sahuápiti	Raíz delgada	Fine root
Siringua tepari	Raíz gruesa	Coarse root
Soil classes		
P'urhépecha	*Spanish*	*English*
Echéricha kurhúnda	Capa	Layer
Echéricha	Todas las clases de tierra	All soil classes
Echeri ietakata	Tierra mixta	Soil mixture
Echeri sahuapiti	Tierra simple o delgada	Simple or shallow soil
Echeri jauámiti	Tierra gruesa o profunda	Deep soil
Echeri jauákurini	Tierra compuesta	Composite soil
Echeri kharíshi	Tierra seca	Dry soil
Echeri ukándeni	Tierra húmeda	Humid soil
Soil function		
P'urhépecha	*Spanish*	*English*
Itsúrhini	Chupar	Water infiltration
Uekándeni	Húmedo	Moist
Jiréjtani	Respirar	To breathe
Apháreni	Sudar	To sweat
Khúhni	Hinchar	To swell

CHAPTER 4
ORCHIDS

Why Conserve Them?

Orchids have morphological characteristics that have led to their presence over a diverse range of microhabitats from the tropics to Patagonia (Arditti, 1992). As they are monocots, there are commonalities in their basic characteristics (i.e. parallel venation, tri-merous flower pattern, etc.). The flowers are frequently bisexual, bilaterally symmetrical with an inferior ovary and have a modified third petal, called the labellum. that makes orchid species distinctive (Fig. 4-1).

There are other adaptive commonalities in orchid plant structure. The foremost is the epiphytic root system, which is characterized by a spongy covering called velamen whose function is to capture and retain sufficient amounts of water to be absorbed internally by the plant's cells. During dry periods, velamen also acts as a barrier against excessive water loss through transpiration, protecting interior cells from ultraviolet radiation (Arditti , 1992).

In many epiphytic orchids, the stalk is highly modified into a structure called a pseudobulb that is also designed for storage and permeated by vascular tissue. Other orchids have rhizomes- although these tend to be terrestrial. A commonality in most orchids is a very long juvenile period (anywhere from two to thirteen years). Flowering is considered the indicator of maturity. Once formed, a mature fruit can hold hundreds of thousands of small seeds, which in the majority of species have a specialized, symbiotic relationship with miccorhizal fungi (Arditti, 1992). The reason for this is that orchid seeds have no endosperm which holds nutrients for the developing embryo. This means that the seeds need outside nourishment, which is provided by the fungi.

Orchids have been prized throughout the world for their beauty, uniqueness, medicinal and culinary value. There is record of orchids as far back as in the *Materia Medica of the Mythical*

Emperor published during the Han dynasty (206 B.C- 220 A.D.) in China. There are also orchids mentioned in several hundred ancient Chinese books on botany and medicine (Arditti 1992). The Aztecs used the vanilla orchid pods frequently in a beverage called *xocolatl*. It is well documented that by the late 1700s, orchids were highly valued throughout the world and were cultivated, collected and traded (especially by Europeans) throughout the world- Africa, Asia, the Americas, etc. They are now understood to have both economic significance and ecological importance (Koopowitz 2001).

Orchids are clearly highly adapted to their environment having very specialized features and interactions. Their exact role in the ecosystems in which they are found is not well understood and has not been the focus of extensive study (Koopowitz 2001); Although, it is understood that their presence indicates a general level of ecological health (Kati et al. 2004). The co-existence implicit in their ecological presence as a comensal species is also indicated by their specific and intimate relationship with many pollinating species, as well as humans (Kearns et al. 1998). There are compelling examples that appear to demonstrate co-evolution (Fig. 4-2) (Dressler 1982).

Orchids have a number of 'purposes' whether it be as indicators of environmental integrity (in terms of their presence in conjunction with general diversity), as a charismatic conservation species, breeding, exotic ornamentals, cultural significance, and/or artistic purposes. The orchids specific to this study are intimately involved in all of these. Because their habitat is forest, conservation is a complex issue (see chapter on P'urhépecha history).

Orchid Culture, Domestic orchids

Orchids, outside of their habitat, are generally grown for ornamental purposes and the unique, often "showy" flowers can bring relatively large amounts of money in the local and world market (Arditti, 1992).

Modern commercial trade of orchids as a valuable commodity appears to have its establishment in the XVIII century through European travelers (merchants, missionaries, etc.) although orchids as ornamentals are mentioned in literature as far back as the XVI century B.C in China (Arditti, 1992). After the XVIII century, they became common features in botanical gardens and valued by private collectors (Koopowitz, 2001).

Orchids were collected in huge numbers (sometimes including the trees that hosted them) to ensure that at least some percentage arrived alive and in breeding condition. This had much to do with the fact that orchids are sensitive and often specific to their environment and therefore the high mortality rate for wild species taken from their natural habitat. Particularly in the 19th century, there was a huge push in the European market for tropical orchids that resulted in the further irrational exploitation of orchids and their habitat (Koopowitz, 2001). It is argued that this, as well as the onset of the industrial revolution and a global economy, is the reason that rare orchid populations are believed to have sustained great damage as well as many forest ecosystems of which orchids were, historically, a natural part (Koopowitz 2001).

Currently, the global market for orchids is very strong. Commercial orchids are generally hybrids that have been developed to have more fragrant and showier flowers, are easier to grow and maintain and can be more easily produced. Rare, wild orchids have a much smaller market niche but bring in larger amounts of money-- sometimes simply based on their endangered or rare status. According to an article published in the Gainesville Florida Sun newspaper in 2004, in the U.S. more than 16 million orchids were sold in 2003, generating more than $121 million in retail monies. It is considered the fastest growing sector of the horticultural market. In some areas of the world, wild orchids have a market niche based on local traditions (i.e.Día de los Muertos) or ornamental value due to beauty, uniqueness and endemism (Yellow Lady's Slipper).

In the markets in South-central Mexico, certain orchid flowers can bring in anywhere from 100 to 400 pesos -- between what would be a typical day's wage and up to a typical week's wage.

Conservation of their habitat (*in situ*) as an important method for maintaining orchid diversity is well known- especially since there are so many that are very difficult to culture and maintain in non-native environments. When it comes to species that are considered 'exotic', it is a necessary form of assuring the longevity of even the hybrids that result from a wild origin. Generally, the features favored by orchid growers are not suitable for survival in the wild (larger flowers, fragrance, colors and patterns that would not appeal to the pollinators a native species has developed for over time). Hybrids are also susceptible to viruses that wild orchids are not. As such, it is important to maintain wild species diversity in order to have a broad and diverse genetic base from which to draw.

As in any breeding practice, it is necessary to offset the consequences of inbreeding. Crossbreeding with wild species to encourage hybrid vigor is a common solution. Wild orchid species are ideal because they can also introduce favorable secondary characteristics into the genetic line (*e.g.,* decreased time to flower, disease resistance, greater tolerance of artificial cultivation conditions, etc). Because of the aforementioned specificity of orchid morphology, line breeding is often employed (otherwise, the favored characteristics would be quickly lost from one generation to the next).

Also, just as there are changes in fashion (whether it be furniture, clothing, etc), there are also changes in ornamental flower style. Sometimes this is fostered by market competition- the drive to have a better "product," a more unique creation or simply a more appealing one. This requires the introduction of wild genes, from time to time, in order to subtly or dramatically influence the characteristics that have become "common," shorten flowering time, and heighten

adaptability, among others. Orchid breeding is a complex and fascinating process, in which hybrid breeders depend heavily on hybrids' native cousins.

"I believe that it is a vitally important…that breeders have a ready access to new germ plasm. But with this also comes the responsibility to protect our [wild] sources and that means effective conservation in the wild." Harold Koopowitz, *Orchids and their conservation (2001).*

Endemic Orchids: *Euchile citrina* and *Laelia autumnalis*

The two species favored in this study are *Euchile citrina* and *Laelia autumnalis*. Both species are endemic to México and have significant economic and cultural value.

Euchile citrina

Euchile citrina is epiphytic with smaller, egg shaped pseudobulbs that tend to range from 4-6 cm in length, 2-3 cm wide (Fig. 4-3). They are commonly covered by a persistent papery sheath that should not be removed. The leaves are a silvery-green and number 2-4 per pseudobulb. They are elliptical in shape and tend to range from 18-25 cm in length and 2-4 cm wide. The foliage has a fine, powdery coating over the leaves. The flowers are generally found in inflorescence of 6-10 cm in length. One or two large, hanging flowers are generally found on each stalk. The blooms are pale yellow to deep yellow (or even almost orange) having fleshy sepals. Petals are elliptical, being 5-6.5 cm in length, 1.5-2 cm wide with a labellum more or less of the same length and ruffled with darker veins that can have varying amounts of white at the tip. Plants may be upright or pendant, but the flowers are always pendant. The flowers release a strong lemony fragrance, which lead to the common name "Limoncito" in Michoacán. They bloom from late winter to spring in the dry oak-pine forests found between 1300-2600m in South-Central México.

Laelia autumnalis

Within the genus *Laelia*, there is a great deal of variation. This variation can even be seen in the species themselves which can vary quite a bit from population to population (Harbinger and Soto 1997). *Laelia autumnalis* can be described generally as an epiphytic orchid, with a dark green and oblong pseudobulb, about 15 cm long and 3 cm wide (Fig. 4-4). Like many psuedobulbs, it is hard and fibrous with the same papery sheath mentioned in *Euchile citrine*. There are generally 1-3 leaves present which are dark green and can be tinged with purple. It has an erect flower stalk with 5 to 12 flowers alternating on bracts and can be as long as a meter (Harbinger and Soto 1997). Flowers can be anywhere from a very light lilac to a rich magenta generally having a yellow stripe on the labellum. The fragrance varies greatly and it is said that the fragrance it stronger if it is exposed to more sunlight (Harbinger and Soto 1997). It flowers during fall, from September to November. This Laelia is typical of the Mexican highlands, generally being found between 1800-2700 meters.

Cultural Significance

Day of the Dead

Laelia autumnalis is used in the altars for the *Día de los Muertos* (Day of the Dead), a ceremony which has been altered through the centuries and varies from location to location (Fig 3-5, 3-6). In Prehispanic Mexico, the general purpose of the Day of the Dead was to celebrate death and, at the same time (paradoxically), the continuity of life.

The original celebration goes back to the festivities held during the Aztec month of *Miccailhuitontli*, ritually presided over by the goddess *Mictecacihuatl* ("Lady of the Dead"), dedicated to children and the dead (Salvador 2003). In the Aztec calendar, this ritual fell roughly at the end of the month of July and the beginning of August. However, in the post conquest era Catholic priests made it coincide with the “All Hallows Eve” likely to further their effort in

converting the native people to Catholicism. The result is that Mexicans currently celebrate the day of the dead during the first two days of November.

The simplest description of the celebration is that families celebrate departed relatives. Some families celebrate the passing of a departed family member one year after their passing and some families celebrate the passing of a dear relative every year for several years. The following description of the altars by Jaime Stransky (1996) is very apt:

"Gravesites or family altars are profusely decorated with flowers (primarily large, bright flowers such as marigolds and chrysanthemums and [the orchid] Laelia autumnalis, and adorned with religious amulets and sometimes with offerings of food, cigarettes and alcoholic beverages." (The latter mentioned items being favorites of the honored relative). Elaborate Catrines (skeletal figurines) are also considered a representative craft that can be seen during the year and sometimes adorning day of the dead celebrations as well as colorful skull confections made from white sugar and paper cut-outs of skulls and skeletons (Fig. 4-5 and 4-6).

The Day of the Dead can range from a very important cultural event, with definite social and economic responsibilities for participants (exhibiting what social anthropologists would term "socially equalizing behavior", for example in the community of El Espiritu near Lake Pátzcuaro) consisting of food, flowers and favorite items of the late relatives, to a religious observance featuring actual worship of the dead (*e.g.*, Cuilapan and Oaxaca), to simply a uniquely Mexican holiday characterized by special foods and confections (*e.g.,* Mexico D.F., Morelia). There is also the tourist element that plays a role in places like the Island of Janitzio, famous for its celebration, in the middle of Lake Pátzcuaro. People from all over México and the world come to see how the Day of the Dead is celebrated there every November.

Economically speaking, its import is due to the tourist value (input) of the holiday and community involvement (expenditure). Because of this, its observance is considered of greater social importance in southern Mexico than in the northern part of the country due to a more dilute indigenous cultural influence (Stransky 1996). It also means a greater importance of Laelia autumnalis in south-central Mexico, which is intimately associated with the flowers. There is a notable impact on wild populations as they are generally collected from the wild and placed on altars or sold in the public markets, in quantity, during this time. It is understood that the more urban the setting the less religious and cultural importance appears to be preserved by observers. It can also be said that the more rural (and indigenous) the locality, the greater the religious and economic significance of most celebrations.

On the island of Janitzio, (located within a few kilometers of the study area), the celebration is elaborate, especially with flower decorations of the many altars.

Pasta de Caña de Maíz

The use of pseudobulbs in making an adhesive compound (gum) is another cultural use of orchids. The P'urhepecha use the word *tatzingui* to describe the adhesive gum, which has been used in making pasta de caña de maíz and other activities during pre-Colombian, colonial times and even into the present day. It has also been used all over Mexico as the adhesive for feather mosaics (called *tzauhtli* by the Aztecs) and tempera paintings (González Tirado 2004).

The reason for its adhesive quality is that pseudo-bulbs, among other things, are the storage area for nutrients taken into the plant. These nutrients are stored in the form of polysaccharides. This can be made into a vegetable gum and then converted into a powder. This is how it was sold in the pre-Colombian markets by the Aztecs and perhaps others (González Tirado 2004). Otherwise, raw cellulose and starch are insoluble in water although starch will suspend in water to form a paste when heated. The percentage of starch in pseudo-bulbs is low-

approximately 7% (Arditti 1992). The fiber content can be considerable, however, depending on the species. When cooked, it generally produces more of a paste or putty rather than a gum (González Tirado 2004).

It is documented in the *Florentine codex* that *tatzingui* was used by the Aztecs as an adhesive in paper-making (González Tirado 2004). It is theorized that it might also have been employed in the creation of three-dimensional paper figures, which have been found in burial offerings in the *Templo Mayor* of Tenochtitlan (González Tirado 2004).

It is also known to be an important ingredient in an additional prehispanic art form known as *Pasta de Caña de Maíz* (Fig. 4-7). The product of *pasta de caña de maíz* (or *pasta de caña*) is a lightweight sculpture made of multiple of ingredients including corn paste (as its name describes) and the orchid adhesive compound, among other ingredients. Many Mesoamerican tribes believed that the presence of effigies on the battlefield served to increase the warriors' power and likelihood of victory (Stransky 1996). In general, the sculptures were believed to have been made largely of metal and wood. The P'urhépecha, however, used *pasta de caña* as a lightweight, practical and durable way to take images of their gods into battle. During the conquest, the procedure was used to create Catholic effigies.

It is believed that many of the statues made of *pasta de caña* that are currently in the churches (especially in the Zona P'urhépecha) are originals from the XVI century. In fact, according to an *informe* created by the state of Michoacán, la Virgen de la Salud, (patron Saint of the region) who resides in the church associated with the hospital in Santa Fe de la Laguna, near Lake Pátzcuaro, is an example of this (Fig. 4-8).

There is documentation that Don Vasco de Quiroga's development plan in this area involved Pátzcuaro as a center for the *pasta de caña* process during colonialization (Stransky

1996). And it is a process that is still practiced there. In fact there is an organization, the Latin American Design Foundation that is dedicated to its preservation as a traditional art form and has developed a program of employment for local women interested in preserving the technique since 2002.

Referring back to the chapter on P'urhépecha history, all of this (history, beauty, hybrid potential) of course, lends itself not only to local tradition and attraction of tourists to the area but it also has enormous implications for marketing the orchids produced with commercialization in mind. Tourism is becoming more and more a solid part of the area's economy and livelihood system (*Mexican Secretaría de Turismo*). This has broad implications in terms of other fountains of employment that spring out of the arrival of people from the "outside." Currently, tourism is national as well as international so that there is a broad spectrum of possibilities for the commercialization of the orchids and other plants that would have a solid national market with international potential.

Propagation Techniques

In order to breed orchids, the stock must be cultivated or collected from wild populations. Historically, the demand for orchids is greater than their natural capacity to reproduce so that humans have developed ways to propagate them in greater numbers. There are many forms of propagation. There are also many variations on general propagation methods. Two basic and well studied techniques will be briefly discussed and in general terms.

Ex situ

Many of the seminal breakthroughs in orchid seed propagation (including recognition of their mycorrhizal relationship) were discovered mainly in the first half of the XIX century (Arditti, 1992). Seeds were unknown to botanists until the mid XVIII century (Koopowitz, 2001). As mentioned previously, orchid seeds (unlike most other plants) do not contain an

endosperm. It is believed that the reason for this is that they are very tiny (sometimes microscopic) and are wind dispersed. This adds greatly to the complexity and difficulty in growing orchids from seed as they require outside help in obtaining necessary nutrients for gestation to occur. While many plants benefit from mycorrhizal fungi in the ground; orchids depend on them to provide necessary nutrients for seed germination. Most orchids have an intimate relationship with specific, local mycorrhizal fungi. The mycorrhizal relationship is a complex and individual association that appears to be largely environmentally contextual and therefore difficult to easily replicate outside of the natural environment.

This indirectly provoked the study of asymbiotic propagation (without mycorrhizal fungi). Asymbiotic seed propagation of orchids is still a common propagation tool and is useful in *ex-situ* conservation as a way of maintaining more diverse gene pools present in wild populations. Just like any breeding outside of natural population breeding *in situ*, it would be a process of crossbreeding individuals and/or sampling seeds from wild populations. This process requires growth medium as well as specific light and temperature conditions. The growth medium contains the necessary nutrients for seed development as the mycorrhizae are not present to provide them.

Another common propagation method is tissue culture. Tissue culture involves taking a piece of the green plant and placing it in a growth medium where the cells multiply and a complete individual plant is created *in vitro* (Arditti, 1992). It is believed that clonal propagation of orchids through tissue culture was developed by a graduate student of Botany in the first half of the 20th century (Arditti 1992). Individuals created by tissue culture are considered clones, which for commercial purposes is not necessarily problematic but for conservation purposes can be disastrous due to limited genetic variation unless certain precautions are taken. In order to

ensure variation, a range of individuals from a population can be cloned then crossed with one another. The seeds that are generated from these crossings have more genetic variability and their seed offspring can be reintroduced back into the natural habitat. This is similar to the process used in asymbiotic orchid culture. However, the tissue must be collected from wild populations or from individuals propagated from seed from the wild populations to ensure the population gene pool is conserved to allow for natural selection. It can also be useful with plants that have fallen from their host tree (ECOSUR 2002). Collection, however, can be complicated if orchids are scarce, threatened or endangered as environmental laws may limit their sampling or availability.

In situ

Conservation *in situ* as an important method for maintaining biodiversity (as more species means higher biodiversity) is well known. It has even been argued that the consummate way to conserve orchids is in their natural habitat. This ensures survival and flexibility through the ecological and biological mechanisms that have allowed orchids to maintain great diversity in a variety of areas across the globe. Their long-term presence for future research and thus (among others) a greater understanding of species' interactions and population dynamics as orchids are very complex, unique and, in these spheres, invaluable.

An (albeit arguable) element of conservation, is the presentation of charismatic species in order to give ecosystem conservation greater impact. Charismatic species have historically given humans a point of reference and impetus to more carefully manage ecosystems (Kotoleon and Swanson 2003). Essentially, these charismatic species give a "face" to the urgency of conservation issues. As is historically apparent, forest conservation becomes a very complicated issue due to socio-economic and political dynamics that cause decision-making to be problematic and frequently environmentally unfriendly. However, as deforestation has been directly linked

to humans' greatest current environmental woes (desertification, water cycling and global climate change to name a few) it would be a reasonable "side benefit" to conserving orchid habitat. Orchids are, due to their ornamental, environmental, botanical and commercial value a species with the kind of charisma and intrigue that make them appropriate for this role.

Orchids as NTFPs

This study looks at the possibility for a rural community in Michoacán, México to link some aspect of community development with conservation. Orchids are a perfect bridge between conservation and development as they have a stable local and international market as well as being threatened species intimately connected to their local forest habitat.

Conservation *in situ* requires a commitment to conserve not only the orchids but their forest habitat, as well. Conveniently, the community participating in the study has already set aside over 100 ha of well conserved, diverse secondary growth forest as a protected area. The species composition is consistent with oak dry forest-- natural orchid habitat. This greatly increases the likelihood of developmental success for this program. However, it is important not to overlook the importance of protection and law enforcement that requires effort and organization on the part of the participants and community members as well as the municipal government for which there is some local infrastructural support (refer to Oponguio chapter).

Non-timber forest products (NTFPs) are becoming a clear instrument in poverty and environmental pressure alleviation in rural communities all over the world. According to a compilation of studies across Mexico and Bolivia edited by Marshall et al. (2006), it was determined that NTFPs make up between 7 and 95% of a household's annual discretionary cash, act as a buffer for economic hardship (particularly when the main cash generating activity is no longer reliable) and can serve as a means for poverty alleviation. In fact, they go as far as to say, "…and never lead to an increase in poverty." Marshall et al. also found that NTFPs serve as a

form of empowerment for community members, particularly women as women tend to be the most involved in processing and cultivation. They also found that these NTFP related activities encouraged labor sharing (versus gender disaggregation) at the household level as labor sharing greatly increases the likelihood of economic viability and return for these activities. While they did not find that involvement in NTFP production/utilization inherently lead to reduced rights for collection of wild individuals, they did find that communally owned resources saw improved harvest and management practices.

According to Shackleton et al. (2007) there are several reasons why natural product commercialization is a favorable addition to livelihood strategies across the globe (assuming it is not a normal part of the local livelihood strategy):

> "[By] providing additional options for income generation in the context of few opportunities, allowing households to diversify and supplement their income base, providing a safety net for those facing shock and hardship, reducing reliance on other safety nets such as inter household transfers and state welfare, and generating extra cash for things like school, etc."

There is a notable example in Chiapas of a successful conservation and cultivation program started in the Soconusco region using the methodology, *El Cultivo Rústico y Sustentable de Orquídeas Nativas en el Soconusco* (1999) (Fig. 4-9). The program was initially developed by a doctoral candidate at the *Colegio de la Frontera Sur* (ECOSUR). It was designed to offer training and long-term advisement for plant growers, specifically coffee producers interested in cultivating and conserving native orchids and diversifying their livelihood strategies. The objectives were to:

- Conserve the existing wild orchid populations in the Soconusco region

- Restore the populations in protected areas and in forest fragments in the area
- Educate the local people in sustainability and more efficient use of natural resources
- Offer a viable economic alternative for the local people in the region

The program began in 1999 and persists to the present day, boasting the participation of 45 producers in 7 communities in *La Reserva El Triunfo* (Damon et al. 2005). According to Damon et al. (2005), the program has successfully achieved cultivation of numerous native orchids. A few government organizations have granted some financial support (Fundación Produce [NGO], SEMARNAT and CONANPO), but she reports that it has not been sufficient to cover all of the expenses incurred by the many tasks associated with the initiation (initial propagation) of such an extensive program that requires long-term monitoring and due to intense external pressures and severe poverty, also requires infrastructural support (see External pressures chapter).

While the expectation of ECOSUR was that all coffee producers would participate, some stopped due to the inordinately long juvenile periods of several of the orchids. There was also the barrier of the general distrust of diversification strategies due to innumerable and devastating past failures. She reports, however, that all 45 of those who maintained participation have achieved positive results. The limit in interest may be related to the orchids as only a commercial product having limited cultural value and market access in this community making it necessary to create a market niches and innovative products.

Damon (2005) does say that the main goal was conservation and the secondary goal was commercialization:

"While the goal of cultivation is important to keep in mind, the most important aspect of these programs is the environmental education that starts a shift in perception which leads to

greater awareness. Since certain commercial products like orchids maintain their value due to uniqueness and rarity, it is not necessarily a failure that not all growers in the ECOSUR study participated until the end. This supports the commercial orchid business but not flooding the market and assuring that these native orchids are conserved in their natural habitat- as well as the protection of their very important habitat."

The method is practical and ideal for rural environments as it requires very little inputs and the inputs that are required can be easily found locally. In the case of the aforementioned project, parts of the plants can also be used to make products for sale. It is also possible to sell the immature plants in "slants" (tubes with growth medium and an explanation of how to grow the orchid plant) as a market product. The plants are grown *in vitro* in a laboratory (until they can be more easily cultivated in the field) and brought to the community once they are sufficiently developed to grow on their own. This makes university involvement key in the ECOSUR project as well as the proposed project in Oponguio, Michoacán.

Pieces of oak bark can be used as substrate for acclimatization of the cultivated plants in shade houses that can be communal or individual (dependent on community preference) before being sold or before being reestablished in their habitat. Oaks (*Quercus spp.*) are the preferred host species for *L. autumnalis* and *E. citrina* so that pieces of their bark and branches are an ideal substrate prior to sale or reestablishment. These pieces of oak are taken from fallen branches or pieces from sustainably logged trees (or *aclareo*). This is already practiced in the study community.

In terms of orchid conservation, once the cultivators have established a solid base of plants, a certain percentage can be reestablished into the habitat. Due to the orchids' economic value, it is important to focus on establishing the cultivators before conserving through

reestablishment or the reestablished plants run a much higher risk of illicit extraction. In the case of Oponguio's reserve area, there is already a system of protection in place. These factors combined with establishing a solid cultivation activity increase the likelihood of the success of both the cultivation and conservation endeavors. The two goals also reinforce one another.

In spite of the differences and complications associated with the orchid commercialization project in Chiapas, there are positive implications for this research project as the local people in the study area of Oponguio, Michoacán have already set aside 100 ha of forest as protected area for conservation. They have greater market access. The orchids chosen for commercialization were intentionally chosen due to their cultural and local market value. The people of Oponguio have been interested in conserving the plants for some time and have the support of the local university (University of Michoacán) to pursue the project if they decide to. First, however, due to limited resources it was necessary to determine the project's viability and for whom.

This kind of cultivation has broader implications as there are many endemic orchids to Mexico (as well as all of Latin America) which could be grown and commercialized as a livelihood in conjunction with conservation efforts. As there are special cultural attributes (*artesanía*) for given areas, there are plants that are also associated with those same areas. The orchids have real potential to become signature of the places in which they are commercialized. They would then be an attraction as well as a way to maintain them, as their presence is instrumental in their value.

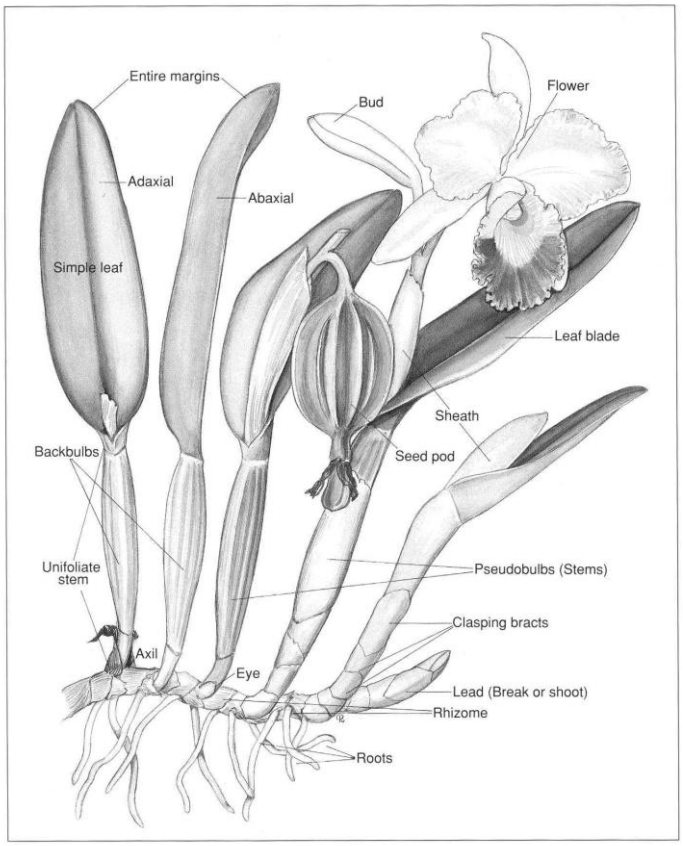

Figure 26. A typical orchid plant (*Cattleya*).

Figure 4-1. Illustrated orchid diagram taken from Sheehan and Sheehan(1994) An Illustrated Survey of Orchid Genera. p.383

Figure 4-2. The Bee Orchid (*Ophrys apifera*)and the Orchid Bee (*Euglossini sp.*); Courtesy of the BBC (online resource).

Figure 4-3. *Euchile citrine* courtesy of Jesús Moreno.

Figure 4-4. *Laelia autmnalis* courtesy of AMO (online resource).

Figure 4-5. Altar decorated for the day of the dead in Janitzio (left); Courtesy of Inside Mexico (onlineresource)

Figure 4-6. A *Catrina* created in Capula, Michoacán 2007; Courtesy of the author.

Figure 4-7. Pasta de caña de maize as practiced today; Courtesy of CREFAL.

Figure 4-8. Burial place of Don Vasco de Quiroga, Basilica de la Virgen de la Salud; Courtesy of the State of Michoacán (online reference).

Figure 4-9. A shade house for Rustic Cultivation in Chiapas; Courtesy of A. Damon (2005).

CHAPTER 5
EXTERNAL INFLUENCES AND PRESSURES

Globalization is the process of networking national economies into an international market system. This process has taken an interesting direction, particularly since the development of neoclassical economic theory. In attempting to standardize the market system with the outcome of balanced participation, the result is an economic homogenization (with a focus on industry and large corporations) that has manifested itself at the local level as greater socio-economic disparity and resource degradation in much of the world.

This outcome is likely related to the disconnect between scientific principles of material and energy related to production and the focus on greater profits and market value. Production is a physical process that relies on a series of activities that requires energy to transform a raw resource into a refined or "productive" one- even in the case of natural products. Christensen (1989) makes a very compelling argument that somewhere between the classic economic theorists and the neoclassic theorists, economic theory began to ignore the material origin of products and the laws of thermodynamics. The integration of basic physical principles of material and energy were apparently present in pre-classical, physiocratic and early XVI century classical economics but absent in modern theory (Christensen 1989). Interestingly, pre-classical and physiocratic economic theorists integrated thermodynamic principles even before they were formulated in the 1840s . To elaborate a bit with an example from Christensen (1989):

"The physiocrats, for example, regarded the land as *productive* because it yielded a surplus of output about the material input advanced at the beginning of production: one livre of seed planted yielded five livres of output. Artisan activities, by contrast, were *transformations* of raw materials. Industry buys raw materials from agriculture [or nature] in order to work them up.

Manufacturing gives raw materials form, but adds nothing to them materially [in a physical sense- the compositional elements].

A similar distinction was made by classical writers. Malthus (1815, 1836) argues that only "the machinery of the land could produce food and raw materials. This was something that no industrial machine could do."

However Christensen (1989) points out that, in the transition from classical to neoclassical economic theory, the material origins of the products themselves were ignored while the application of theory focused on the process of transforming the materials. In other words, neoclassical economic theory took the classical theory's omission in specifying the material and energy resources moving through the "productive system" and extended it into the manufacturing process and origin of "capital stock" which is fundamental to the current economic system as units of material worth that can be invested in at a fixed point in time, in monetary units. This converts worth into a concept of investment in a firm versus the worth of the materials and their origin. Removing the material origins further translates into a failure to take environmental services provided by natural resources into account when determining the value of a market product.

The assumptions that are made in defining the "marginal productivity" of an input according to neoclassic economic theory are very much at odds with the basic physical principles governing material and energy transformations (Christensen 1989; Ayres 1978; Georescu-Roegen 1971). Marginal productivity makes the assumption that the output above the input cost is based solely on the market value of the inputs, again not taking into account the socio-ecological costs and benefits. This is even further reflected in the concept of "diminishing marginal returns". The marginal product of one input is assumed to fall as long as some other

input to production does not change but the market is constantly changing and the nature of finite resources as finite must be taken into account unless the long term accessibility of the raw material is assured in the process. The value cannot be determined responsibly if the input and output cost/benefit analysis excludes opportunity costs of the depletion of the raw materials at their point of origin. That is to say, the value is then determined without taking into consideration the long term existence of such resources and their value as existent sinks of possible products and services in the present and in the future- thus arriving at only a partial present value of the product.

These external political and economic pressures have a great impact on community development and livelihood development both in urban and rural areas, something particularly true in a world with a globalized economy and foreign interests which depend on the national and regional infrastructure. Infrastructure, in socio-economic terms, is represented by the structural elements that allow for production of goods and services without being part of the production process- the avenues for product transport (roads, railroad, airports, etc.), markets for finished products, etc. In socio-political terms, it refers to many aspects of a nation's overall framework of support to provide for its people, for example public works, political structure, social programs, education, etc. Clearly these two kinds of infrastructure overlap in many areas and are dependent on one another to function optimally.

The institutional fabric that underlies these production systems that underpin the socio-political structures (i.e. government and non-government agencies, laws and their enforcement, regulations, subsidies, capacity building, information dissemination, etc.) is very important to highlight in this process. It is this fabric that is both the result and the perpetuator of the disconnect between value assessment and market value that creates such a gap between rural

communities and particularly rural poor and these institutions. The result is limited access to markets and few, if any, input provisions which in turn result in lower economic resilience and higher levels of poverty.

A Brief Examination of External Pressures

Symptomatic of the disconnect, environmental deterioration (particularly in rural areas) is a consequence of greater numbers of people looking to fragile ecosystems and poor ecosystem management practices for subsistence. There is also an historic trend of community dissolution and reorganization caused by outside, systemic pressures which result in the loss of traditional knowledge, successful long term resource management and culture (Ramirez 2007; Henrich 1997; Toledo and Argueta 1990) particularly where infrastructure is weak. As infrastructure is central to management of resources, governments (whether they be local or national) are relied upon to provide infrastructure supporting institutions to aid in the integration or reintegration of marginalized communities or groups into the socio-economic system. Private sector support it usually limited and specialized in investment scope. When governments do not or cannot support efforts to reintegrate rural communities into the economy, there are limited private sector initiatives to invest in rural communities thus leaving rural people further from the market. This is largely due to rural communities being considered poor investments as a result of their limited production potential per capita and limited market access. Because of these limitations, there is a dependence on support in the form of subsidies, loans, capacity building programs and regulation. Many developing countries turn to market liberalization and international investments to satisfy these needs and with the goal of building a stronger economy.

Market liberalization and trade, in theory, give all producers the opportunity to participate in the market system, whether it be through local production or international trade. However, in practice, it is apparent that economic growth does not ensure poverty alleviation.

According to Kuyvenhoven (2004),

"Most developing countries have implemented a wide array of market liberalization and trade policy reforms in recent decades as part of structural readjustment programs…but there has been little progress in dismantling the repressive restrictions imposed by rich countries on access to their own agricultural [and other] markets…Removal of input subsidies and public marketing agencies has opened up new opportunities for the private sector, but which have often been curtailed by inadequate public investment in key infrastructures like roads and communications and by weak market regulation and support services."

NAFTA and Immigration

NAFTA, the North American Free Trade Agreement, is a clear example of the trend that has been perpetuated as a result of the disconnect and the immense difficulties that arise from creating development programs without taking socio-economic and environmental implications of market behavior into account. Apart from having been implemented recently (in the last twenty years), it is also a piece in the myriad of political and economic influences that affect the very fabric of development in terms of sociopolitical and economic infrastructure. It will be briefly discussed in the context of its overall impact on the Mexican economy and its implications for development and environmental impact as a direct result of trade and foreign investment.

Among the stated aims of NAFTA was the goal of stimulating Mexico's struggling economy. The peso had been devalued in order to reduce Mexico's inflation and NAFTA was to be a major force in generating employment for the large percentage of Mexico's impoverished population (Hufbauer and Schott 2005; Weintraub 2004; Faux 2003; Cameron and Tomlin 2000). In practice, what it failed to do was aid in the elaboration of infrastructure to ensure maximum benefit for all parties involved, focusing solely on the industrial private sector. The

agreement only extended protection to corporate interests in that trade was liberalized but mainly benefited large industry (Table 5-1) (IDS 2006; Tornell and Esquivel 1997;Husted and Logsdon 1997; Esquivel and López 2003).

Mexico is privy by its very physical location to have direct access to U.S. borders and, therefore, the U.S. Market. This created a focus on Northern Mexican development and upper and upper-middle class professionals at the expense of the southern agricultural producers and rural indigenous people (Hufbauer and Schott 2005; Weintraub 2004; Faux 2003; Wiggins et al. 2002; Cameron and Tomlin 2000).

One of the promises made by the Mexican government was that as tariffs on US agricultural products went down, subsidies and technical assistance would be prioritized for small farms so that they could augment productivity and increase quality in order to effectively compete (Faux 2003). However, according to Faux (2003), farm program funding dropped from 2 billion dollars a year to 500 thousand between 1994 and 2000 while subsidies for US farmers exporting to México were increased over that time period. To further exacerbate the issue, there was limited employment in nearby urban areas. The subsidy cuts were a result of de-prioritizing rural infrastructure in response to structural readjustments that focused on industrial development due to its greater initial economic growth potential. For example, according to Faux (2003), economic stimulation was almost exclusively on the border that Mexico shares with the United States in *maquiladoras* (assembly factories) and between the years of 1994 and 2000 *maquiladora* employment doubled while employment growth was stagnating elsewhere. Added to this, one must look at the privatization of Banks and other investment services resulting in an opening here, as well, for foreign investment.

Wiggins et al. (2002) outline a pertinent synopsis of critics of the agricultural reform that was a result of trade liberalization started in the late 1980s (including NAFTA), part of which is pertinent here:

"A free market does not necessarily deliver social justice. If the distribution of income and assets that determines the market power is skewed and unjust-- and Mexico's home distribution is notably unequal – then the market outcome cannot be socially optimal (unless government intervenes). *The buying power of the rich few will dictate what is produced, rather than the needs of the many poor*…Liberalization amounts to globalization with a marked bias to capital. The economic liberalism of the Salinas administration integrated Mexico within the world economy, thereby exposing the peasantry to the cold winds of global competition. If market forces work against organized labour in industrial societies such as the USA, then they are likely to be equally if not more destructive when operating in rural Mexico."

The removal of subsidies is not by itself problematic inasmuch as doing so when crucial input activities are the object of subsidy. Kuyvenhoven (2004) provides a good example in the removal of pesticide subsidies in Indonesia. Because the subsidy removal was offset by integrated pest management techniques, the input costs were lowered over the long term and agriculture production and producers benefited both in the short term and in the long term. However, Kuyenhoven (2004) is careful to clarify that removal of input subsidies that are the difference between productive farming practices and poverty and environmental degradation as illustrated by following the example given from Africa. Because of reduced fertilizer subsidies on small farms and areas of low productive potential, there is a marked increase in soil nutrient mining, lower yields and thus lower future yields in an environment where subsistence is already tenuous and environmental degradation and poverty are reaching frightening levels.

NAFTA ultimately plays a definitive role in the kind of external pressure that forces dispersion- rather like bearing down on a box full of ball bearings. Eventually, the pressure forces the ball bearings from a high entropy state to a state of lower entropy- although in this case, the pressure is not physical so much as socio-political and economic. In this instance, a lower entropy state translates into a dispersion more commonly known as emmigration. A significant indicator of this imbalanced policy and the result of overlooking the importance of rural infrastructure specific to NAFTA are the hundreds of thousands of Mexican immigrants' crossing into the United States every year. These numbers have increased steadily over the last twenty years (USINS 2003) meaning that the economic stimulation promised by NAFTA did not stimulate employment growth as was anticipated and therefore did not benefit over all development or economic stability in Mexico (Weintraub 2004; Cameron and Tomlin 2000; Esquivel and Rodriguez-Lopez 2003; Krueger 1999; Husted and Logsdon 1997).

According to the U.S. Immigration and Naturalization service (USINS) 2003, from 1991-2001 Mexico accounted for 24.7 % of all legal immigrants coming into the U.S. It is estimated that during that time they made up as many as 55% of all illegal immigrants coming into the U.S. (USINS 1999). This contrasts starkly with the next highest group of immigrants during that time, El Salvador, registering around 7%. Michoacán, Mexico is considered in the top five states for highest emigration to the United States in the country.

To give some historical context, Mexico (before 1970) made up a small percentage of immigrants to the U.S. during the latter half of the XIX century and beginning of the XX century when the largest number of immigrants (legal and illegal) were coming from Europe. In fact, Mexican immigration until the 1990's was seasonal and impermanent. This seasonal migration was a product of the *Brasero* program implemented after WWII.

The relatively recent spike in immigration is believed to be a result of the disparate economic growth stimulated by NAFTA, poor infrastructure and other inadequate Government policies. The labor and lower-level jobs that were expected to have been created by NAFTA never materialized, pressuring rural and urban poor to look for employment wherever it was available. The devaluation of the peso served to exacerbate this and the immigration vectors that had been established during seasonal *Brasero* labor in the U.S .became means for encountering permanent employment (partially due to stricter immigration law enforcement making crossing the border a higher risk and more costly). The exchange rate between the devalued peso and the U.S. dollar (the strongest world currency at the time), created further incentive for job-seeking across the border. The U.S.'s job market was flourishing while Mexico was in a recession. Remittances became a major source of income to Mexican communities at this time, in the mid 1990s. Although it is projected that remittances will drop steadily as US immigration reform tightens, the U.S. economy weakens and with the drastic drop in population growth in Mexico- from 6.1 children per female in 1974 to 2.4 children in 1999 (Bean and Lowell 2004; CONAPO 1999).

The labor surplus and economic need in rural Mexico have opened the door to an exodus in the last several decades to seek work outside of rural communities. This has heavily impacted Michoacán so that community fragmentation has been an enormous obstacle to rural development. There are various communities where women, children and the elderly stay behind while the working age males seek work elsewhere in larger urban centers or even outside of the country. The general study area of the Pátzcuaro basin has shown diverse impacts as each community is impacted with varying degrees of severity. Some communities have lost the vast majority of their working age males, while others still eke out a living through services, trade,

agriculture and remittances. The particular community that participated in this analysis has been impacted, certainly, by the aforementioned factors however, the community is struggling to maintain a local economy in order to keep community members at home (refer to Oponguio chapter).

Remittances

Remittances are considered to play a vital role in the Mexico's economy and certainly remain a buffer for many low income families when income generating activities are scarce and/or limited. While the monthly amount is often not enough to support the entire household, it is enough to supplement the household income when cash is scarce raising the income status of the household. Remittances are helpful in the temporary improvement of living conditions in households that receive them (Acosta et al. 2008). Remittances can make a difference in the development and evolution of household livelihood strategies (Ruiz 2004) if the quantity and frequency facilitate participation in a particular activity. There are isolated examples of migrants organizing remittances for community betterment (Ruiz 2004). A recent study by Acosta et al. (2008) found that, while remittances raised the household income and therefore lowered the poverty level, it was not as significant as the monetary figures of income flow would suggest in poverty alleviation, in general (Acosta et al. 2008; Taylor 1999). It is also interesting to note that remittances are slowing substantially both to Mexico (a significant drop of 6.8%) and Brazil which are the two largest remittance providers in Latin America, according to a report by the Multilateral Investment Fund in 2007 (Fig. 5-2). These are the largest drops to have been reported in the last thirteen years. This is related to the current U.S. economic downturn and economists are speculating that this will result even greater emigration to the U.S. as remittance dependent families seek income unavailable to them in their communities and cities (Roig-Franzia 2008, Washington Post).

Remittances, although individually they are relatively small quantities per month, are considered to be the second highest source of income for many communities with high emigration rates, in Mexico. In the study community of Oponguio, remittances have been instrumental in some family economic development (for example the creation of one of the restaurants in the community). They are not a widespread or generally consistent augmentation of discretionary household income for many families. There are families that receive sporadic remittances but few that receive consistent remittances to make them part of the livelihood strategy. This has great potential to change if the labor surplus continues to grow without alternatives within the community or even the study area for income generating activities. This shift towards dependence on external support is consistent in areas with poor resource management and few cash generating alternatives.

Nafta and the Environment

Industries from affluent countries take advantage of the absence or under enforcement of laws in developing countries as the short-term investment will be prioritized over future costs (IDS 2006; Daly 1993; Faber 1992). This kind of industrial behavior exists largely due to poor internal infrastructure in developing countries on the local scale and a weak institutional base that result in ineffective ministries, weak and/or under-enforced laws, regulations that favor large international business and short term economic gains that allow for competition in international markets and attract foreign investment (Hufbauer and Schott 2005; Kuyvenhoven 2004; Weintraub 2004; Faux 2003; Wiggins et al. 2002; Cameron and Tomlin 2000). The previously discussed neoclassical disconnect between resource use and exploitation is both a result and a perpetuator of this infrastructural weakness.

For example, Canada negotiated much more rigidly with the U.S. than Mexico ensuring that their environmental concerns were addressed in the contract. The Canadian government

even issued a review of the NAFTA agreement of 1992 and its environmental impact potential looking at the environmental degradation that was a result of the impact of multinational companies constructing factories in Northern Mexico. This review was in response to the severe environmental damage done by certain factories called *maquiladoras* and as a way to add strength to their own argument in reference to environmental concerns.

A study done by SEDUE (*Secretaría de Desarrollo Urbano y Ecología International*) in 1990 on the *maquiladoras* shows the progression and devastating impacts of these factories on the Mexican environment (speaking both ecologically and socially). This study showed that only a minute percentage (6%) of the more than one thousand factories that were a result of foreign investment capital in the first decade of NAFTA complied with operating license requirements in relation to environmental considerations (emissions, hazardous waste production and disposal, etc.) in spite of the NAFTA contract requirements that clearly outline participants' cooperation with environmental laws and standards to avoid sanctions or embargo (Weintraub 2004; Husted & Logsdon 1997; Bowen et al. 1995; Frumpkin et al. 1995; Gomez 1993).

According to the Science and Technology Division of the Parliamentary Research Branch of the Canadian government (Murray 1993),

"Suppression of the labour movement and human rights has prevented Mexican workers from achieving the benefits of industrialization. Workers in the *maquiladora* region receive the lowest manufacturing wages in Mexico and are subjected to poor air quality and to some of the most environmentally degraded land and water in the country."

Murray (1993) goes on to explain that the cost lower cost of factory wages in Mexico (in the case of Canada, 1/10 the hourly wage) along with the lack of environmental law enforcement

create “strong inducements for the migration of capital investments to Mexico” in spite of the costs of environmental law compliance rarely exceeding 2% of value added, in these cases.

There is some evidence that the implementation of NAFTA between the U.S., Canada and Mexico created an elevated continental consciousness of environmental issues and their impact on development (both for “developing” and “developed” nations) which is indicated by the subsequent creation of the North American Commission of Environmental Cooperation or CEC after investigations like that of SEDUE (1990). This is likely due to the costs of such industrial behavior outweighing the benefits for Mexico. This is also attributed in some part to trade negotiations and foreign investment creating greater dissemination of technical information among the involved parties. It is also implied that because the U.S. and Canada are industrial nations that enforce comparable levels of environmental protection, standard of living, civil rights, labor standards, health care and education, Mexico benefits by proxy through the interaction and exposure to such established socio-political and public works infrastructures. A supporting example of this is the enactment of the *Federal Law on Ecological Equilibrium and Environmental Contamination* in Mexico in 1988 as a companion to the NAFTA agreement to enforce environmental laws that were previously being abused and overlooked. This was a major advancement for Mexico without further undermining their bargaining power; Although, with the recent shift in the late 1990s to early 2000 in foreign investments to Asia, Mexico is enjoying less leverage in industrial trade negotiation.

The double edge to that “by proxy” sword is that Mexico’s weak infrastructure stands in stark contrast to the U.S. and Canada and while the example is present, building such infrastructure requires time and independence- something that the free trade agreement has not fostered to this point. This means that while Mexico has benefited from greater information

dissemination, more political transparency, technological awareness and environmental consciousness, the level of political transparency both in Mexico and between negotiating parties has not been sufficient to optimize economic and trade policies in holding negotiating governments fully accountable for their actions. Problematically, the same limited infrastructure that results in under enforced environmental laws and dependence on foreign investment in poorer countries, preclude the enforcement of NAFTA rules by the exploited party. While there is a dispute-resolution mechanisms particularly for environmental issues written into the NAFTA agreement through the CEC, it has (at least until 2004) not been employed. A contract is only as legitimate as its enforcement. This is a blatant indicator of the imbalance that such an "agreement" creates as one party is privileged over the other. This imbalance perpetuates the already stratified social structure exacerbating social disparity and disorganization resulting in irrational further environmental exploitation and degradation, particularly in rural areas. This has had a huge negative impact on Michoacán's rural communities and the creation and implementation of development programs there.

Bilateral Resource Management Limitations

As general trade agreements like NAFTA are drafted and adopted, there is a pressure for "developing" nations like Mexico to step up to the 'rules' established by the more economically powerful "developed" ones with out an underlying support of the necessary infrastructure to maintain such an agreement. The premise of NAFTA (after 1993) has been discussed as a "two level bargaining approach" (Cameron and Tomlin 2000). This means that a more comprehensive linkage between domestic and international politics is sought by negotiators so that the impacts of decisions made in one political sphere impact others. The failures that are associated with NAFTA are largely due to the inability of countries like Mexico to meet such stringent and broad international demands for higher standards without multilateral investment in the production

process of goods and services as well as market accessibility. This comes with a complex set of issues (social capital, resource allocation and usage, education, health, among many others) that must be confronted internally and supported in the agreement itself. A strong socio-political and public works infrastructure is central to this (particularly developmental security). Infrastructure development is dependent on internal needs and priorities as well as the needs and priorities of the external stakeholders- not withstanding the investment potential of both sectors. This means that the basic needs of the local stakeholders are fundamental to any agreement, particularly where local, natural resources are essential.

Resource management is further complicated when the management is shared by a wide array of stakeholders from many scales-- local to national to international. This implies the need for a framework by which all involved parties can negotiate and from which agreements can be reached that are mutually beneficial to all negotiating parties. Because each stakeholder group (from local to international) has different resources, specialties and priorities, developing a framework can be very difficult. Management within a framework that looks beyond the neoclassical economic approach and takes long term resource management into account to ensure a greater likelihood of equal participation and/or benefit is imperative.

There are enormous implications that are apparent in ecological strain and degradation worldwide caused by current livelihood and industrial practices. This disconnect does not represent all vectors to the socio-economic disparities experienced by many rural people, however, it is very useful in considering development plans that seek to bridge the gap between conservation of local resources and the inescapable human development that requires their use and, therefore, management.

Rural poor have been, in many cases, removed from historic practices that allowed for a successful, albeit subsistence, way of life through the process of globalization (Barrera Brassols & Zink 2004; also refer to Chapter on P'urhépecha history). Livelihood activities were based on local resource availability and trade with nearby communities. Their livelihood strategies were not based on a greater market access and sociopolitical limitations from a large central government.

Sustainability as a Compromise

According to the World Resources report (2000), there is consistency between areas high in biodiversity and rural poor. This has been considered an impetus for development programs that integrate the local natural resource base with livelihood strategies in order to conserve the natural environment thus ensuring long-term stability (Shakleton et al. 2007). The general consensus is that sustainable commercialization of local, natural resource products is an important vector for this to be achieved (Shackleton et al. 2007, Scherr et al. 2004, IDS 2006). Although many sources refer to poverty as the impetus for resource dependence, it seems more appropriate to frame it in the context of the greater production system. It is well researched that most of the world's rural poor are dependent on local natural resources for their subsistence and household economy (Shackleton et al. 2007; IDS 2006; Belcher 2005; Scherr et al., 2004; Belcher et al. 2004; Arnold 2001; Narendran et al., 2001; Godoy et al., 2000; Sherr 2000). In areas of high biodiversity and natural resource wealth, this fundamentally means that the basic elements are present to assure food security, livelihood diversity and sustainable development. Restrictions, however, are placed on activities and development of communities not based on local resource availability but by land tenure laws, political boundaries and government policy having little or nothing to do with on local conditions, traditions or knowledge (Shackleton et al.

2007; IDS 2006; Scherr 2000). This perpetuates the aforementioned "disconnect" between people's basic needs, sustainable livelihoods and the greater sociopolitical infrastructure.

Kuyvenhoevn (2004) expresses the need for a legal framework for the enforcement of contracts in the market system that must be provided by the state. He goes on to discuss how inappropriate interventions by the state can be very destructive environmentally and socially. An example to revisit would be the removal of fertilizer subsidies in Africa. Public works infrastructure is also an issue that must be approached taking local circumstances into account. The inappropriate construction of public works infrastructure in environmentally fragile areas that would be seriously damaged by wider access and settlement which is evident, for example, in the Brazilian rainforest (Laurance 1998; Turner 1996). There is also the danger of over-subsidizing activities that cannot be locally sustained creating dependence on external funds and environmental use practices that are unsuitable for the area as in South Africa in the 1980s (Kuyvenhoven 2004; O'Meager et al. 2001).

The issue of government-generated market price distortions cannot be overlooked. Market prices rarely adequately reflect environmental costs and benefits associated with market products and are undervalued not only by the market dictates but also by local producers who have little flexibility to take these costs and benefits into account (Kuyvenhoven 2004). A problematic result of this is that even when market access is improved, the producers gain more by growing or selling what is commercially valuable without taking into consideration environmental impact because of this. A clear compromise would be policy and development programs that reflect the local environmental and social circumstances in needs assessments, development programs and policy definition.

A term that has been used liberally in the last twenty years "sustainability" will be used here in the context of sustainable development. For the purposes of this discussion the term 'sustainable development' is defined as ensuring the indefinite perpetuation of a natural resource in its use and management while contributing in no way to the detriment of the environment in which it is found nor to the individuals (in a eco-biological context) who utilize it in order to meet basic and future needs. To extend that definition of sustainable development to 'sustainable livelihood', the definition adapted by the IDS team in Scoones' "IDS Working Paper 72" was adopted:

> "A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base." (also see Fig. 5-3)

An area where these issues of development, market and natural resource management dovetail is the natural product trade. Since the introduction of the concept of sustainability in the 1980s, some attention has been given to developing links between conservation of local resources and the "natural product trade" (Shakleton et al. 2007). Livelihood diversification in rural communities is often based on risk mitigation and to improve standards of living and dependent on local natural resources (Kunyenhoven 2004, Hildebrand and Schmink 2004, Tarasaki et al. 2004, Ellis 1998). These activities range from seasonal production (due to seasonal availability) and raw vs. processed materials (produce vs. skilled craft products) to emergency use as a fall back in the event of scarcity or disturbance (natural disaster, economic) (Shackleton et al. 2007; McSweeny 2004; Takasaki et al. 2004). It has also been asserted that natural product trade is one of the few low barrier and direct links that the rural poor (particularly

women) have to the income generating market (Shackleton et al. 2007; Shackleton & Shackleton 2004; Campbell et al. 2002).

This kind of trade can act as a buffer between the sectors involved in bilateral and multilateral management that result in a global market. There are many examples in Africa and Latin America where these products have secured the welfare of even the most marginalized rural poor, yielding financial and non-financial benefits (Shackleton et al. 2007; Marshall et al. 2006; Shackleton & Shackleton 2004; Campbell et al. 2002; Ashley & Maxwell, 2001).

A development plan based on livelihood diversification through sustainable, natural product trade results in a more solid compromise between market dictates and political ambition. A more responsible approach to rural development and resource management, taking local resources and their total value into account creates a valuation that incorporates ecological opportunity costs and social capital. Since diversification is an important element of a stable economy (national, community or household), biodiversity becomes integral in the development process as a means for assuring ecological as well as socioeconomic resilience. This requires that conservation oriented approaches to natural resource trade and management be adopted in order to assure long-term sustainability of the resources and the livelihoods that depend on them.

Table 5-1. Mexico: indicators of tariff protection by percentage; Tornell and Esquivel, 1997.

Year	Domestic product covered by import permits (%)	Production-weighted average tariff (%)	Maximum tariff (%)	Imports subject to permits (%)	Fraction subject to permits (%)
1985	92.2	23.5	100.0	35.1	10.4
1988	23.2	11.0	20.0	21.2	3.4
1993	16.5	12.5	25.0	21.5	1.6

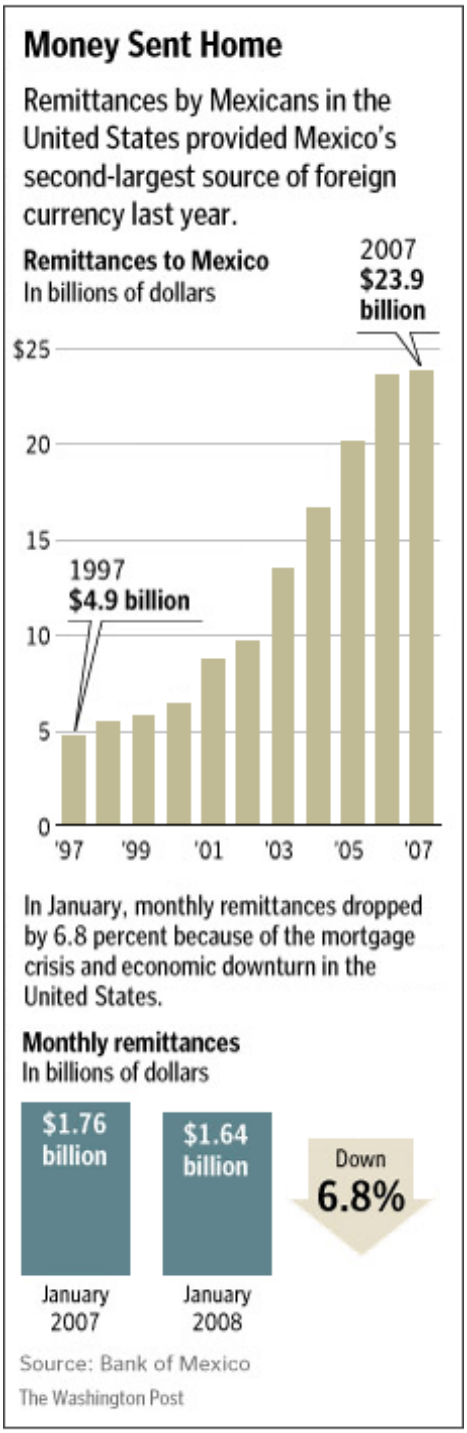

Figure 5-1. Taken from Roig-Franzia 2008, "Mexicans get less aid from immigrants" The Washington Post.

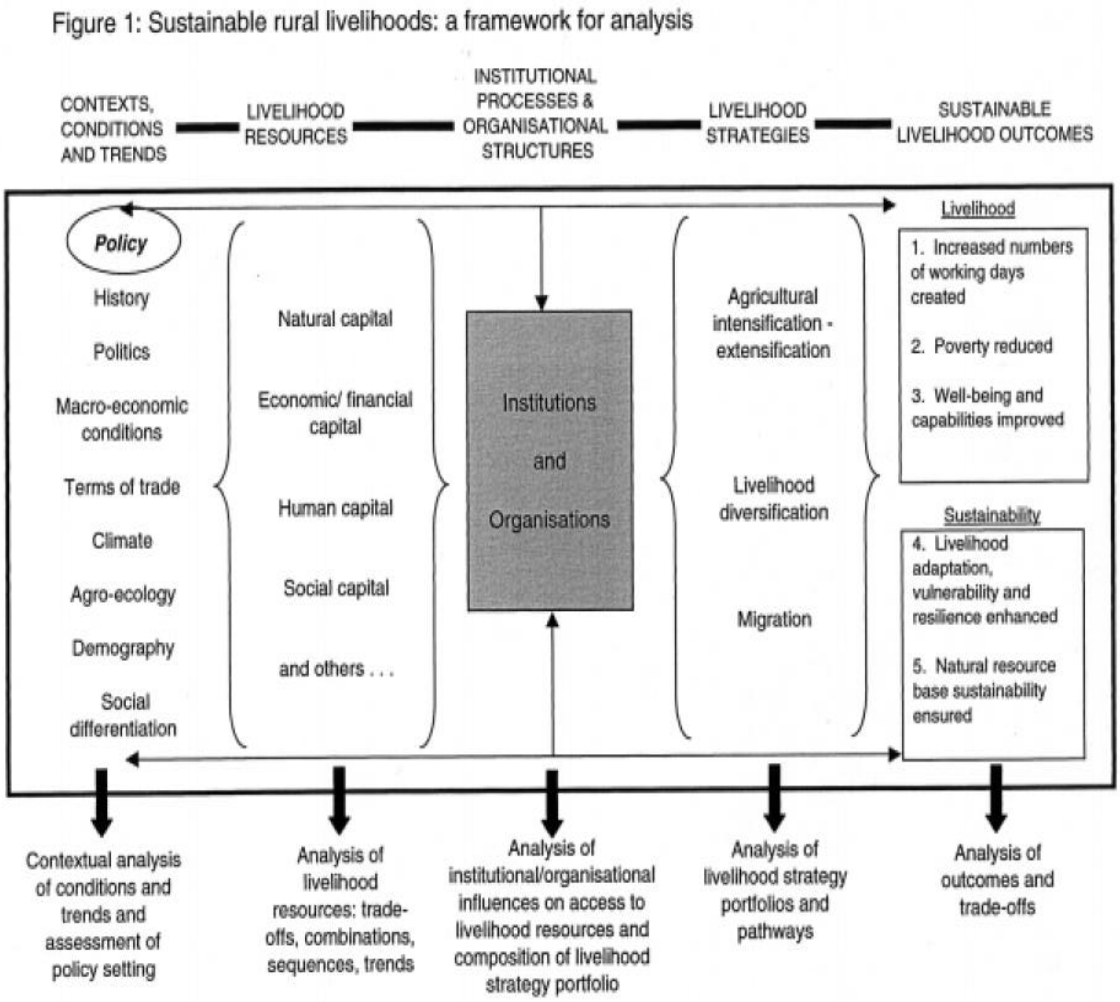

Figure 5-2. A framework for sustainable rural livelihoods taken from Scoones (1998).

CHAPTER 6
METHODS

Diversification is a common way that rural households strategize to achieve some level of economic resiliency (refer to External pressures chapter). Recognizing and supporting this diversity is instrumental in determining the factors that contribute to the success or failure of a development program. Development program is defined here as a proposed modification of the livelihood system. *Livelihood system* is defined as the composite of activities available to all households within a community from which to choose to secure their household livelihoods (Hildebrand 1980).

When considering development programs it is necessary to take this diversity external influences into account in order to ensure that a proposed development program does not fail over time due to poor internal support, and/or systemic limitations within and without the greater livelihood system--i.e. market access, political support, etc. (refer to External pressures chapter). Many development programs overlook the essential diversity of livelihood activities needed for the long term ecological and economic survival of communities. It is this diversity that makes them more resilient to external market changes and influences as well as local disturbances (drought, plague, etc.). It also means that, where poverty is rampant (especially where there is natural resource diversity), alternatives are imperative for household and ecological sustainability.

Researchable Problem and Objectives

This study was designed to find a way to determine the viability of introducing an activity like commercializing orchids in a rural livelihood system in order to avoid as many of the historic development pitfalls as possible. In this community and others there is a need to improve the livelihood system (mainly production) to alleviate poverty, community

fragmentation and ecological pressure. Also, because this is a proposed project that would require a number of years to generate money due to the reproductive characteristics of the orchids, it was necessary to perform an *ex ante* analysis.

The project objectives are as follows:

a. to determine the viability of the addition of orchid culture for both commercial and conservation purposes in a rural community based on their current livelihood strategies by employing the methodology of Ethnographic Linear Program modeling.

b. to determine the viability of an orchid cultivation activity based on resource availability, historic success and traditional knowledge for commercial development.

It is hypothesized that, if an *ex-situ* production system is created that takes into account a household's current livelihood strategies, then a household's discretionary income will be increased by the modification of an orchid growing activity if deemed viable by the *ex-ante* analysis developed through ELP modeling. This will in turn influence conservation efforts (both *in-situ* and *ex-situ*) once established.

It is important also to consider that what is viable for one household, or certain household members, is not necessarily viable for all households or all members. This makes an *ex-ante* viability determination a necessary and useful tool to avoid undermining the livelihood system developed over time by communities. Chambers (1997) argued that the only feasible approach to poverty and livelihood analysis was by allowing the people themselves to define the criteria which are important which increases the likelihood of success.

Sondeo

The Sondeo methodology is an informal but structured interview type originally developed at the Guatemalan Institute of Agricultural Science and Technology (ICTA) to more thoroughly gather information in relation to agricultural systems where technological alternatives were being

considered and promoted (Hildebrand 1981). It is a methodology ideal for interdisciplinary studies as it incorporates a number of researchers of various backgrounds to conduct the semi-structured interviews in teams. This ensures a more thorough and less biased obtaining of information that results in a more objective assessment of the interaction between the agro-socio-economic circumstances in the community and the resources on which it is dependent.

A Sondeo is a practical means for acquainting researchers with the research area as a system-- instead of focusing on one specific facet that does not incorporate all factors in the local decision-making process. The Sondeo can also highlight the limitations to certain activities that may exist but that are not obvious to the outside observer. It also serves to illustrate the framework that makes up the greater livelihood system. According to Hildebrand (1981), it was useful to determine the homogeneity of farming systems to discover the adjustments that were common to farmers in the system. It is also useful for determining the boundaries of a diverse livelihood system and clarify the limitations that community members confront when choosing activities to secure their household livelihood strategies. For this reason it was considered ideal for this project as an orientation tool.

In order to initiate the Sondeo, four multi-disciplinary teams of two researchers per team were organized to interview all willing households in the community. Each team was rotated before each interview day and interviewed as many households as were possible in the workday period. Participant interviewers ranged from a social scientist, botanist, ecologist, sustainable technology specialist, agriculturalist, to university students with a focus in biology and agriculture. The interviews were focused on the elements that make up and affect the livelihood system. Once the interviews were concluded each working day, they were discussed among all members and the interview topic was refocused for the next outing. Once all interviews were

completed, a brief report was corroborated and discussed among all members of the interview teams. This report served to summarize the community livelihood system and focus subsequent interviews specifically to the information needed to complete the ELP model. The variables, constraints and resources were specified in more in-depth questioning of interviewees (particularly families that voiced interest in participating in the project) once the Sondeo was completed.

Linear Programming

Linear programming has been used since the 1950s in order to maximize (or minimize) an objective, subject to a set of specific constraints (Dorfman, 1951). It was initially used to help farmers determine better farm management practices and to augment their profits (Heady 1958). The method optimizes the allocation of constrained resources (i.e. land, labor, capital) in potential alternative combinations.

Bernard (2000) defines Ethnographic methods as causal analyses that predict what kinds of choices people will make under specific circumstances. Here, the term ethnographic is being interpreted as a way to approach understanding a human system by looking at the decisions that were made in the recent past and are likely to continue to be made in the same manner (based on slowly changing local circumstances and consistent limitations), in the future. This creates a pattern of predictability that allows for further (and more specific) predictions on how any change or modification would impact the general system or its component parts.

The Ethnographic Linear Programming (ELP) model is based on these premises but uses specific information regarding the decisions made in a household. ELP is a basic tool for the economic and ethnographic analysis of a livelihood system based on household decision-making and local economy.

It is assumed that the criteria will be similar in making future decisions. Where the ELP model methodology incorporates the term "model" it is not a purely stochastic mathematical model. This model is a descriptive and predictive tool based on the actual activities that a given household or community participates in. This is a method that acts as an intermediary by giving a quantifiable element to what has traditionally been considered purely qualitative and therefore less precise or predictable.

The basic mathematical description of linear programming is as follows:

$$Max\ (or\ min):\ P = C_j X_j \quad (j = 1...n)$$

$$Subject\ to:\ A_{ij} X_j <= R_j \quad (i = 1...m)$$

$$X_i >= 0$$

P is the variable objective to be maximized (or minimized); C_j is the cost (debit) or returns (credit) of X_j (each of the n activities); A_{ij} is the set of input or output coefficients for each activity ($_j$) and resources or constraints ($_i$) and R is the set of total minimum or maximum constraints or restrictions. P frequently represents the end of year, discretionary cash available to the household and was used for this purpose in this study.

ELP Model

When it became evident that the ideal approach would be an *ex-ante* determination of viability, the Ethnographic Linear Programming (ELP) model became methodologically significant (Hildebrand et al. 2003). This *ex-ante* analysis creates a detailed description of the livelihood system of the community without falling prey to the assumptions common in general economic analyses. It is also consistent with fundamental elements outlined in the Sustainable Livelihood Framework developed by the Institute of Developmental Studies (IDS) and elaborated by Scoones (1998).

The ELP modeling of a potentially sustainable livelihood system based on the actual community livelihood system is a gentler and more practical alternative to the previous "trial and error" method of resource management. ELP modeling was designed to specify the variables and constraints of the people involved in the research program while taking into consideration local resources-- along with their potential and limitations. This ensures that, even with ample room for error, the communities (and/or those suggesting livelihood modification) will obtain an educated preview of how a proposed modification might impact a livelihood system be before its implementation. It is a powerful tool through which the *ex ante* viability determination of a sustainable livelihood modification plan is utilized as a guide in order to avoid wasting precious time and limited resources in rural communities, with broad applicability throughout the world.

ELP modeling takes into account not only the diversity in household livelihood activities but also the diversity in variables that impact the participation in each household's activities and resources. Since the communities are made up of diverse households (based on household composition, gender disaggregation, economic stability, skills, access, etc.), what might be viable for one household will not be viable for all households in a community. While this is intuitive many development programs have not, historically, taken this into account. It is often assumed that one activity will be appropriate for all community members or even enough to contribute substantially to the local economy based on widespread participation and is frequently based on using averages. Averaging makes the assumption that all households are similar and will respond in the same way.

It is also important to mention that the model (as a reflection of the actual system used by a household) is a way to quantify that which has historically been considered entirely qualitative. This means, based on the previous and consistent decisions that are made by a household, one

can ascertain what changes and in what quantities would be necessary to the current livelihood system to render any modification viable-- or not. Specifically, with respect to the current study, it is possible to see how the current activities would be impacted by the addition of the commercialization of the endemic orchids, as proposed. This saves the households that are interested in participating (as well as the community) a great deal of time and resources (both natural and social) by having an *ex-ante* determination versus an analysis after the fact. In this way, various policy and production alternatives can be tested in the virtual ELP system giving an educated approximation of how the actual system might respond. This also has implications for the delicate community economy which would not suffer the impacts of trial and error (i.e. limited resources that could have been reserved for other activities or conserved for future use-- land, labor, money, etc.). It also allows program developers to target specific economic domains. This is especially pertinent where development programs have a history of being implemented with low success rates and large debt accrual as a result (not to mention the natural resources that were exhausted in the process).

Historic use of this methodology demonstrates a diverse utility due to its fundamental function as a descriptive tool with the ability to project certain impacts and outcomes. Its utility on a more general scale lies within the structure of the methodology itself. It supplies a framework (matrix) that is situational (as well as circumstantial, as necessary) but broadly applicable. This means the method can be used anywhere, under any circumstances and still have useful predictive abilities based on what is available to the people in the research area. In fact, ELP and linear programming modeling have been used on several occasions in sustainability studies, comparing agro-ecosystem management practices and production over

multiple spatial and temporal scales (Davis et al. 2007; Thangata et al. 2007; Cabrera et al. 2004; Breuer 2003; Mudhara et al. 2003; Turner et al. 2002; Raja et at.1997).

It is a predictive model due to its projective capabilities based on what is entered into the model. This makes it very useful as factors like changing household composition, production potential and other factors (like production time) can be taken into account over successive years, thus its predictive ability for specific activities as well as how they would be impacted by a development program. This method was employed to understand the basis of the diverse livelihood system and how modifying household livelihood strategies (or activities) with an additional livelihood activity would impact the households.

Once the specific information is gathered, it is integrated into a matrix in a spreadsheet in the Excel© program of Microsoft Office© that includes the minimum quantity of products necessary to continue the current livelihood status of the household, and what variables affect it (including seasonality, labor availability, market changes, etc). Labor and expenditures that are necessary for household subsistence are taken specifically into account. Then the Excel Solver© function (found in the program tools) performs hundreds of iterations of all the variables in all possible combinations until the objective as specified by the modeler is maximized (or minimized). In the current model, "end cash" refers to the discretionary cash that is left after necessary expenses are met (necessary referring to those expenses relating directly to the maintenance of the household).

The rows hold the input-output coefficients related to the livelihood system (*e.g.,* labor, consumption, production, land allocation for certain activities, etc.). Rows also include the amount of cash necessary to complete each activity as well as accounting rows for consumption. In this model (since discretionary cash has been delineated as the objective to be maximized), the

maximization function is used in Solver© in order to seek the combination of variables that will result in the greatest amount of end-year discretionary cash. However, anything in the model can be maximized or minimized, from end cash and crop production to cattle production, labor and leisure time. In this model, the *end cash* is maximized.

It is important to note that once a model is created, it is still useful as long as the livelihood system remains generally consistent. It can also be modified as necessary as new inputs and outputs appear.

The Variables and Constraints

Input tables were used to enter data related to household composition and consumption directly into the model without having to recalculate and enter the data into the matrix for each change in household composition (Table 6-1). This made modeling each household easier and left less room for human error in the transfer of information. Below is the family composition of Household 5. The example tables are taken directly the household analyses.

Household composition influences labor availability and consumption greatly as they contribute differently to both. Aged family members are considered like children as they are able to give very little support and still require resources be it from the household income or time that might otherwise be devoted to household or production labor. They are comparable across labor, consumption and monthly expenses to children and are therefore considered the same for analysis purposes. Elderly household members are considered able to contribute approximately the equivalent of an adolescent family member (Table 6-1). In order to categorize each member group, it was necessary to determine the ages that were appropriate per category (Table 6-2).

Family or household compositions in the results section are represented as numbers to the side of the household number (created for anonymity), for example *HH 1 1 2 0 1 0*. The first number represents the number of Adult Males, the second represents the number of Adult

Females, and so on (refer to household composition table 6-1). This numeric representation will appear next to the corresponding household number when discussing individual households, for convenience.

Labor refers to the amount of human days that a given household composition category can expect to contribute per unit of time. The total hours devoted to an activity are broken into 8 hour segments that represent "days" worked in reference to a given activity. The total available labor was determined for males by the total amount of labor they could contribute based on 8 hour workdays, 6 days a week. Female labor, however, was the available labor after household reproduction activities were completed. Children and the aged are considered a labor drain as they require care and maintenance but cannot contribute to household labor activities.

This information was placed into the corresponding activity column in the matrix from the labor input table (Table 6-3). For practical purposes the time units used were increments of two months: Period I represents January-February, period II represents March-April, etc. Because labor and consumption vary consistently between the gender groups in the various households, they are gender disaggregated. The livelihood activities are also generally (although not always) gender disaggregated. The labor availability table is connected directly into the household composition table so that the amount of total male and female labor is household composition specific. The bottom row named "total labor" signifies the labor available based on household composition. It is this value that is connected to the matrix.

The Consumption table (Table 6-4) works much the same way that the labor table does. The amount that each adult male consumes of a given product is multiplied by the total number of adult males in the household (the same is applied to each of the other household member categories) and then totaled for each consumption category (i.e. *maíz* [corn], *frijol* [beans], etc.)

and linked directly into the available resource column in the model for inclusion in the Solver function.

Table 6-5 is based on a linear regression of expenses per household member category per two month time period to tie expenses to household composition and enter it directly into the model. Using this regression, a close approximation of the monthly expense per household member category was determined using data from 31 interviewed households in the community.

In cases where external influences are pertinent, for example consistent remittances, those are incorporated as a part of the monthly family cash. In the case of inconsistent remittances, the months of low discretionary cash are the months in which remittances are added to act in the model as they do in the household economy-- as a stabilizing factor during times of cash shortage.

In the elaboration of the livelihood system model, certain actions were taken to ensure that the impacts of the orchid activity in the scenarios that were performed would be consistent. First, the livelihood activities that are currently part of each individual household strategy are fixed in the Excel Solver© so that they do not exceed the maximum dictated by the original data collected. The value is set, however, as less than or equal to the demand so that the influence that the orchid activity has can be measured in relation to which activity is prioritized.

Environmental or demand limitations (as in the case of fishing, music activity and tortilla selling) are taken into account in the solver itself so that the model does not exceed certain levels that, in reality, are restricted by limited availability or demand (which can mean ability for others to pay for the goods or services or environmental supply limitation making the product unavailable beyond a certain quantity). Because of over-fishing and pollution in Lake Pátzcuaro, the number of fishermen and the quantity of fish that can be taken from the lake is severely

limited to personal consumption and many are limited to certain times of year that they can fish. For this reason, the fishing activity was set to no more than 10% of what is caught as this reflects the catch limit due to low fish populations. Due to limited local demand, activities (like selling tortillas, the music activity, carpentry, etc.) are constrained by the demand within the community as expansion of these activities is currently infeasible due to travel costs and common availability of these services elsewhere. It was also necessary to restrict the household models to the original activities in which the individual households participate due to low demand and surplus labor. This is due to the model's tendency to utilize all available labor in activities that earn the most cash per day of labor.

This demand constraint is taken into account directly in the Solver function of Excel©. In this way, the livelihood strategies employed by each household in the livelihood system are individually recreated so that the impact of the addition of an alternative activity (or activities) can be estimated. All approximations or speculations were conservative.

The orchid activity data that was used in the ex-ante analysis in the livelihood strategies of the individual households was loosely based on the orchid cultivation activity developed by ECOSUR and Damon (2005) in Chiapas, Mexico (refer to Orchid chapter). The methodology includes either individual, household shade houses or, in the case of Damon (2005) a communal shade house (this is dependent on community and cultivator preference). The labor requirements were calculated based on the same project resulting in higher labor requirements during the first year and slightly lower and more consistent labor in subsequent years, once the plants are established, seeds are collected and the environment is created for their care and development in the community (refer to ELP models and Table 6-6). The costs were calculated based on fuel, transportation and material costs for plant maintenance that resulted in approximately 600 pesos

in start up costs. Initial involvement by the university is required and the costs incurred by the University were not considered as they would be under university protocol and research project funding. University involvement in the initial orchid propagation is instrumental if seed propagation is the method of choice to minimize further impact on wild orchid communities as they provide laboratory facilities and professional involvement.

The orchid activity was added into the livelihood system after the modeled livelihood system was calibrated. When credit was added for orchid production, it was necessary to set the male and female credit cells less than or equal to the amount of orchid activity so as not to take credit for other activities (see Appendix A).

Two scenarios were explored to determine what level of participation in the orchid activity could be expected. One considered that initiation of the activity had no cost to producers (EPWCP) and the other involved associated start-up costs with credit (SUCC) at 15% interest compounded over 3 years. An analysis was performed over 6 years and the outcome was comparable so that the initial 3 year analysis was elected. The orchid activity is not set to generate income until the third year in the three year models and in the 6th year in the 6 year model as the orchids take between 2 to 5 years to reach reproductive maturity. The cash earned from the orchid activity is a conservative estimate based on the lowest amount that the plants bring when sold in the markets (210 pesos per 2 month period per 100 plants).

Table 6-1. An example of household composition input table for HH 5.

Family Composition	
Adult Male	1
Adult Female	3
Elderly/Adolesc. Male	0
Elderly/Adolesc. Female	0
Aged/Children	2

Table 6-2. Age classification for household composition as used in this thesis.

Children 0-12
Adolescent 13-18
Adult 19-69
Elderly 70-80
Aged 81 and up

Table 6-3. Labor availability across household member categories and unit time (available days per two month time period).

Labor Availability						
Unit of time (per 2 mo. period) in days	*I*	*II*	*III*	*IV*	*V*	*VI*
Adult Male	55	55	55	55	55	55
Adult Female	22	22	22	22	22	22
Elderly/Adolesc. Male	30	30	30	30	30	38
Elderly/Adolesc. Female	22	22	22	22	22	22
Aged/Children	-5	-5	-5	-5	-5	-5
Total Male Labor	55	55	55	55	55	55
Total Female Labor	46	56	56	56	56	56

Table 6-4. Example of household consumption requirements input table.

Consumption					
Unit of time (yr.)	*Masa (kg)*	*Frijol (kg)*	*Charal (kg)*	*Acumara (kg)*	*Leche (kg)*
Adult Male	300	72	35	35	140
Adult Female	250	68	30	30	140
Elderly/Adolesc. Male	300	72	35	35	140
Elderly/Adolesc. Female	250	68	30	30	140
Aged/Children	150	50	20	20	140
Total	1350	376	165	165	700

Table 6-5. Example of regression results of bimonthly household expenses input table.

Table 4: Gastos (regression)	
Unit of time (2mo.)	
Adult Male (AM)	92.93958
Adult Female (AF)	422.8771
Elderly/Adolesc. Male (E/AM)	0
Elderly/Adolesc. Female (E/Af)	0
Aged/Children (A/Ch)	404.8728
Total	920.685

Table 6-6. Labor requirements for orchid activity per period.

Labor Requirements for Orchid activity (days)	Year 1	Year 2-3
Period I (Jan-Feb)	8	8
Period II (Mar-Apr)	8	8
Period III (May-Jun)	14	8
Period IV (Jul-Aug)	8	8
Period V (Sep-Nov)	12	8
Period VI (Nov-Dec)	14	8

CHAPTER 7
THE PARTICIPATING COMMUNITY: OPONGUIO

The vast majority of the information contained in this chapter comes from the interviews and subsequent personal communication after the completion of the Sondeo. San José Oponguio is located at 19° 36' 0" North, 101° 40' 30" West and falls within the municipality of Erongaricuaro which extends from Quiroga to Pátzcuaro, approximately 242.67 km^2 (Fig. 7-1). The name, Oponguio, means "place to rest" in the P'urhépecha language. This area is known for local production of crops like corn, beans, peaches, avocado, cherries (*Prunus salicifolia*), figs (*Ficus carica*), apricot and *cherimoya* (*Anona cherimolia*). It also falls within the zone known for its lumber, woodworking, pottery and hand embroidery. The products produced for sale are: milk, tortillas, corn, beans, beef, lamb, pork, goat, and some crafts, for example *petate*, *mezcal* and hand-embroidery.

There are 400 people in the community of Oponguio that make up approximately 80 families. The community is broken up into four *barrios* (or concentrations of houses): *La Hacienda*, *La Cancha*, *Los Bautistas*, and *Las Palmas*. Not a great deal is known about them. Only the stories that are passed down from older members of the community throughout the generations provide historic information.

La Hacienda is the oldest of the *barrios* (Fig. 7-2). The older community members talk about it having been a functional *hacienda* having been owned by a very wealthy man and his family (Mejia) and established before the revolution of 1910. The *hacienda* system forced the local indigenous people to work under the wealthy owners with the idea that they would work off their debt and eventually own their allotted parcel of land. This was often done through share-cropping and was equated with indentured servitude. The hacienda system hugely influenced the mix of European and indigenous culture that is still present today.

La Cancha is the next oldest and is also the largest of the *barrios.* It was founded by the *hacienda* owner's cousin along with several laborers who were able to gain independence from the *haciendado* (or hacienda owner) after the revolution. It now contains the auditorium, the small church and the primary school (Fig. 7-3, 7-4).

The *barrio Los Bautistas* is named for the family that came to Oponguio from Janitzio (a nearby island in Lake Pátzcuaro). They were the first traditional fishermen to return to the area after the establishment of the *hacienda*. They were the only family that spoke P'urhépecha as a first language (native languages were forbidden in many *haciendas*). Many in the family still speak P'urhépecha. They would come seasonally every year to farm on land that was lent to them in exchange for produce and forage for the land owners' cattle. Eventually, they settled permanently in the *barrio*.

Las Palmas is the most recently established of the *barrios* and is so named for the abundance of palm trees found there. It is notable that it was in this *barrio* that the first local celebration of the town occurred in honor of José Mejia, a member of the original founding family. The celebration occurs yearly on the 19th of May on the Day of Saint José- the patron saint of José Mejia and of the community, San José Oponguio.

Household Goods

The majority of families from all four barrios generally go to the markets in Eróngaricuaro on Tuesday and to Quiroga on Thursdays as this is the day of the *tianguis* (the day all venders come together to sell their products in the local market) (Fig. 7-5). *Combis* (Volkswagen buses converted into micro-buses) or buses are the means of local transportation (Fig. 7-6). Travel to either commercial center (Quiroga or Erongaricuaro) takes approximately 20 minutes and costs 8 pesos each way.

According to the interviews, residents purchased things like: tomato, avocado, lettuce, radish, zucchini and potato that are not grown in the community because of the climate. Winter is cold and can even frost for several consecutive days as the community is in the highlands. The majority of the rainfall occurs in the rainy season (June-September) making it too wet for many crops during that time. The soil is also very saline.

According to interviews, chicken is consumed more than beef (4 times per week and once a week, respectively). Eggs are generally not consumed on a regular basis. All of these, when consumed are purchased in the market.

The local store stocks the things that households run out of quickly like instant coffee, sugar, chili peppers, flour, bread, and sometimes seasonal fruit. In general, the local store sells the products that are in cans or packages with a long shelf life. The prices at the local store are comparable to the markets and supermarkets in the commercial centers.

Agriculture

Agriculture as an income generating activity was once a great deal more prevalent than it is today. It is still the main form of community subsistence accounting for approximately 90% as the vast majority of the people in the community grow and store the produce for household consumption.

Land preparation begins in February, planting begins in June and harvesting occurs in late November to early December. January is a month of rest before preparations for the next year begin again. The staple crops are corn and beans (also *Habas*, a legume), which are often intercropped. Corn is largely used for *masa* (the flour paste or dough made from the corn that is used for a variety of food products like *atole*, *corundas* and *tortillas*), although the grain can be used for *nixtamal* (hominy) before grinding. Corn is sometimes used for animal feed and/or *rastrojo* (the corn plant after the ear of corn is harvested). Surplus beans and corn are sold

locally and in the markets when possible. Also cultivated are wheat, oats, alfalfa, and forage grasses.

The farmers no longer plant crops in the same manner as they previously did, due to a government program, *ProCampo*, that was established in the community which taught them to plant using a form of resource conservation farming. This technique was introduced in 2001 by five community members. The other farmers were hesitant in the beginning but all of them ultimately accepted its utility. The process is locally called *labranza de conservación* which employs the use of a machine called *dobladence* (Fig. 7-8) that serves the purpose of planting, fertilizing and applying pesticide. The machine was purchased among the farmers in 2001 with a grant from the *Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias* (INIFAP). It is used communally by the farmers and a schedule is decided based on size of plot and need.

After the initial planting and application of chemicals, there are two more fertilizing events once in July and once in August. The previous method used by farmers prior to this one required a great deal more manual labor, time and inputs. According to a local farmer, when the two methods are compared after the initial cost of the machinery, the previous cropping method cost approximately 2800 pesos, while the new method results in a cost of approximately 1800 pesos. Labor and costs are considerably lower with the second method but productivity is the same. According to the local farmers, this method saves resources as well by working with the right quantities of fertilizer, pesticide, seed and season.

Three families have gardens, one of whom grows avocado and the rest have home gardens that produce lettuce, *chili peppers*, various greens, and herbs for cooking that include mint,

cilantro, cumin, marjoram, etc. These gardens are for family consumption and not for sale. They are sometimes shared, particularly between and among family households.

Wild Plants

Various plants are harvested in the wild. The staple plant is Nopal (Prickly Pear), an *Opuntia* sp. of cactus native to Mexico. According to the information gathered in the interviews, 20 of the *pencas* (platyclades) are harvested every two weeks. This is likely a dietary staple due to its high nutritional value and even medicinal benefits. They contain vitamin A, vitamin C, vitamin K, riboflavin, vitamin B6, magnesium, potassium, and manganese, as well as iron and copper (Sawaya et al. 2005). They are also believed to lower the glycemic effect of certain foods and particularly benefit diabetics (Frati et al. 1990). It is not known locally how extraction impacts the wild populations but it does not appear to have caused any scarcity of the Nopales.

Wild greens are also collected for dietary consumption (*e.g., verdolagas*, *acelgas*, *quelites* and certain species of fungi). Some of the greens are cultivated in home gardens or simply in plant pots near the home.

A few herbs are collected for their medicinal benefits and are commonly cultivated around the home for example, chamomile (ex. Anti-inflammatory and calming agent), *gordolobo* (*Gnaphalium spp.)* (ex. for blood circulation, anti-inflammatory), mint (ex. for stomach discomfort and as an herb), *Camelina spp* (ex. teas and food), eucalyptus (ex. colds), *borraja (Borago officinalis), epasote (Chenopodium ambrosioides)*, arnica (ex. joint health) and passiflora (ex. anxiety). Aloe (*Savila spp.*) and *Maguey* (*Agave* sp.) are often used to treat animals for superficial wounds and skin irritations. Some cooking spices can be both collected and cultivated around the home like laurel, anis, marjoram and rosemary.

Cattle

Cattle do not represent a prevalent activity in the community but they are a significant one for those who do (Fig. 7-9). Five families participate in this activity. Of the five families that rely on cattle as their primary income generating activity, only one has a herd larger than four animals. There are others that have one animal for milk and dairy products to supplement the household diet and as a limited source of cash. Sometimes the dairy products are purchased or traded. Neither dairy nor meat are staples in this community. The animals are sold in June or December mostly in Quiroga and secondarily in Erongaricuaro and sometimes in Pátzcuaro. Usually no more than two animals are sold per year as the herds are small and they are sold in the commercial centers outside of the community. One animal can bring in (depending on the market) around 5,000 pesos. They are not sold inside the community as they are considered primarily a cash-generating activity and not a food item.

Fishing

One of the activities that was once prevalent in the lake-side communities but has been seriously limited by over consumption and lake contamination is fishing (Fig. 7-10, 7-11, 7-12). Previously, fishing was a stable livelihood activity for two-thirds of the people who live in communities around the lake for centuries. Now there are approximately 30 fishermen and often there are not enough fish to keep fishing as a viable livelihood by itself. In general, the native fish are *Charral* (*chrostoma spp.*), *Acumara* (*Algansea lacustris*), and the endemic White Fish (*Chirostoma estor*). Carp, *Mojarra* and tilapia are non-native species that are also fished from the lake. There are only three fishermen who fish year round, the rest fish between January and May (particularly during Lent). Usually 300 kilos of fish per fisherman are taken out of the lake each fishing season and the fish that bring in the best market price are C*harales, Acumara* and M*ojarra*. The native fish population of Lake Pátzcuaro has suffered greatly in the last thirty

years. The non-native species were introduced into the lake to help cut down eutrophication (a serious problem in the lake) and alleviate pressure on native species. Most of the fished species are natives due to the higher price and market demand as the others are more common and easier to acquire.

Those who fish often do it at night, particularly during the mating of the *acumara,* which are harvested young and still relatively small (approximately the size of a large sardine or small herring) during lent.

Education

The general education level of people between the ages of 60-80 is primary school (grades K-4). The average education level of those between the ages of 40-60 is secondary school (grades 5-8) and average education level for those between the ages of 30-40 is high school (grades 9-12). However, education level is rarely a priority for those who wish to stay in the community as there are few jobs that require skilled labor and can pay for a higher skill level within the community itself. There is also a financial barrier for those who have low household income levels and are not eligible for grants and scholarships (which are few and very competitive) in order to continue on to higher education.

The community has a primary school located in the *barrio La Cancha*. However, children must travel to San Andrés (a nearby community approximately 5 km distance) to attend secondary school. They must travel to Quiroga (approximately 20 km) to attend high school. Public school is free to attend but requires expenses like uniforms and school supplies costing around 500 pesos per year and additionally 50-60 pesos per week, per student for things like supplies and food. In order to attend colleges or universities, students generally travel to Morelia. In a few cases, students will study in Guadalajara and Mexico City where the largest universities are located. One's academic specialty determines the school that one attends. The

costs associated with college are between 300-600 pesos per week and are dependent on the academic focus (*e.g.*, teaching totals 300-400 pesos while biology averages 500-600 pesos per week). According to local statistics, of 10 students, one or two finish a two-year degree (*carrera*) while most complete the secondary school or high school level.

Employment

Many of the jobs created in the community are services provided to other community members like construction/carpentry, gardening/lawn care, house cleaning, waiting tables in local restaurants, cooking, day laborers, livestock hand, field laborer, tortilla making, construction/carpentry, yard-work, agriculture, etc. There are also several areas of entrepreneurship like store-keepers, restaurants, *Mezcal* production (from local agaves), etc. There are also farmers whose activities are discussed more in depth in the section on agriculture.

The restaurants employ 22 people from the community. Twelve of the employees have permanent, full-time employment while the rest work when there is need-- most frequently on weekends and holidays. The first restaurant opened 18 years ago and started as a *cocina económica.* This means that it was a very small establishment that was run out of the home kitchen. The other restaurant opened 11 years ago in the *Hacienda barrio* in much the same way. Since then two others have opened in the last five years. They all take advantage of the lake view and tourists who utilize the scenic highway on their way to Pátzcuaro, Erongaricuaro, Quiroga and Morelia.

A group of eight local musicians play music generally twice a month- *quince-años*, birthdays, holidays, etc. The instruments are varied: guitar, mandolin, violin, base, trumpet, clarinet, trombone, saxophone and drums. Members are taught in neighboring San Andrés or by a local music teacher. Three members sing and groups are formed depending on circumstance and availability of members. The musicians practice regularly and only in their spare time. The

demand for musicians is limited to local need and can be cost prohibitive (travel, instruments, etc.). During large community celebrations and certain family functions they will sometimes volunteer their services. This is a supplemental but significant livelihood activity and most musicians devote the majority of their available labor to more consistent jobs.

Some community members are employed outside of the community. A wide variety of outside jobs exist which generally require some level of education or skill: office work, teachers, administrators, architects, engineers, veterinarians, health care workers administrative assistants and advertisers. One of the women in the community is a nurse and travels five hours to work weekly, staying in the area where she works during the week and coming home on weekends. Others work on the railroad, construction and carpentry in companies or nearby communities when employment is available. Railroad workers are also few in this community as a small crew of people work over an established area of railroad and only two from the community are needed. One of them has worked for the railroad for over 25 years.

Artisanal Products

The main skilled and traditional craft produced in Oponguio involves the weaving of water reeds (*Typha spp.*). The water reeds (locally called *tule*) grow in the shallow waters near the lake shore (Fig. 7-12 and 7-13). The *tule* is cut in the month of March for use throughout the rest of the year. It is woven into products and is often made into mats that the P'urhépecha traditionally use as beds called, *Petate*. The sleeping mats (they are made in single sizes as well as a full size called "*matrimonial*") are laid out for sleeping and rolled up when not in use to take better advantage of habitational space. They can also be used for drying other products like tortillas, pumpkin seeds, corn, etc. in the sun. Other products like baskets, bags and woven animal figures are made out of *tule* as well and sold in larger markets, along the highway and in tourist centers. They are a mid level of labor intensity (one full sized *petate* taking 3 hours to

complete if woven until finished) and bring in a very low monetary amount (20 pesos per full sized *petate* and 10 pesos for a bunch of *tule*).

External Support Programs

Several support programs are available to the community members of Oponguio: *Tercera edad* (for elderly people), *Oportunidades* (for poor families), and *ProCampo* (for farmers). Women who are not eligible for *Oportunidades* but have children in school may be eligible for grants through a government agency, SEDESOL (*Secretaría de Desarrollo Social*). The programs are briefly detailed as follows:

Community members eligible for *Tercera Edad* are given support for 70% of estimated monthly expenses. Whatever this does not cover, as it is considered a very conservative estimate, is supplemented by a package of food staples that are given to qualifying individuals every month.

Of the community members who farm, about 60% have some support coming from *ProCampo*. This helps with input needs and capacity building (from extension) for qualifying farmers. The aid they are currently receiving is only from extension.

About 85% of the women in the community count on *Oportunidades*. This program gives qualifying (impoverished) mothers 315 pesos every three months.

About 15% of the school age children receive scholarships through SEDESOL. The rest either have jobs that bring in enough income for education (about 5%) or are unable to afford education above primary school. This grant results in 450 pesos per eligible student per school year and covers the cost of attendance for the school year.

The clinic in San Andrés gives eligible families medical care covered under their socialized medicine program-- although medication is not included and must be purchased through the pharmacy. Four families in the community have elderly persons in the household

who require special care due to chronic illness. For example, there is an elderly woman who needs a wheelchair, supplies and medications. The other three require costly medications and their families cannot afford insurance and are not eligible for government aid and are forced to pay for them out of their household cash when possible. Otherwise they rely on natural remedies and herbs found locally.

Emigration

A number of families have left their homes to find work outside the community. Some of them have even left the country and can be absent from the community for months, sometimes years at a time. Those that have houses keep them in the family and they are looked after and maintained by family members who stayed in the community or by community members contracted to do so. When possible, the emigrants pay for those services. Limited information was available on this topic as the dynamics of emigration are still being studied and it is taboo to discuss it in great detail with outsiders.

Remittances

Families that receive remittances are relatively few and are spread out among the four barrios. Of the 12 families in *La Hacienda barrio* six receive sporadic remittances. In *La Cancha,* six of the 42 families also receive sporadic remittances. Only one of the families receives consistent monthly remittances. In the barrio *Los Bautistas*, there are six of the eighteen families that also receive sporadic remittances. In the final barrio, *Las Palmas*, there are eight families. Of these eight, two of them receive regular bimonthly remittances. The majority of the family members who send remittances are sending them from the U.S. although there are some who are sending them from large urban centers in Mexico, for example Monterrey and Mexico City.

Homes

In general, established families live in homes that are already paid for-- whether it be through inheritance, building by hand or paying for construction as they go (although many of them are finished as the parents have children who are almost grown). Houses can be made of adobe, brick or plywood (Fig. 7-14). The households are usually made up of several generations of family members-- grandparents, parents and their children. Children live at home in most cases until they marry (and even after), often helping with the maintenance and income of the household. It can also be said that the larger the household, the larger the diversity of activities and even more so when children are of working age. Working age is dependent on accessibility to school and usually starts between 13-18 years of age.

Livelihood Strategies

The vast majority of families participate in a variety of activities in order to meet and, when possible, go above the basic household and family needs (Table 7-1). For example, a large number of male family members farm corn and beans for household consumption but work in other activities when they are not farming in order to generate cash. Many participate in more than one alternate activity on a part-time basis in order to retain flexibility for seasonal labor requirements like farming and fishing.

Women are more limited in the activities that they can participate in outside the home than men but also diversify their livelihood strategies when labor and access allow. Some women make and sell tortillas from surplus *masa*. Others participate in service oriented activities like house cleaning (particularly for wealthier home owners who are only in the community seasonally) or waitressing in the local, family owned restaurants. Some women participate in more than one activity, however the household responsibilities lower their available labor for such activities, particularly if they have young children or aged family members.

If remittances are sent back to the household from those who emigrate then they are considered part of the household income, especially if they are consistent and can be depended on by the household on a regular basis. Many, however, are not consistent as stated earlier in the chapter and act as an economic buffer during times of severe cash shortage.

Marginalization

According to the *Comisión Federal para el Desarrollo de los Pueblos Indígenas* (Federal Commission for the Development of Indigenous Communities) (2005), Oponguio, Michoacán, falls in an indigenous area that is considered to represent a mid-level of marginalization (Fig. 7-16). According to the Miriam Webster dictionary, marginalization is "to relegate to an unimportant or powerless position within a society or group." Socio-economic marginalization as referenced in the literature takes Miriam-Webster's definition into account as it pertains to rural communities and poverty. Howard (1998) includes the ecological (or resource) aspect of marginalization by saying:

"Ecological marginalization results from a rapid growth in human population and a degradation in the quality or quantity of natural resources within the context of an inegalitarian resource regime that denies a portion of the population regular access to healthy resources."

The integration of the environment into the concept of marginalization is appropriate in Mexico as it is still a system where the wealthy few own the majority of the fertile, agricultural or building land. This means that land is generally utilized in accordance with its market value without taking into account the environmental opportunity costs of exploiting it and limiting who can use it.

Land tenure in Oponguio is made up of small personal properties that were gained by the members of the hacienda over the years after it was no longer operational. The rest is still owned by the Mejia family. It is interesting that land and resources are often shared in the community.

For example, one family's grazing land can be used by another who wishes to farm it. If the farmers leave forage (rastrojo) for the cattle, they can use the land free of charge. In another case of private land with community access, approximately 100 ha of forest was set aside in 2005 as protected community forest land by the Mejia family and the Forest Commission. All community members take part in protecting the protected forest land from clandestine logging, unsustainable firewood collection, over-collection of herbaceous and flowering plants and forest fires. A reforestation project called Proyecto de Forestación organizes conservation efforts. It was established by the community, the University of Michoacán, and UNAM to ensure sustainable extraction practices, and aclareo, a process which aids in the conservation of large, native trees and protects old growth stands by appropriate thinning.

According to one community leader,

"We take care of it because it feels as if it belongs to the whole community even though the Mejia family actually owns it. But everyone in the community has open access to it with no problem from the owners. We all consider it a community resource."

The political organization of this community lends itself to this kind of management as local decisions are agreed upon by the majority of the community of Oponguio. Community meetings are set up monthly to discuss any events or decisions that will involve or impact the community as a whole. This is a remnant of the historic P'urhépecha political process.

A cooperative was also formed to give community residents access to loans and as a way to save money without having to travel all the way to a commercial center bank. It is centered in the community of Oponguio but now extends to eight other neighboring communities in the area. Sixty eight members live in Oponguio. A savings account (fondo de ahorros) is available where a minimum of 10 and a maximum of 200 pesos must be deposited every week in order to

participate. Any loans that are provided accumulate 3% interest and are only given to community members to avoid collection difficulty. This is largely to cover management costs and so that lenders receive a small benefit for participation. The interest is given out at the end of every year in December. A member's money can be withdrawn at any time although a minimum of two to four weeks' notice is required. It is believed that this cooperative has been the difference between a successful livelihood strategy and extreme poverty for some participating families as it gave them start-up capital for activities that augment their household discretionary cash.

Figure 7-1. Map of Oponguio relative to Lake Pátzcuaro. A) It is approximately 50 kilometers around the lake; Courtesy of *www.segundamano.com*.

Figure 7-2. This is the *Hacienda* found at the head of the *barrio* for which it is named. A) It is the original structure and has been kept up since it was built before the Mexican Revolution; Courtesy of the author.

Figure 7-3. The local church; Courtesy of the author.

Figure 7-4. The primary school; Courtesy of the author.

Figure 7-5. A local woman selling produce in the large market in Quiroga; Courtesy of the author.

Figure 7-6. Public transportation: A *combi*; Courtesy of the author.

Figure 7-7. An example of a similar machine to the one used in agriculture. A) It is called the *Sembradora de precision* (precision planter) and acts similarly to the *dobladence*; Courtesy of the author.

Figure 7-8. Cattle grazing *rastrojo*; Courtesy of the author.

Figure 7-9. Local fisherman, courtesy of Carlos Villaseñor.

Figure 7-10. Charales after preparation for cooking, courtesy of the author.

Figure 7-11. Local fishermen, courtesy of Carlos Villaseñor.

Figure 7-12. Woman weaving traditional *petate* bed.

Figure 7-13. Woven baskets and assorted crafts for sale in front of a residence; Courtesy of author.

Figure 7-14. One of the typical mid-level houses in the community; Courtesy of the author.

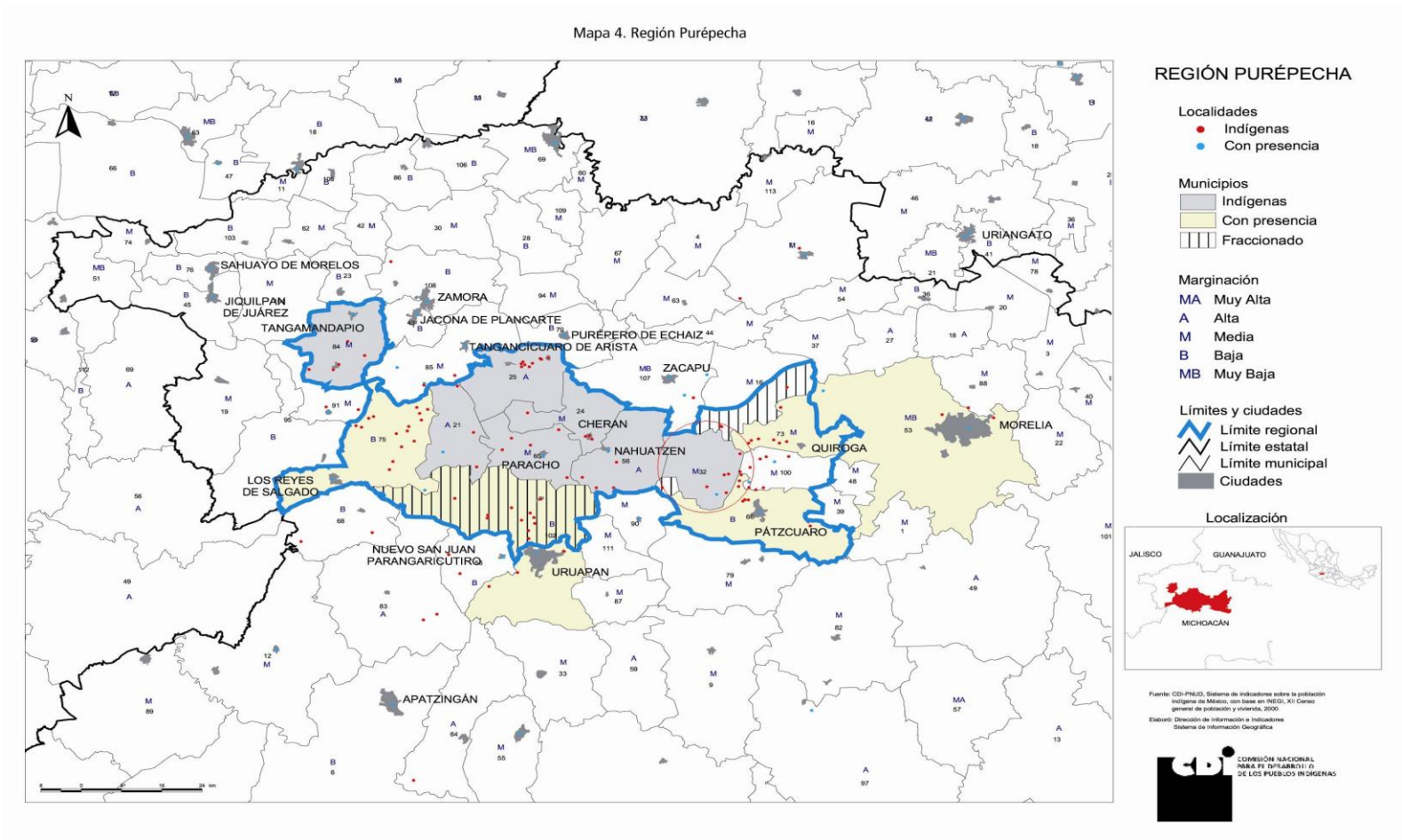

Figure 7-14. Map of marginalization and indigenous presence, Courtesy of the *Comisión Federal para el Desarrollo de los Pueblos Indígenas*. A) The study area, the municipality of Erongaricuaro is demarcated by a red circle between Nahuatzen and Pátzcuaro.

Table 7-1. Labor requirement activity calendar for livelihood system.

	Maize/frijol	*Cattle*	*Fishing*	*Petate*	*Tortillas*	*Orchids*	*Musico*	*Jardineria*	*trabajo fuera*	*limpieza*	*mesero*	*albanil*
January												
February												
March												
April												
May												
June												
July												
August												
September												
November												
December												

Labor Requirement	
light	
medium	
heavy	

CHAPTER 8
RESULTS

The results from the two scenarios that were modeled (as described in the Methods chapter) will be discussed in this section:

1) The earning potential without cost to producers (EPWCP); associated start-up costs.

2) The addition of credit (SUCC) at 15% compound interest payable at the end of 3 years along with the option of not using credit. An analysis was performed over 6 years and the outcome was comparable so that the initial 3 year analysis was elected in the interest of practicality and consistency with the previous scenario.

In order to test the EPWCP, the revenue started at 560 pesos per two-month period and decreased incrementally by half until reaching 0.000188 pesos. The cash amount used for orchid earnings in the SUCC scenario was a conservative 210 pesos for one hundred orchids and over each two-month period as this is the lowest amount that that these orchids bring in the local market. The amount of start-up cost was estimated at 600 pesos (Damon 2005).

The household livelihood strategies are briefly outlined at the beginning of each household section. In the interest of convenience, the headings for each household will contain the household number followed by the household composition in abbreviated form (ex. HH 1 *1 2 0 1 0,* as seen below). The first number represents the number of Adult Males, the second represents the number of Adult Females, and so on (refer to household composition table 6-1). This numeric representation will appear next to the corresponding household number when discussing individual households, for convenience.

HH 1 12010

Corn is produced for consumption only, which is not uncommon. The females participate in the *petate*-making activity while the adolescent male participates in the part-time

albañil (construction/carpentry) activity. The male activities were not impacted by the addition of the orchid activity. The livelihood activity that was impacted by the orchid activity was the making of *petate* which is a female activity.

The results from the EPWCP scenario showed that participation was unaffected by the amount of cash generated by the activity (Appendix A). Males participated equally regardless of how much the activity earned until revenue dropped to zero. Females produced 453 plants until the activity earned less than 140 pesos per two month unit of time. At that point, females dropped production to 385 plants where production stayed until the earning reached zero. Only when the earning potential reached zero was the activity abandoned by the model.

Male labor in year 1 was constraining in period III (Table 8-1) because of start-up labor requirements. Years 2 and 3 show a more even and consistent distribution of labor throughout the year and there was no time period when labor was completely used up. More female labor was utilized in year 2 and 3 than in year 1 (Table 8-1). Unused female labor was at a minimum in period VI and was non-existent in year 1. In years 2 and 3, unused female labor decreased and labor was more evenly distributed as the females participated more in the orchid activity than the *petate* activity. Male and female labor are limiting in period III for year 1 effectively determining the limit of participation in the orchid activity.

In the SUCC scenario, male participation (103 plants) dropped dramatically to 11 plants when credit decreased from 600 to 500 pesos. Participation by males completely stopped once credit went below 500 pesos (Fig. 8-1).

Female participation produced 453 plants when they received full credit. Once credit dropped from 600 to 500 pesos, participation dropped dramatically to 15 plants. Females continued to participate although participation remained low (10 plants and under) as credit was

reduced (Fig. 8-1). Females participated even when there was no credit to cover start-up costs although participation was limited to fewer than 10 plants.

In comparing the two scenarios (EPWCP vs. SUCC), female participation was higher when the value of the orchids was above 140 pesos per two month unit of time, producing 453 plants versus 385.

HH 4 11001

In this young household, corn is produced for household consumption. The Adult Female participates in the *limpieza* (house-cleaning) activity part time while the adult male participates in the *jardinero* (gardening) activity full time. The orchid activity did not impact participation in any of the original livelihood activities.

The results from the EPWCP scenario showed that participation in the orchid activity was unaffected by the amount of cash generated by the activity. Male participation remained constant at 206 plants and female participation stayed at 97 plants. Only when the earning potential reached zero was the activity abandoned by the model.

Male labor was not constraining for participation in the orchid activity in any of the time periods although it comes closest in period VI of year 1 (38 of a possible 43 days). Years 2 and 3 show a more even and consistent distribution through all time periods (Table 8-2). Between years 1 and 2 male unused labor increases, particularly in periods III (12 days), V (8 days) and VI (12 days). Labor remains consistent from year 2 to year 3. Participation in the *jardinero* activity is unaffected by the addition of the orchid activity.

Female labor was constraining in period VI of year 1, limiting participation in orchids, however, labor was more consistently and evenly distributed in years 2 and 3 with the addition of

the orchid activity. The female's participation in the *limpieza* activity was unaffected by the addition of the orchid activity.

The SUCC scenario showed that male participation decreased as credit decreased (Fig. 8-2). Initial male participation producing 206 plants dropped to 102 plants when credit was reduced to 300 pesos and continued to drop by approximately half each time credit was reduced. Female participation, however, was consistent regardless of credit amount staying at approximately 95 plants.

Participation was comparable in both the EPWCP and SUCC scenarios except in the case of male participation once credit dropped below 400 pesos at which point male participation decreased as credit decreased.

HH5 13002

In this cash-constrained household with abundant female labor, male labor is devoted to corn production for sale as well as for consumption. Females in this household do not participate in any cash generating activities because there is no demand for their services. Female labor is reduced a bit due to the presence of two children that require labor time.

The results from the EPWCP scenario showed that participation fluctuated when orchids brought in between 560 and 8.75 pesos per two month unit of time. Female unused labor increased slightly between years 1 and 2 for all periods except V and VI. In periods V and VI between years 1 and 2, unused labor goes up considerably – 9 days and 13 days, respectively. Female labor use is consistent between years 2 and 3 for all periods. Because of the cash constraint an relatively abundant labor, this household is ripe for emigration of the male member. However, this may not be possible because in this community women do not produce corn.

The SUCC scenario for this household showed that male participation dropped substantially after credit was reduced to 400 pesos and ceased completely after it dropped from

300 pesos. Female participation decreased slightly when credit dropped to 500 pesos and also ceased after credit dropped below 300 pesos (Table 8-3).

Comparing the two scenarios, male participation fluctuated as credit decreased and remained relatively constant in the EWPCP scenario. Females participated equally in the EWPCP and SUCC but only when there was full credit.

HH 6 31230

In this household with abundant male labor, corn is produced for sale as well as for consumption. The males dedicate labor to growing and selling corn as well as fishing for consumption. One of the males participates part time in the *jardinero* activity. There is also one male who lives outside of the household and sends remittances which are consistent and significant to the household income but does not impact consumption or add to available household labor. Females participate in the *limpieza* activity but no other income generating activity. The remittances that the family receives go to the adult female to cover household expenses. According to the ELP model, the female shares this cash with the male. The remittances, *limpieza*, *jardinero* and sharing activities were not impacted by the addition of the orchid activity. Corn production, however, goes up 193 kg in year 3 in the EPWCP scenario.

In the EPWCP scenario, the participation level for both males and females remained consistent (males producing 414 plants and females producing 555 plants) until revenue reached zero, at which point the model abandoned the activity (Appendix A).

Male labor was constraining in period II (Table 8-4) thus determining the limit of participation. This is also true in years 2 and 3.

Unused female labor was low as the orchid activity raised labor to 86 days in period VI in the first year, which is 2 days under the total available female labor for the household. However, female labor in all periods was consistent between years 2 and 3.

The SUCC scenario in this household showed that female participation dropped dramatically (from producing 555 plants to producing only 4) once credit decreased from 600 to 500 pesos. Female participation ceased altogether below 500 pesos of credit.

Male participation decreased when credit dropped from 600 to 500 pesos (from 414 plants to 389 plants). Production decreased more dramatically when credit dropped from 600 to 500 pesos (389 plants to 110 plants) and ceased completely once credit went below 400 pesos.

In comparing the two scenarios, participation was the identical between EPWCP and SUCC. However, when credit dropped below 600 pesos, participation also decreases in the SUCC scenario where there is no change in participation in the EPWCP scenario until the cash price for the orchids reaches zero.

HH 7 43000

In this mature household, corn is produced and fish are caught exclusively for household consumption. These are male dominated activities. There is also male labor allotted full time to the *jardinero* activity and the *albañil* activity quarter time. Female labor is allotted to the *limpieza* activity. The participation in these activities was unchanged by the addition of the orchid activity.

The EPWCP scenario showed that participation in the orchid activity remained constant (408 plants) for the females while male participation started at 909 plants and decreased to701 plants when cash generated by the activity dropped below 560 pesos per two month unit of time. After that drop in credit amount, male participation stays at 701 plants until the cash earnings reach zero.

Male labor was constraining in period III of year 1. In years 2 and 3 labor remained consistent between all periods.

Female labor remained consistent among years in all periods except in periods V and VI where unused labor increased 16 days and 25 days, respectively. Female labor in these periods remained consistent between years 2 and 3.

In the SUCC scenario, male participation ceased completely (from 669 plants to zero production) once credit dropped from 600 to 500 pesos (Fig. 5). Female participation decreased dramatically (from 408 plants to 19) when credit dropped from 600 to 500 pesos. Once credit dropped below 400 pesos, female participation was nominal showing a production of only 3-4 plants.

In comparing the two scenarios, participation by males is lower in the SUCC scenario even with full credit (dropping from 909 plants to 687 plants) while female participation is the same at full credit. Both male and female participation decreases as credit decreases, while participation remains constant in the EPWCP scenario regardless of cash generated by the orchid activity.

HH 8 21001

In this household with relatively abundant male labor, corn is grown both for both consumption and sale. The males devote their labor to this activity as well as fishing for consumption and cattle production for sale (as well as for milk for household consumption). One of the males works outside of the community to earn money for the household but contributes to household labor and consumption. Female labor is used in the *limpieza* activity which uses all but 2 days of her available labor (8 days) in year 1 and she has no available labor in years 2 or 3 in period I and comes within a day of using all available labor in periods II, III, IV and V (Table 8-6).

The amount of labor necessary for these activities uses all available male labor in period II for all years and all available female labor in period I in years 2 and 3 and leaves one day of

available labor for periods I-V in years 2 and 3. This makes participation in the orchid activity labor constraining and the model is unable to incorporate the orchid activity into the livelihood strategy for this household.

HH 16 43000

In this labor abundant and mature household, corn is grown by males for household consumption. Fishing by males for consumption is also present in this livelihood strategy. The males earn cash by participating in the *jardinero* and *albañil* activities full time. Females participate in the *limpieza* activity.

The EPWCP simulation showed male and female participation remained constant regardless of the cash amount generated by the activity. Males and females participated almost equally with males producing 400 plants and females producing 408 plants.

Labor was not constraining in any time period in any year for males or females, however, females came within two days of the total available labor (66 days) in period VI in the first year. Female labor remained consistent for all periods except for periods V and VI in year 1.

The SUCC scenario showed that males and females participate in the orchid activity at the same level as the EPWCP simulation regardless of the amount of credit available.

HH 19 02100

This is a female headed household. The adolescent male participates in growing corn for consumption. One of the women works as a *mesera* (waitress) full time and the adolescent male participates in odd jobs earning the equivalent of a *jardinero* working quarter time. According to the ELP model, the females shared cash with the male in the original scenario. However, once the orchid activity is incorporated, females shared with the male until year 3 when he had a surplus and shared with the females.

The results of the EPWCP scenario show that participation in the orchid activity remained consistent for both the male (188 plants) and females (157 plants) so that participation was unaffected by the amount of cash generated by the activity. Only when the earning potential reached zero was the activity abandoned by the model.

Available labor fluctuated across periods and across years for both males and females (Table 8-8). In some periods unused labor increased substantially. Maximum labor was reached in year 1, period VI for females and reached within a day of maximum labor for males in the third year during period VI.

The results of the SUCC scenario show that male participation remained consistent (188 plants) regardless of credit amount. Female participation, however, decreased from 157 plants to 97 plants once the credit amount drops to 300 pesos. Female participation continues to decrease as credit is reduced.

The comparison of participation between the two scenarios shows that participation in the orchid activity was consistent between the EPWCP and the SUCC scenarios until credit dropped below 300 pesos at which point participation decreased as credit decreased.

HH 21 21101

In this household with relatively abundant male labor, several activities that are participated in for household consumption only: growing corn, milk cow and fishing. These are predominantly male activities. The cash generating male activities consist of working outside the community (*fuera*), and livestock. The female participates in the *limpieza* activity to generate cash.

The amount of labor necessary for these activities uses all available male labor in period II in years 2 and 3 (Table 8-9). Female labor is also constraining as there is less than a full day available in periods I-V for all years. These labor constraints prohibit participation in the orchid

activity and the model does not incorporate the orchid activity into the livelihood strategy for this household under either scenario.

HH 31 21203

This household has abundant adult and adolescent male labor and highly limiting female labor because of the number of children. Corn is produced and fish are caught exclusively for household consumption. Male labor is devoted to these activities as well as devoting full time labor to the *albañil* activity (construction/carpentry). The female has very little labor available due to the three children that constrain female labor and prior to the orchid activity does not participate in any cash generating activities. The addition of the orchid activity does not impact male participation in the other cash generating activities as the labor devoted to those activities does not change.

The results of the EPWCP scenario show that female participation remained constant and low (only producing 16 plants) throughout the three year simulation but did not cease until cash value reached zero (Appendix A). Male participation, however, remained constant until the cash value per two month approached zero (0.000375 pesos).

Male labor is not constraining in any time period, even with the addition of the orchid activity(Table 8-10). In fact, unused male labor goes up considerably in the third year in periods I, II and III. Female labor remained consistent in all periods for years 2 and 3. There is no unused female labor in period III and VI and only a fraction of a day available in period V in year 1. In years 2 and 3 there is less than one day of unused female labor.

The results of the SUCC scenario show that male participation decreased from 202 plants to 59 plants as credit was reduced from 600 to 500 pesos (Fig. 8-8). There was a further decline in participation (from 59 to 21 plants) as credit dropped from 500 to 400 pesos. Once credit was

reduced from 300-200 pesos, male participation dropped below 10 plants. Male participation ceased once credit dropped below 200 pesos.

Female participation remained low and constant (16 plants) until credit dropped below 200 pesos, at which point female participation dropped gradually. Female participation, although low, did not cease even when there was no available credit.

A comparison of the SUCC and EPWCP scenarios shows that initial participation is consistent in both scenarios when there is full credit and the cash value does not fall below 0.000375 for males, respectively.

Discussion

Individual Households

In HH 1, the only income generating activity impacted by the addition of the orchid activity was *petate*. When end cash is maximized, the activity that earns more per unit of labor is favored. In this case, the orchid activity has more cash earning potential than the petate activity and is therefore favored. The *petate* activity is not abandoned, however. This is probably because there is enough surplus labor to allow for participation in both activities and the model considers the petate activity lucrative and labor inexpensive enough to continue participation. Female participation varies depending on credit available in the SUCC scenario and earning potential in the EPWCP scenario. This is likely because the model considers *petate* more remunerative per unit of time once orchids drop below 140 pesos.

In HH 4, female participation was consistent regardless of credit. The cash sharing activity showed that the male supplied the necessary cash for her to continue participation.

HH 5 the fluctuations in labor are due to the need to give males a large amount of start-up cash (7500 pesos) to make the model feasible to run the scenarios. This means that the male of the household is able to produce more in year 1 (according to the model) because of start-up

capital. In year 2, the male can only expand the activity to the amount of cash that was transferred from year 1 to year 2 and is this limited as the amount is less than the start up cash that was inserted for year 1. Labor goes back up in year 3 as the male expands labor into the orchid activity as year 2 yielded less cash than was available in year 1 for the corn activity.

HH 6 shows that there was positive impact on one of the subsistence activities-- corn production goes up goes up 193 kg in year 3. The model shows that female cash sharing with the male allows him to grow more corn in year 3. It is interesting that the female participation stopped when credit dropped from 600 to 500 pesos where the male did not stop until credit dropped below 400 pesos. This is likely due to the greater number of adult males (3) than females (1) in the household thus raising the quantity of available adult male labor for income generating activities and therefore the amount of discretionary cash available to fund the activity.

It is notable that in HH 7, male and females ceased participation in the orchid activity once credit dropped below 500 pesos. This household is able to participate in all of the livelihood activities present in their household strategy because there is a more mature household composition and the members were able to establish a livelihood strategy that includes non-farm labor.

HH 16 is a more economically stable household, having all household members of adult working age and participating in steady cash generating activities. It is interesting that, due to surplus labor, all household members of working age appear to participate in the orchid activity. Males and females participated consistently regardless of scenario likely due to higher discretionary cash available to household members. It is interesting to note that females share cash with males for year 1 and then males share with females in years 2 and 3. Credit did not

impact participation at all, which is likely due to the available cash and sharing that allows for household members to participate regardless of credit availability.

It is noteworthy in HH 19 that females share cash with the adolescent male thus making male involvement in the activity possible. However, in year 3 the Adolescent male in the household shared with the females. Male unused labor decreases between year 2 and 3 in periods V (5 days) and VI (13 days). This was likely due to the different labor requirements per time period for farming which was increased as a result of the increased cash available and increased participation in the corn growing activity.

General Observations

It is clear that agricultural activities are still the main activity as food production for household consumption is common in the majority of the households in this study, as well as across various Latin American countries. Davis et al (2007) talk about the importance and interrelation of agriculture and non-farm activities:

"In rural areas, this implies that a shrinking agricultural sector and expanding rural non-farm (RNF) activities, as well as a changing definition of rural itself, should be viewed as likely features of economic development. The available empirical evidence unequivocally points out to the existence of a large RNF economy. While few data sources exist which allow for consistent measurement of changes in RNF income and employment over time, available information points to an increasing role for RNF activities. It would be misleading, however, to see this growth in RNF activities in isolation from agriculture, as both are linked through investment, production and consumption throughout the rural economy, and both form part of complex livelihood strategies adopted by rural households."

Of the 31 households interviewed for this study, ten households elected to participate in the ELP modeling. Eight, according to these results, would be able to participate in the orchid activity. Two households would be unable to participate due to labor constraints. It is significant to mention that none of the original livelihood activities were abandoned as a result of the presence of the orchid activity (with or without start-up costs) although there were some impacts on the labor allocated to the *petate* and corn activities.

The labor tables show that all households adopted the orchid activity to utilize unused resources (labor) where they were available but did not compromise the other income generating activities. The consistent increase in unused male and female labor after year 1 in all scenarios is due to the decrease in labor requirement for the orchid activity in years 2 and 3. There is a greater labor requirement in year 1 due to initial preparation activities of the *ex-situ* habitat. The vast majority of the unused labor in all of the households was allocated to the orchid activity when start up costs were not constraining. If all available labor is used in the first year, then that limits participation in subsequent years.

Even based on a conservative amount of cash earned for orchid sales, in several households the orchid activity substantially raised the cash earned at the end of three years for orchid growers. In some cases, it was the difference between having discretionary cash or not having any cash at all.

While production time is sometimes a barrier to participation, there are many successes in the case of tree crops and other perennial crops (*e.g., Agave*). In the case of the orchids used in this study, *Euchile citrina* and *Laelia autumnalis*, the development period ranges from 2 to 5 years to (flower) but the plants without flower are marketable at a lower return by the first or second year. This is where the pressure is high for extraction of wild populations, as opposed to

cultivating them, because the return is relatively immediate in the market. However, besides selling plants that are reproductively mature (flowering) there is also the option of selling "slants" where orchid plants are in early stages of development but come with a picture of the eventual flower and instructions for their care. These could be sold to tourists at a low price and generate income within the first and certainly second year of production. They would be a direct result of cultivation and help alleviate pressure on wild populations.

These results and their implications support the previously cited literature and that shows how diversification "makes sense" in these places. Activities are chosen based on earned cash per unit of labor as well as utilizing surplus labor when alternatives are available. In the absence of a variety of cash generating alternatives, any activity that generates cash, however small will be utilized.

Table 8-1. Labor availability and use by season and year with no cash cost (EPWCP) for HH1.

HH 1 Available Labor (days) by 2 month period	Yr 1	Yr 2	Yr 3
Male labor I (43)	35.03	35.03	35.03
Male labor II	34.28	34.28	34.28
Male labor III	43	36.83	36.83
Male labor IV	35.03	35.03	35.03
Male labor V	38.39	34.28	34.28
Male labor VI	34.7	28.53	28.53
Female Labor I (66)	39.17	66	66
Female Labor II	38.96	54.24	54.24
Female Labor III	66	54.24	54.24
Female Labor IV	38.96	54.24	54.24
Female Labor V	56.99	54.24	54.24
Female Labor VI	65.92	50.04	50.04

Table 8-2. Labor availability and use by season and year with no cash cost (EPWCP) for HH4.

Labor HH 4 Available Labor (days) per 2 month period	Yr 1	Yr 2	Yr 3
Male labor I (43)	21.66	21.66	21.66
Male labor II	21.16	21.16	21.16
Male labor III	35.20	22.86	22.86
Male labor IV	21.66	21.66	21.66
Male labor V	29.39	21.16	21.16
Male labor VI	38.00	25.66	25.66
Female Labor I (17)	11.32	11.32	11.32
Female Labor II	11.32	11.32	11.32
Female Labor III	11.32	11.32	11.32
Female Labor IV	11.32	11.32	11.32
Female Labor V	15.11	11.32	11.32
Female Labor VI	16.00	10.32	10.32

Table 8-3. Labor availability and use by season and year with no cash cost (EPWCP) for HH5.

Labor HH 5 Available labor (days) per 2 month period	Yr 1	Yr 2	Yr 3
Male labor I (43)	14.34	12.71	14.78
Male labor II	12.25	11.30	12.51
Male labor III	26.34	16.08	20.23
Male labor IV	14.34	12.71	14.78
Male labor V	16.92	11.30	12.51
Male labor VI	38.00	23.95	32.93
Female Labor I (56)	18.63	17.00	17.00
Female Labor II	18.63	17.00	17.00
Female Labor III	18.63	17.00	17.00
Female Labor IV	18.63	17.00	17.00
Female Labor V	26.25	17.00	17.00
Female Labor VI	30.06	17.00	17.00

Table 8-4. Labor availability and use by season and year with no cash cost (EPWCP) for HH6.

HH 6 Available Labor (days) by 2 month period	Yr 1	Yr 2	Yr 3
Male labor I (180)	111.37	111.02	111.70
Male labor II	179.81	179.61	180.00
Male labor III	71.06	45.55	46.90
Male labor IV	40.57	40.22	40.90
Male labor V	54.76	38.01	38.40
Male labor VI	84.29	57.97	60.90
Female Labor I (88)	54.68	54.68	54.68
Female Labor II	54.68	54.68	54.68
Female Labor III	54.68	54.68	54.68
Female Labor IV	54.68	54.68	54.68
Female Labor V	76.89	54.68	54.68
Female Labor VI	86.00	52.68	52.68

Table 8-5. Labor availability and use by season and year with no cash cost (EPWCP) for HH7.

HH 7 Available labor (days) by 2 month period	Yr 1	Yr 2	Yr 3
Male labor I (172)	128.54	128.54	128.54
Male labor II	127.14	127.14	127.14
Male labor III	172.00	131.88	131.88
Male labor IV	73.34	73.34	73.34
Male labor V	98.69	71.94	71.94
Male labor VI	118.35	78.23	78.23
Female Labor I (66)	41.52	41.52	41.52
Female Labor II	41.52	41.52	41.52
Female Labor III	41.52	41.52	41.52
Female Labor IV	41.52	41.52	41.52
Female Labor V	57.84	41.52	41.52
Female Labor VI	64.00	39.52	39.52

Table 8-6. Labor availability and use by season and year with no cash cost (EPWCP) for HH8.

Labor HH 8 Available labor (days) per 2 month period	Yr 1	Yr 2	Yr 3
Male labor I (86)	58.26	60.95	60.95
Male labor II	86.00	86.00	86.00
Male labor III	32.00	41.15	41.15
Male labor IV	29.46	32.15	32.15
Male labor V	28.40	28.40	28.40
Male labor VI	37.92	62.15	62.15
Female Labor I (8)	6.50	8.00	8.00
Female Labor II	6.50	7.13	7.13
Female Labor III	6.50	7.13	7.13
Female Labor IV	6.50	7.13	7.13
Female Labor V	6.50	7.13	7.13
Female Labor VI	4.50	4.81	4.81

Table 8-7. Labor availability and use by season and year with no cash cost (EPWCP) for HH16.

Labor HH 16 Available labor (days) per 2 month period	Yr 1	Yr 2	Yr 3
Male labor I (172)	144.61	144.61	144.61
Male labor II	143.22	143.22	143.22
Male labor III	172.00	147.95	147.95
Male labor IV	89.41	89.41	89.41
Male labor V	104.05	88.02	88.02
Male labor VI	99.60	75.55	75.55
Female Labor I (66)	41.52	41.52	41.52
Female Labor II	41.52	41.52	41.52
Female Labor III	41.52	41.52	41.52
Female Labor IV	41.52	41.52	41.52
Female Labor V	57.84	41.52	41.52
Female Labor VI	64.00	39.52	39.52

Table 8-8. Labor availability and use by season and year with no cash cost (EPWCP) for HH19.

Labor HH 19 Available labor (days) per 2 month period	Yr 1	Yr 2	Yr 3
Male labor I (35)	17.38	17.38	16.80
Male labor II	16.80	16.80	18.75
Male labor III	30.00	18.75	17.38
Male labor IV	17.38	17.38	16.80
Male labor V	24.31	16.80	21.95
Male labor VI	33.20	21.95	34.57
Female Labor I (44)	34.57	34.57	34.57
Female Labor II	34.57	34.57	34.57
Female Labor III	34.57	34.57	34.57
Female Labor IV	34.57	34.57	34.57
Female Labor V	40.86	34.57	34.57
Female Labor VI	44.00	34.57	0.00

Table 8-9. Labor availability and use by season and year with no cash cost (EPWCP) for HH21.

HH 21 Available labor (days) per 2 month period	Yr 1	Yr 2	Yr 3
Male labor I (116)	67.68	82.96	82.96
Male labor II	102.72	116	116
Male labor III	35.68	56.92	56.92
Male labor IV	30.48	44.92	44.92
Male labor V	28.32	39.92	39.92
Male labor VI	36.55	58.92	58.92
Female Labor I (8)	7.25	7.25	7.25
Female Labor II	7.25	7.25	7.25
Female Labor III	7.25	7.25	7.25
Female Labor IV	7.25	7.25	7.25
Female Labor V	7.25	7.25	7.25
Female Labor VI	5.25	5.25	5.25

Table 8-10. Labor availability and use by season and year with no cash cost (EPWCP) for HH31.

HH 31 Available labor (days) per 2 month period	Yr 1	Yr 2	Yr 3
Male labor I (140)	124.62	124.62	69.42
Male labor II	123.26	123.26	68.06
Male labor III	140.00	127.88	72.68
Male labor IV	69.42	69.42	69.42
Male labor V	76.14	68.06	68.06
Male labor VI	67.40	55.28	55.28
Female Labor I(7)	6.04	6.04	6.04
Female Labor II	6.04	6.04	6.04
Female Labor III	7.00	6.04	6.04
Female Labor IV	6.04	6.04	6.04
Female Labor V	6.68	6.04	6.04
Female Labor VI	7.00	6.04	6.04

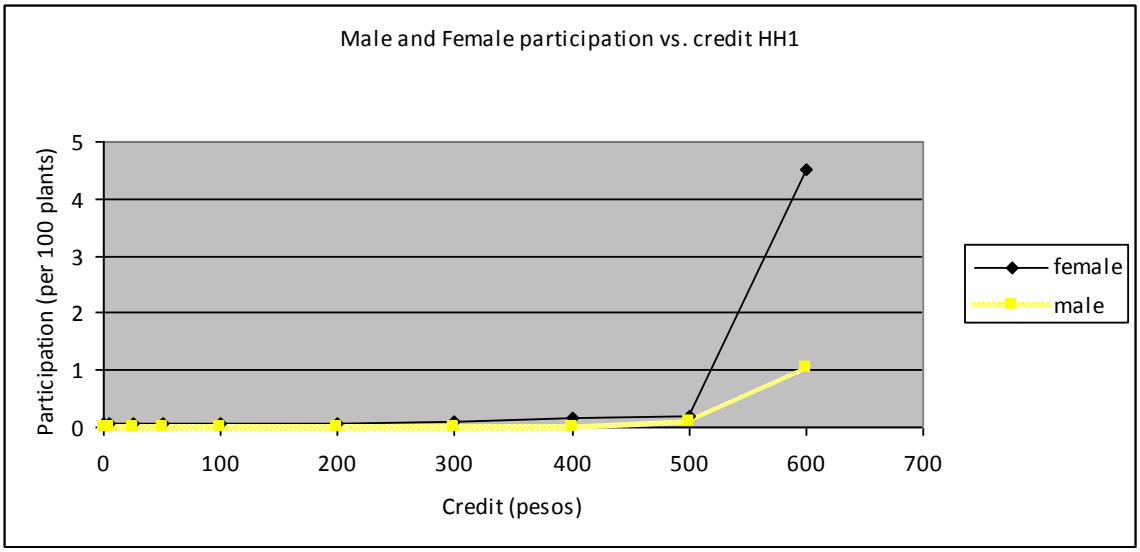

Figure 8-1. Male and female participation vs. credit in SUCC scenario for HH1.

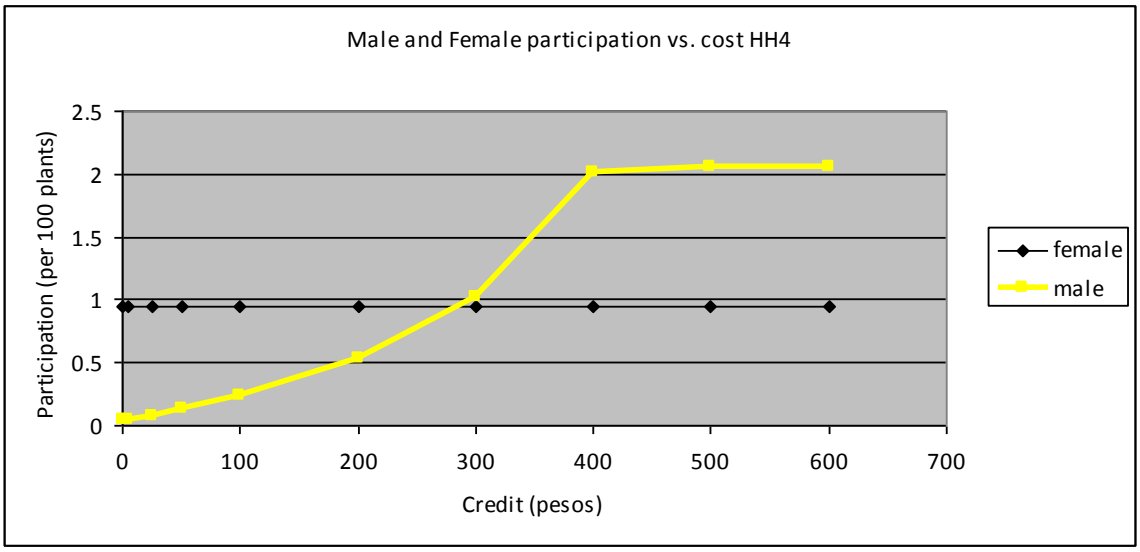

Figure 8-2. Male and female participation vs. credit in SUCC scenario for HH4.

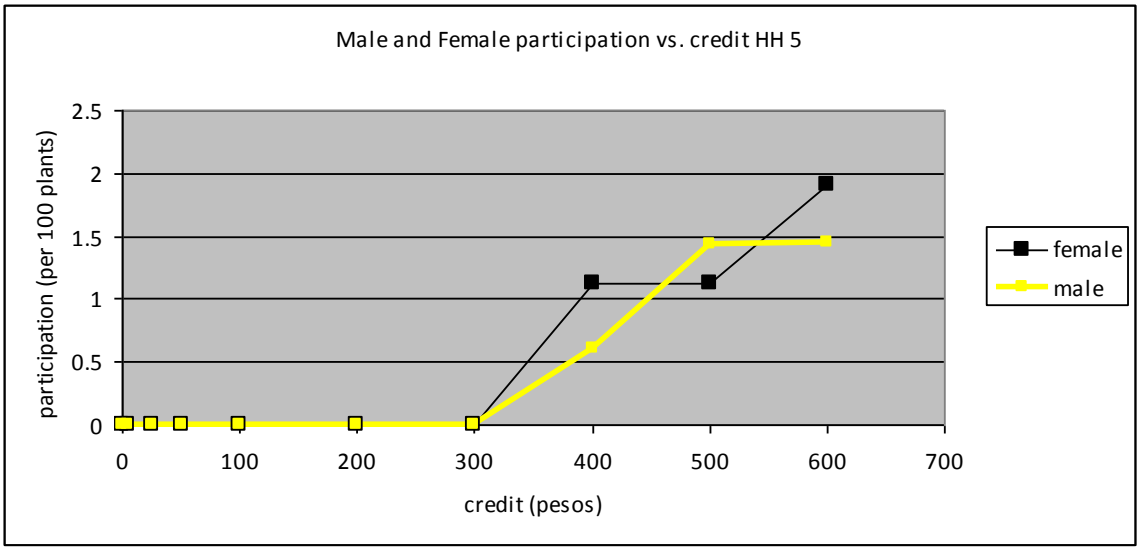

Figure 8-3. Male and female participation vs. credit in SUCC scenario for HH5.

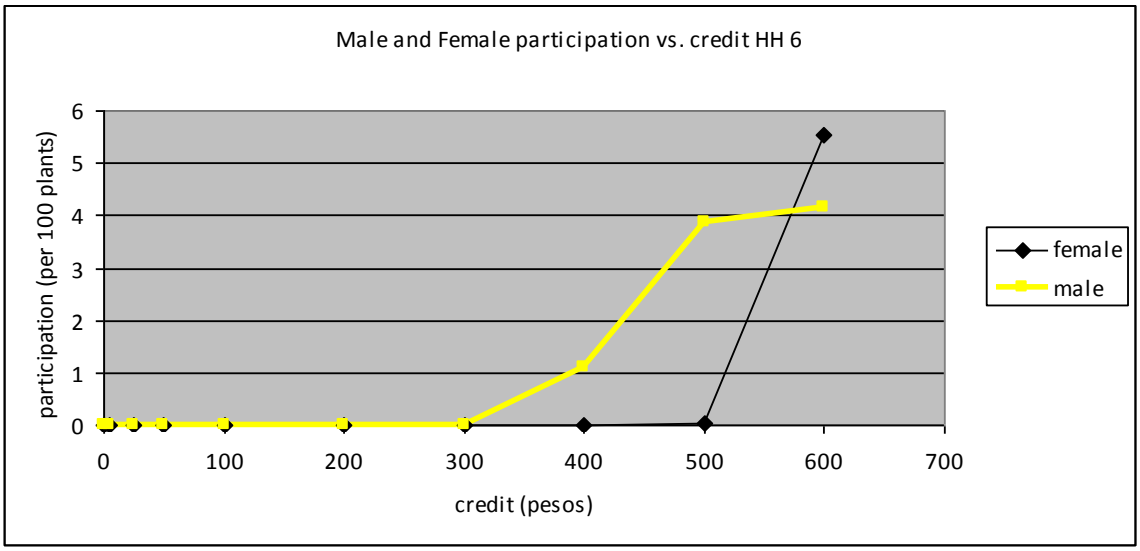

Figure 8-4. Male and female participation vs. credit in SUCC scenario for HH6.

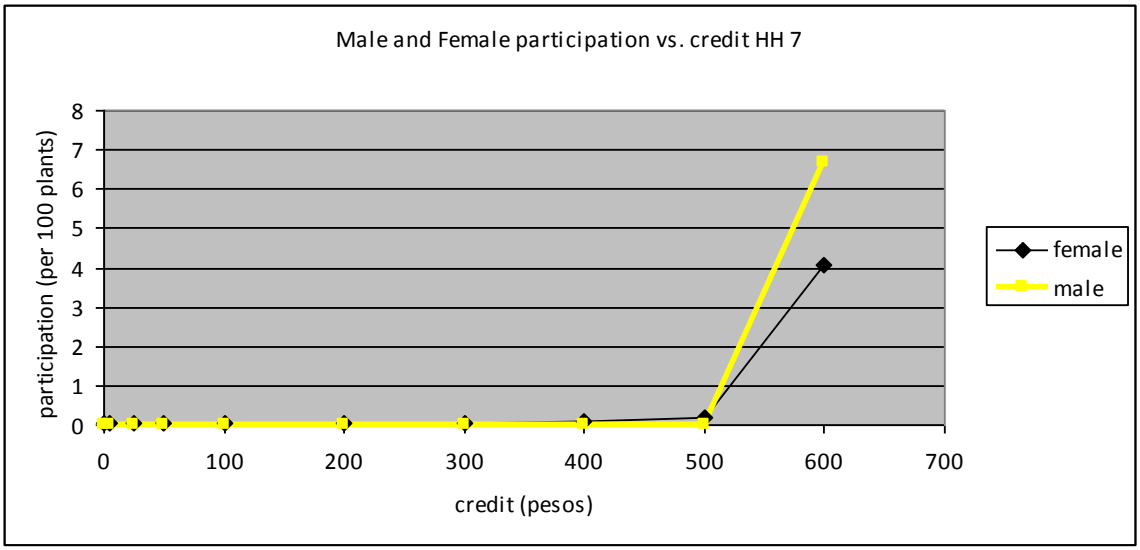

Figure 8-5. Male and female participation vs. credit in SUCC scenario for HH7.

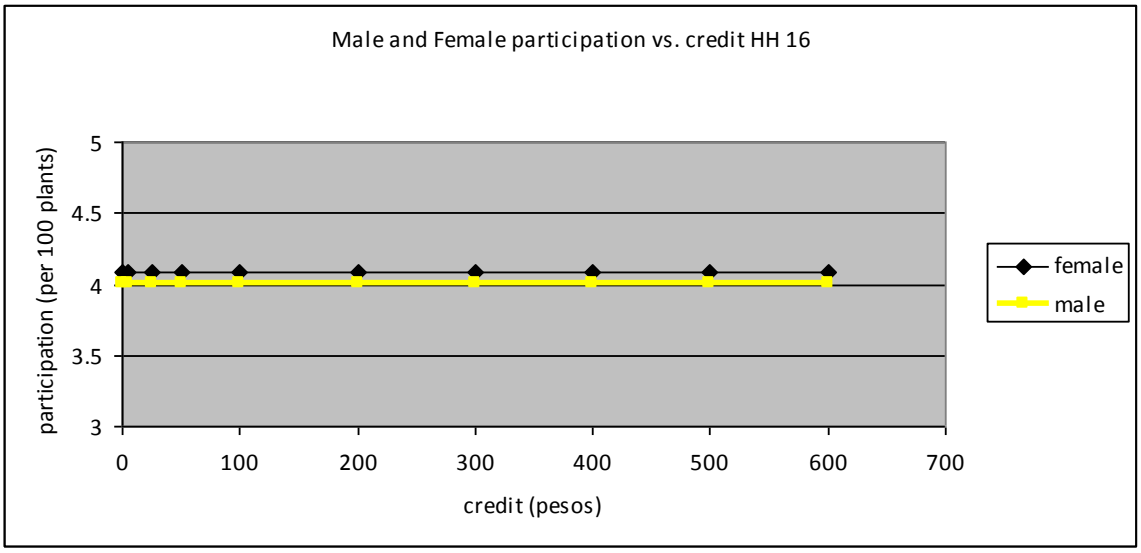

Figure 8-6. Male and female participation vs. credit in SUCC scenario for HH16.

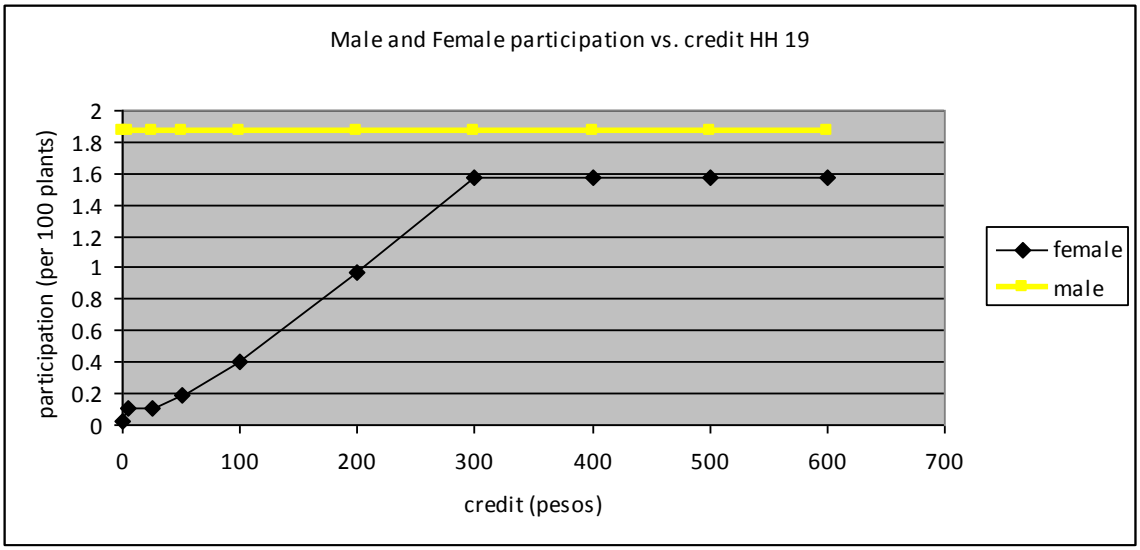

Figure 8-7. Male and female participation vs. credit in SUCC scenario for HH19.

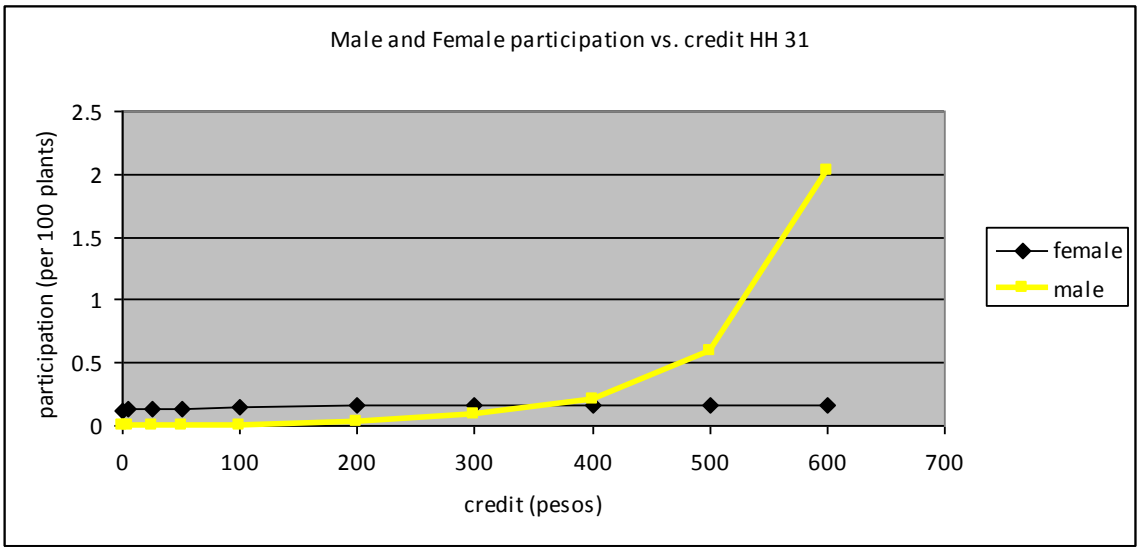

Figure 8-8. Male and female participation vs. credit in SUCC scenario for HH31.

CHAPTER 9
CONCLUSIONS AND RECOMMENDATIONS

This study is an *ex-ante* analysis of the impacts and viability that introducing an orchid cultivating activity would have on the small-scale livelihood system of the community of Oponguio, Michoacán. There is also a conservation aspect of the cultivation activity that is integral in assuring the sustainability (in the literal and development sense) of the cultivating activity as well as improving the environmental integrity of the protected forest area established by the community. Thirty-one of the eighty or so households participated in the Sondeo and ten participated in the modeling process. Eight of the ten households that were chosen to participate, were chosen based on willingness to participate in the modeling process and showed great interest in the orchid cultivating activity. The other two households were chosen to demonstrate how labor can be a limiting factor in accepting a new activity into the livelihood strategy.

The goal was to determine the viability and general impacts of the addition of the orchid activity for commercialization and conservation purposes on the livelihood strategies of various households through Ethnographic Linear Program modeling. It was also to consider the viability of the orchid activity based on historic success and traditional knowledge. The results supported the hypothesis that the households' discretionary income would be substantially increased by the addition of the orchid activity. The literature review supported the viability of the activity based on historic success and traditional knowledge.

The two factors that were equally influential in participation in the orchid activity were labor availability and available cash (this includes credit and refers to the presence of start up costs). The results for all households show that those that have the available labor to participate can participate if there is no start-up cost that they have to cover, or if there is credit available for the start-up costs. The models also show that in general, the higher the proportion of start-up

costs covered by credit, the greater the participation. Households with sufficient surplus cash have greater potential to participate when start-up costs are present. In most cases, participation by household members (male and female) remained consistent regardless of the amount (high or low) of cash generated by the orchid activity when there were no start-up costs. This is due to the presence of substantial unused labor and the absence of alternative cash generating activities.

The projected return for the orchid activity was conservative and based on the minimum amount possible for orchids in the market. Notwithstanding, the activity was still substantial in augmenting the households' end cash in all cases and in some cases, the orchid activity was the difference between having discretionary cash or not- sometimes it even made a difference in augmenting other production activities. It is also interesting to note that participation occurred in many households regardless of how much the orchid activity earned. Frequently, development programs are disregarded because the return is low and appears nominal. In a study of diverse livelihoods, Shackleton et al. (2007) emphasize that commercialization activities should not be rejected if the economic return for a natural resource product is not sizeable. They go on to explain that households in rural communities participate in livelihood activities for different reasons and with differing goals in mind making each household and each community distinct. This is very much supported in this analysis for the community of Oponguio.

Interestingly, based on the results of the models, there is little likelihood that orchids (particularly in the local market and with widespread participation), in this community of abundant labor, would make enough money per unit time to take labor priority away from other activities with greater remuneration. Also, greater remuneration for the orchid activity does not lower the utility of the services that are provided by service and production activities like farming, *albañil* (construction/carpentry), *jardinero*(gardening), *musico* (music), *limpieza*

(cleaning) and *mesero* (restaurant work), etc. This is supportive of the research that underscores the importance and relevance of rural livelihood diversity.

Utility of This Research

Looking at the over-all implications for this particular program, even though there was no cash return until the third year in the simulations there was substantial participation in all households with available labor and access to credit (if necessary). This supports the benefit from having a broad activity base to choose from when there is limited demand for other cash generating activities in the livelihood system. Orchids as natural products in this area worked very well as a cash generating activity in the simulations. This, combined with the existence of an established market niche for them (particularly *Laelia autumnalis*) due to their cultural and ornamental value, significantly increase likelihood of implementation. The precise details of the application of the orchid development plan might vary a bit in reality but the trends will very likely be those demonstrated by this study since the household priorities are very much reflected in the model-- maximizing end cash and utilizing available labor while first prioritizing household consumption needs. This combined with available labor and willingness to participate means a high likelihood of success with possibilities for further natural product activities with similar cash generating potential in the future. These results also support the research that such activities have great potential to aid in poverty alleviation, as well as increased economic stability and resilience for rural communities.

Recommendations

In order to initiate an organized market activity, there is some level of start up capital and capacity building necessary. Support for communities in diversifying their activities allows for the possibility of the natural progression of subsistence into specialization thus aiding in the eventual alleviation of rural poverty. In this way the process can be adaptive versus abrupt:

subsistence activities are not abandoned while cash generating alternatives are explored in order to improve quality of life and improve household economic stability. This is where external involvement and infrastructural support is beneficial and required. In cases like this one, community participants require support and training. Researchers trained in orchid propagation and conservation would mean the difference between success and failure in the start-up of the activity as there is a wide research base from which to draw that is not directly accessible by community members. Strong, long-term links are imperative in the implementation of the proposed program and others like it.

Further, it is important to remember that socio-economic development programs and ecological research have been ongoing in this area for more than a decade. Orchids have been an evasive, charismatic species with the potential to bridge these diverse efforts. Participation, particularly with the involvement of the University of Michoacán in asymbiotic (non-miccorhizal) propagation and conservation, is viable for even the poorest households with available labor. It is not unreasonable that the university participate in the conservation aspect of this project as it would simply mean continuing the work that has already been started. University participation is key in the orchid conservation effort and particularly the initial seed propagation.

Development programs, like the one proposed, must be focused on aiding the households in diversifying livelihood activities based on local resources, traditions and need. In accordance with the literature, Oponguio is an ideal place to implement this kind of joint venture between the university and the community. Infrastructure is in place to conserve habitat (the conservation area established by the community which is also protected by the community and the state). The area has historically been traditional habitat for these and other orchids, and there is a significant

ecological research base to draw from for long term management. These factors and the results of this study signify a real possibility to locally resolve the conundrum of long-term sustainable development and conservation of natural products.

APPENDIX A
DATA

The following tables represent the data from the EPWCP scenario for all households modeled.

Table A-1. EPWCP data for HH1.

HH1	yr 1	yr 1		
Prices	**M orchid**	**F orchid**	***low value***	***high value***
560	1.028571	4.526786	**-420**	**-840**
280	1.028571	4.526786	**-210**	**-420**
140	1.028571	4.526786	**-105**	**-210**
70	1.028571	3.855208	**-52.5**	**-105**
35	1.028571	3.855208	**-26.25**	**-52.5**
17.5	1.028571	3.855208	**-13.125**	**-26.25**
8.75	1.028571	3.855208	**-6.56**	**-13.125**
4.38	1.028571	3.855208	**-3.28**	**-6.56**
2.19	1.028571	3.855208	**-1.64**	**-3.28**
1.10	1.028571	3.855208	**-0.82**	**-1.64**
0.55	1.028571	3.855208	**-0.41**	**-0.82**
0.28	1.028571	3.855208	**-0.21**	**-0.41**
0.14	1.028571	3.855208	**-0.1**	**-0.21**
0.07	1.028571	3.855208	**-0.051**	**-0.051**
0.035	1.028571	3.855208	**-0.026**	**-0.026**
0.018	1.028571	3.855208	**-0.0128**	**-0.026**
0.012	1.028571	3.855208	**-0.0064**	**-0.0128**
0.006	1.028571	3.855208	**-0.0032**	**-0.0064**
0.003	1.028571	3.855208	**-0.0016**	**-0.0032**
0.0015	1.028571	3.855208	**-0.008**	**-0.0016**
0.00075	1.028571	3.855208	**-0.0004**	**-0.008**
0.000375	1.028571	3.855208	**-0.0002**	**-0.0004**
0.000188	1.028571	3.855208	**-0.0001**	**-0.0002**

Table A-2. EPWCP data for HH4.

HH4

Prices	M orchid	F orchid	*low value*	*high value*
560	2.057143	0.946429	**-420**	**-840**
280	2.057143	0.946429	**-210**	**-420**
140	2.057143	0.946429	**-105**	**-210**
70	2.057143	0.946429	**-52.5**	**-105**
35	2.057143	0.946429	**-26.25**	**-52.5**
17.5	2.057143	0.946429	**-13.125**	**-26.25**
8.75	2.057143	0.946429	**-6.56**	**-13.125**
4.375	2.057143	0.946429	**-3.28**	**-6.56**
2.19	2.057143	0.946429	**-1.64**	**-3.28**
1.10	2.057143	0.946429	**-0.82**	**-1.64**
0.55	2.057143	0.946429	**-0.41**	**-0.82**
0.28	2.057143	0.946429	**-0.21**	**-0.41**
0.14	2.057143	0.946429	**-0.1**	**-0.21**
0.07	2.057143	0.946429	**-0.051**	**-0.051**
0.035	2.057143	0.946429	**-0.026**	**-0.026**
0.018	2.057143	0.946429	**-0.0128**	**-0.026**
0.012	2.057143	0.946429	**-0.0064**	**-0.0128**
0.006	2.057143	0.946429	**-0.0032**	**-0.0064**
0.003	2.057143	0.946429	**-0.0016**	**-0.0032**
0.0015	2.057143	0.946429	**-0.008**	**-0.0016**
0.00075	2.057143	0.946429	**-0.0004**	**-0.008**
0.000375	2.057143	0.946429	**-0.0002**	**-0.0004**
0.000188	2.057143	0.946429	**-0.0001**	**-0.0002**

Table A-3. EPWCP data for HH5.

HH5				
Prices	**M orchid**	**F orchid**	***low value***	***high value***
560	0.824964	0.423439	**-420**	**-840**
280	1.469563	1.387972	**-210**	**-420**
140	1.412639	1.90625	**-105**	**-210**
70	1.333311	1.90625	**-52.5**	**-105**
35	1.28174	1.90625	**-26.25**	**-52.5**
17.5	1.256565	1.90625	**-13.125**	**-26.25**
8.75	1.244127	1.90625	**-6.56**	**-13.125**
4.375	1.237944	1.90625	**-3.28**	**-6.56**
2.19	1.237944	1.90625	**-1.64**	**-3.28**
1.10	1.233331	1.90625	**-0.82**	**-1.64**
0.55	1.232558	1.90625	**-0.41**	**-0.82**
0.28	1.232179	1.90625	**-0.21**	**-0.41**
0.14	1.231982	1.90625	**-0.1**	**-0.21**
0.07	1.231884	1.90625	**-0.051**	**-0.051**
0.035	1.231884	1.90625	**-0.026**	**-0.026**
0.018	1.231884	1.90625	**-0.0128**	**-0.026**
0.012	1.231884	1.90625	**-0.0064**	**-0.0128**
0.006	1.231884	1.90625	**-0.0032**	**-0.0064**
0.003	1.231884	1.90625	**-0.0016**	**-0.0032**
0.0015	1.231884	1.90625	**-0.008**	**-0.0016**
0.00075	1.231884	1.90625	**-0.0004**	**-0.008**
0.000375	1.231884	1.90625	**-0.0002**	**-0.0004**
0.000188	1.231884	1.90625	**-0.0001**	**-0.0002**

Table A-4. EPWCP data for HH6.

HH6

Prices	M orchid	F orchid	*low value*	*high value*
560	4.1375	5.553571	**-420**	**-840**
280	4.1375	5.553571	**-210**	**-420**
140	4.1375	5.553571	**-105**	**-210**
70	4.1375	5.553571	**-52.5**	**-105**
35	4.1375	5.553571	**-26.25**	**-52.5**
17.5	4.1375	5.553571	**-13.125**	**-26.25**
8.75	4.1375	5.553571	**-6.56**	**-13.125**
4.375	4.1375	5.553571	**-3.28**	**-6.56**
2.19	4.1375	5.553571	**-1.64**	**-3.28**
1.10	4.1375	5.553571	**-0.82**	**-1.64**
0.55	4.1375	5.553571	**-0.41**	**-0.82**
0.28	4.1617	5.553571	**-0.21**	**-0.41**
0.14	4.1617	5.553571	**-0.1**	**-0.21**
0.07	4.1617	5.553571	**-0.051**	**-0.051**
0.035	4.1617	5.553571	**-0.026**	**-0.026**
0.018	4.1617	5.553571	**-0.0128**	**-0.026**
0.012	4.1617	5.553571	**-0.0064**	**-0.0128**
0.006	4.1617	5.553571	**-0.0032**	**-0.0064**
0.003	4.1617	5.553571	**-0.0016**	**-0.0032**
0.0015	4.1617	5.553571	**-0.008**	**-0.0016**
0.00075	4.1617	5.553571	**-0.0004**	**-0.008**
0.000375	4.1617	5.553571	**-0.0002**	**-0.0004**
0.000188	4.1617	5.553571	**-0.0001**	**-0.0002**

Table A-5. EPWCP data for HH7.

HH7

Prices	M orchid	F orchid	*low value*	*high value*
560	9.090306	4.080357	**-420**	**-840**
280	7.014286	4.080357	**-210**	**-420**
140	7.014286	4.080357	**-105**	**-210**
70	7.014286	4.080357	**-52.5**	**-105**
35	7.014286	4.080357	**-26.25**	**-52.5**
17.5	7.014286	4.080357	**-13.125**	**-26.25**
8.75	7.014286	4.080357	**-6.56**	**-13.125**
4.375	7.014286	4.080357	**-3.28**	**-6.56**
2.19	7.014286	4.080357	**-1.64**	**-3.28**
1.10	7.014286	4.080357	**-0.82**	**-1.64**
0.55	7.014286	4.080357	**-0.41**	**-0.82**
0.28	7.014286	4.080357	**-0.21**	**-0.41**
0.14	7.014286	4.080357	**-0.1**	**-0.21**
0.07	7.014286	4.080357	**-0.051**	**-0.051**
0.035	7.014286	4.080357	**-0.026**	**-0.026**
0.018	7.014286	4.080357	**-0.0128**	**-0.026**
0.012	7.014286	4.080357	**-0.0064**	**-0.0128**
0.006	7.014286	4.080357	**-0.0032**	**-0.0064**
0.003	7.014286	4.080357	**-0.0016**	**-0.0032**
0.0015	7.014286	4.080357	**-0.008**	**-0.0016**
0.00075	7.014286	4.080357	**-0.0004**	**-0.008**
0.000375	7.014286	4.080357	**-0.0002**	**-0.0004**
0.000188	7.014286	4.080357	**-0.0001**	**-0.0002**

Table A-6. EPWCP data for HH16.

HH 16

Prices	M orchid	F orchid	*low value*	*high value*
560	4.008163	4.080357	**-420**	**-840**
280	4.008163	4.080357	**-210**	**-420**
140	4.008163	4.080357	**-105**	**-210**
70	4.008163	4.080357	**-52.5**	**-105**
35	4.008163	4.080357	**-26.25**	**-52.5**
17.5	4.008163	4.080357	**-13.125**	**-26.25**
8.75	4.008163	4.080357	**-6.56**	**-13.125**
4.375	4.008163	4.080357	**-3.28**	**-6.56**
2.19	4.008163	4.080357	**-1.64**	**-3.28**
1.10	4.008163	4.080357	**-0.82**	**-1.64**
0.55	4.008163	4.080357	**-0.41**	**-0.82**
0.28	4.008163	4.080357	**-0.21**	**-0.41**
0.14	4.008163	4.080357	**-0.1**	**-0.21**
0.07	4.008163	4.080357	**-0.051**	**-0.051**
0.035	4.008163	4.080357	**-0.026**	**-0.026**
0.018	4.008163	4.080357	**-0.0128**	**-0.026**
0.012	4.008163	4.080357	**-0.0064**	**-0.0128**
0.006	4.008163	4.080357	**-0.0032**	**-0.0064**
0.003	4.008163	4.080357	**-0.0016**	**-0.0032**
0.0015	4.008163	4.080357	**-0.008**	**-0.0016**
0.00075	4.008163	4.080357	**-0.0004**	**-0.008**
0.000375	4.008163	4.080357	**-0.0002**	**-0.0004**
0.000188	4.008163	4.080357	**-0.0001**	**-0.0002**

Table A-7. EPWCP data for HH19.

HH 19

Prices	M orchid	F orchid	*low value*	*high value*
560	1.87551	1.571429	**-420**	**-840**
280	1.87551	1.571429	**-210**	**-420**
140	1.87551	1.571429	**-105**	**-210**
70	1.87551	1.571429	**-52.5**	**-105**
35	1.87551	1.571429	**-26.25**	**-52.5**
17.5	1.87551	1.571429	**-13.125**	**-26.25**
8.75	1.87551	1.571429	**-6.56**	**-13.125**
4.375	1.87551	1.571429	**-3.28**	**-6.56**
2.19	1.87551	1.571429	**-1.64**	**-3.28**
1.10	1.87551	1.571429	**-0.82**	**-1.64**
0.55	1.87551	1.571429	**-0.41**	**-0.82**
0.28	1.87551	1.571429	**-0.21**	**-0.41**
0.14	1.87551	1.571429	**-0.1**	**-0.21**
0.07	1.87551	1.571429	**-0.051**	**-0.051**
0.035	1.87551	1.571429	**-0.026**	**-0.026**
0.018	1.87551	1.571429	**-0.0128**	**-0.026**
0.012	1.87551	1.571429	**-0.0064**	**-0.0128**
0.006	1.87551	1.571429	**-0.0032**	**-0.0064**
0.003	1.87551	1.571429	**-0.0016**	**-0.0032**
0.0015	1.87551	1.571429	**-0.008**	**-0.0016**
0.00075	1.87551	1.571429	**-0.0004**	**-0.008**
0.000375	1.87551	1.571429	**-0.0002**	**-0.0004**
0.000188	1.87551	1.571429	**-0.0001**	**-0.0002**

Table A-8. EPWCP data for HH31.

HH 31

Prices	M orchid	F orchid	*low value*	*high value*
560	2.020408	0.160714	**-420**	**-840**
280	2.020408	0.160714	**-210**	**-420**
140	2.020408	0.160714	**-105**	**-210**
70	2.020408	0.160714	**-52.5**	**-105**
35	2.020408	0.160714	**-26.25**	**-52.5**
17.5	2.020408	0.160714	**-13.125**	**-26.25**
8.75	2.020408	0.160714	**-6.56**	**-13.125**
4.375	2.020408	0.160714	**-3.28**	**-6.56**
2.19	2.020408	0.160714	**-1.64**	**-3.28**
1.10	2.020408	0.160714	**-0.82**	**-1.64**
0.55	2.020408	0.160714	**-0.41**	**-0.82**
0.28	2.020408	0.160714	**-0.21**	**-0.41**
0.14	2.020408	0.160714	**-0.1**	**-0.21**
0.07	2.020408	0.160714	**-0.051**	**-0.051**
0.035	2.020408	0.160714	**-0.026**	**-0.026**
0.018	2.020408	0.160714	**-0.0128**	**-0.026**
0.012	2.020408	0.160714	**-0.0064**	**-0.0128**
0.006	2.020408	0.160714	**-0.0032**	**-0.0064**
0.003	2.020408	0.160714	**-0.0016**	**-0.0032**
0.0015	2.020408	0.160714	**-0.008**	**-0.0016**
0.00075	2.020408	0.160714	**-0.0004**	**-0.008**
0.000375	0	0.160714	**-0.0002**	**-0.0004**
0.000188	0	0.160714	**-0.0001**	**-0.0002**

The following tables are the data that was collected from the SUCC scenario.

Table A-9. SUCC scenario data for HH1-31.

HH 1

cost	M orchid	F orchid	credit
600	1.028571	4.526785714	600
600	0.106741	0.200629507	500
600	0	0.153685166	400
600	0	0.102456777	300
600	0	0.076842583	200
600	0	0.061474066	100
600	0	0.055885515	50
600	0	0.05345571	25
600	0	0.051658879	5
600	0	0.051228389	0

HH 4

cost			
600	2.057143	0.946428571	600
600	2.057143	0.946428571	500
600	2.004523	0.946428571	400
600	1.020873	0.946428571	300
600	0.529047	0.946428571	200
600	0.233952	0.946428571	100
600	0.126645	0.946428571	50
600	0.079989	0.946428571	25
600	0.045488	0.946428571	5
600	0.037222	0.946428571	0

HH 5

cost			
600	1.446314	1.90625	600
600	1.433537	1.12917003	500
600	0.599904	1.12917003	400
600	0	0	300
600	0	0	200
600	0	0	100
600	0	0	50
600	0	0	25
600	0	0	5
600	0	0	0

Table A-9. Continued.

HH 6

cost			
600	4.1375	5.553571429	600
600	3.885312	0.043085918	500
600	1.097303	0	400
600	0	0	300
600	0	0	200
600	0	0	100
600	0	0	50
600	0	0	25
600	0	0	5
600	0	0	0

HH 7

cost	M orchid	F orchid	credit
600	3.343367	2.040178571	600
600	0	0.194732495	500
600	0	0.064910832	400
600	0	0.048683124	300
600	0	0.038946499	200
600	0	0.035405908	100
600	0	0.033866521	50
600	0	0.03272815	25
600	0	0.032455416	5
600	0	0.032455416	0

HH 16

cost			
600	4.008163	4.080357143	600
600	4.008163	4.080357143	500
600	4.008163	4.080357143	400
600	4.008163	4.080357143	300
600	4.008163	4.080357143	200
600	4.008163	4.080357143	100
600	4.008163	4.080357143	50
600	4.008163	4.080357143	25
600	4.008163	4.080357143	5
600	4.008163	4.080357143	0

Table A-9. Continued.

HH 19

cost	M orchid	F orchid	credit
600	1.87551	1.571428571	600
600	1.87551	1.571428571	500
600	1.87551	1.571428571	400
600	1.87551	1.571428571	300
600	1.87551	0.967418002	200
600	1.87551	0.398832361	100
600	1.87551	0.192073946	50
600	1.87551	0.102178983	25
600	1.87551	0.102178983	5
600	1.87551	0.019775267	0

HH 31

cost	M orchid	F orchid	credit
600	2.020408	0.160714286	600
600	0.588019	0.160714286	500
600	0.213653	0.160714286	400
600	0.088864	0.160714286	300
600	0.026469	0.160714286	200
600	0	0.149746723	100
600	0	0.136133384	50
600	0	0.130214541	25
600	0	0.125837582	5
600	0	0.124788935	0

Table A-10. Labor associated with Household composition for EPWCP scenario.

Amount of activity as associated with HH composition

	Orchid M	Orchid F		AM	AF	E/AM	E/ A F	A/Ch
HH1	1.028571429	3.855208	---->	1	2	0	1	0
HH4	2.057142857	0.946429	---->	1	1	0	0	1
HH5	1.651290986	0.123068	---->	1	3	0	0	2
HH6	1.93021594	5.553571	---->	3	1	2	3	0
HH7	7.014285714	4.080357	---->	4	3	0	0	0
HH8			---->	2	1	0	0	1
HH16			---->	4	3	0	0	0
HH19	1.875510204	1.571429	---->	0	2	1	0	0
HH21			---->	2	1	1	0	1
HH31	2.020408163	0.160714	---->	2	1	2	0	3

APPENDIX B
BREVE REPORTE SONDEO

Familias: En general, las familias tienen casa propia por generaciones o se construye cada que se puede. También se quedan los hijos en casa hasta que se casen- a menos que salgan a la escuela y se quedan en otra ciudad trabajando. A veces se quedan aún después con sus esposos e hijos.

Pesca: Temporada Feb-Abr. Se pesca en las noches cuando los acúmaras (más bien sardinas grandes) están reproduciendo. También pescan carpa, charales, mojarra. Desafortunadamente, los poblaciones de peces de varias especies han declinado a tal grado que hay pocos pescadores desde que no se puede sacar en cantidades para vender en el mercado. Ahora los pocos pescadores que hay pescan simplemente lo que puedan para autoconsumo.

Agricultura: Era la actividad mas prevalerte en la comunidad. Sin embargo ahora es generalmente para autoconsumo y cada casa usa un pedacito de tierra con 0.15-0.25 ha. Maíz se siembra más que otra cosa para auto-consumo (en su mayoría para tortillas y como uso secundario atole, corundas, etc.). Junio empiezan la siembre y cosechan en Diciembre. Enero es el mes de descanso y empiezan a preparar para la siguiente temporada en Febrero. Por causa de un programa social y animo de lideres comunitarios, se ha mecanizado un poco con una maquina que se compro entre los agricultores. Maíz también sirve para forraje de animales de ganadería, los dos la mazorca y el rastrojo dependiendo de necesidad.

Ganadería: Usualmente de vende en mayo o septiembre. Hay una familia que vende en Diciembre porque se gana más como la carne es escasa. Solo hay pocas familias que participan en la venta pero hay varias que tienen animales para leche o como inversión.

Otros fuentes de trabajo:
Jardinería, limpieza de casa, músico, albañil, producción de Mezcal, agricultura (pagan por sembrar y cuidar a veces), tienda, restaurante,

Trabajo fuera de la comunidad: promotor de ingeniero , secretaria, enfermería, educación. Todos trabajan tiempo completo y requieren la misma cantidad de horas. Se puede viajar muy lejos para conseguir tales trabajos.

Consumen del monte varias cosas: Nopales- sacan 20 pencas cada dos semanas. Aún más en cuaresma. También verdolagas acelgas y chile pero ellos tienen estas plantas en su jardín de masetas.
Especies: laurel, anís, romero, mejorana. En su mayoría estas plantas están también en el jardín de mesetas.

Plantas medicinales: manzanilla, gordolobo, hierbabuena, camelina, eucalipto, borraja, pasote, árnica, pasiflora. Para los animales: savila, maguey. Muchas veces la gente tiene estas o algunas de ellas en sus jardines para tenerlas a la mano.

Alimentos que compran: jitomate, aguacate, lechuga, rábanos, calabaza, papa. Estos se compran en Quiroga o Erongarícuaro en el mercado. En general no se siembran en casa por el clima- bastante frío en invierno y demasiado agua cae en tiempo de lluvia.
Carne: Res (4 veces por semana/60 x kilo) Pollo (1 por semana/ 30 x kilo)
Casi no consuman huevo. Tortillas se hacen en casa.

Pagan todos los servicios: agua, luz, gas o cada mes o cada tercera mes. Hace poco que llegaron los servicios. Si alguien no puede pagar, se deja el servicio hasta que se pueda volver a pagar.

Atención Medica: Clínica de San Andrés- gratis por el gobierno (seguro social). Medicamentos también son gratis tanto como haya. Si no hay lo medicamentos requeridos se tiene que ir y comprar en la farmacia. Unos van a Erongaricuaro, el DF, Quiroga, Morelia. Algunos tienen apoyo de seguro social y otros tienen apoyo de sus hijos.

APPENDIX C
ELP MODEL

Link to ELP Model

The following links are ELP models that are hyperlinked for convenience and demonstration. Feel free to contact the author for the remainder of the household models or with any questions specific to these models and/or households.

ELP Model HH 1 hyperlink.

ELP Model HH 21 hyperlink.

BIBLIOGRAPHY

Adams, W.M.; Aveling, R.; Brockington, D.; Dickson, B.; Elliott, J.; Hutton, J.; Roe, D.; Vira, B.; Wolme, W. (2004). Biodiversity Conservation and the Eradication of Poverty. Science November Vol 12.

Alvarez-Icaza, P.; Argueta, A.; Avila, P.; Barrera-Bassols, N.; Caballero, J.; Castilleja, A.; Chacón, A.; Esteva, J.; Garibay, C.; Mapes, C.; Múzquiz (QEPD), E.; Reyes, J.; Rojas, P. and Toledo, V. (1996). *Plan Pátzcuaro: diagnóstico, propuestas, recomendaciones. Programa de Naciones Unidas para el Desarrollo y Secretaría de Medio Ambiente, Recursos Naturales y Pesca y la Delegación Estatal de SEMARNAP en Michoacán.* 1996

Alvarez-Icaza, P.; Argueta, A.; Avila, P.; Barrera-Bassols, N.; Caballero, J.; Castilleja, A.; Chacon, A.; Esteva, J.; Garibay, C.; Mapes, C.; Muzquiz, E.; Reyes, J; Rojas, P. & Toledo, V. (1990). *Plan Patzcuaro 2000: Prognosticos, Propuestas, Recomendaciones. Promotional Literature for El Secretario del Medio Ambiente Recursos Naturales y Pesca. p. 1-51*

Araujo, A.A. (1997). Agroforestry systems as an economic alternative for small farmers in the state of Acre, Brazil. M.S. thesis. Univ. of Florida, Gainesville.

Arditti, J. (1992) Fundamantals of Orchid Biology. John Wiley & sons, Inc. Toronto, Canada.

Arnold, J.E.M. (2001) Forest, poverty and Aid. CIFOR occasional paper No. 33 Center for International Forestry Research (CIFOR) Bogor, India.

Barrera-Bassols, N., (2003). Symbolism, knowledge and management of soil and land resources in indigenous communities: ethnopedology at global, regional and local scales. PhD Dissertation. Faculty of Science, University of Ghent, Belgium.

Barrera-Bassols, N., Zinck, J.A., (2000). Ethnopedology in a Worldwide Perspective: An Annotated Bibliography. ITC Publications 77. Enschede, The Netherlands.

Barrera-Bassols, N., Zinck, J.A., (2003). Ethnopedology: a worldview on the soil knowledge of local people. Geoderma 111 (3–4), 171– 195.

Barrera-Bassols, N., Zinck, J.A., (2004). Land moves and behaves: indigenous discourse on sustainable land management in Pichátaro, Pátzcuaro Basin, Mexico. Geografiska Annaler 85A (3–4),229– 246.

Barrett, C.B., T. Reardon, and Webb, P. (2001) Nonfarm income diversification and household livelihood strategies in rural Africa: Concepts, dynamics, and policy implications. Food Policy 26:315-331.

Barbier, E. (1990) Alternative approaches to economic-environmental interactions. Ecological Economics Vol. 2 pp. 7-26

Bastidas, E.P. (2001). Assessing potential responses to changes in the livelihood system of diverse, limited-resource farm households in Carchi, Ecuador: Modeling livelihoodstrategies using participatory methods and linear programming. Ph.D. diss. Univ. of Florida, Gainesville.

Bebbington, A. (1999). Capitals and capabilities: a framework for analyzing peasant viability, rural livelihoods and poverty. World Development Vol. 27 No. 12 pp. 2021-2044

Belcher, B. (2005). Forest product markets, forests and poverty reduction. International Forestry Review,7(2), 82–89.

Belcher, B., Ruiz-Pérez, M., & Achdiawan, R. (2005). Global patterns and trends in the use and managementof commercial NTFPs: Implications for livelihoods and conservation. World Development, 33(9),1435–1452.

Berlanga-Robles, C.; Madrid-Vera, J. and Ruiz-Luna, A. (2002) Fish abundance and trophic structure from the commercial catch in Lake Patzcuaro, Mexico. *Hydrobiologia* 467: pp.117–122.

Bernard, R. (2000). Social Research Methods: Qualitative and Quantitative Approaches. Sage Publications, Inc. Thousand Oaks, California.

Borgerhoff Mulder, M. and Coppolillo, P. (2005). Conservation: Liking ecology, Economics and Culture. Princeton University Press, Princeton, N.J.

Bowen, M.; Kontuly, T and Hepner, G. (1995) Estimating *maquiladora* hazardous waste generation on the U.S./Mexico border. Journal of Environmental Management Vo. 19 No.2 p. 281-296.

Brandon, K; Gorenflo, L; Rodriguez A.; Waller,R. (2005) "Reconciling Biodiversity, Conservation, People, Protected Areas, and Agricultural Suitability in México." Colombia Press, Ithaca, NY.

Platt Bradbury, J. (2000) Limnologic history of Lago de Pátzcuaro, Michoacán, Mexico for the past 48,000 years: impacts of climate and man. Palaeogeography, Palaeoclimatology, Palaeoecology 163 pp. 69–95

Breuer, N.E. (2000). The role of medicinal plants in rural Paraguayan livelihoods. M.A. thesis. Univ. of Florida, Gainesville.

Breuer, NE. (2003). Linking sustainability food security and improved worker livelihoods in an Ecuadorian agrosocioecosystem. PhD dissertation, University of Florida, Gainesville.

Cabrera, V.E. (1999). Farm problems, solutions, and extension programs for small farmers in Cañete, Lima, Peru. M.S. Thesis. Univ. of Florida, Gainesville.

Cabrera, V.E.; Hildebrand P.E. and Jones, J.W. (2004) The effect of household composition on the welfare of limited-resource farmers in Coastal Cañete, Peru. Agricultural Systems Vol. 9 pp.55-67.

Caballero, J. (1982). *Notas sobre el uso de recursos naturales entre los antiguos P'urhepecha. Biotica Vol.7 No.1 31-42*

Cameron, M and Tomlin, B. (2000) The making of NAFTA: How the deal was done. Cornell University Press, Ithaca and London.

Carton de Grammont Lara, P. y Cruz Antón, A. (*editores*) (2007). *Estrategia para la conservación y uso sustentable de la biodiversidad biologica de estado de Michoacán. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, Secretaría de Urbanismo y Medio Ambiente y Secretaría de Desarrollo Agropecuaro. Morelia, Michoacán, México y Mexico D.F.*

CESE (2000). *Patzcuaro: pasado, presente…(versión de la exposición itinerante). Centro de Estudios Sociales y Ecológicos, la Secretaría de Medio Ambiente, Recursos Naturales y Pesca y Delegación Michoacán (con colaboración del Fondo Mexicano para la Conservación de la Naturaleza)* Morelia, Michoacan.

Chamber, R. (1997). Whose reality counts? Putting the first last. ITDG Publishing, Southampton Row, London.

Chambers R., and G. Conway. (1992) Sustainable rural livelihoods: Practical concepts for the 21st century. Institute of Development Studies, Sussex, UK.

Christensen, P. (1989). Historical roots for ecological economics- biophysical versus allocative approaches. Ecological Economics. Vol. 1 17-36 Elsevier Science Publishers B.V. Amsterdam, Holland.

CONAPO (2005) "Índices de marginación por localidad 2005", en el marco del Día Mundial de la Población, elaborado por la Secretaría de Gobernación (Segob) y el Consejo Nacional de Población. Mexico D.F., Mexico.

CONAPO (1999) La *situación demográfica de México. Consejo Nacional de Población* Mexico City, Mexico.

Correa Pérez, G. (1997) *"La Región Purépecha y su diversidad cultural", História de Zitácuaro, EDDISA, México, 1997.*

Costanza, R. (1991) Ecological economics: The science and management of sustainability. Columbia University Press, New York.

Costanza, R., H. Daly, and J.A. Bartholomew. (1991). Goals, agendas, and policy recommendations for ecological economics. p. 1-20. *In* R. Costanza (ed.) Ecological economics: The science and management of sustainability. Columbia University Press, NY, New York.

Creswell, J.W. (2003). Research design: Qualitative, quantitative, and mixed method approaches. 2nd ed. Sage, Thousand Oaks, CA.

Davis, B.; Winters, P.; Gero Carletto, G.; Covarrubias, K.; Quinones, E.; Zezza, A.; Stamoulis, K. and DiGiuseppe, S. (2007) Rural Income Generating Activities: A Cross Country Comparison. Paper for presentation at the 106th EAAE Seminar on"Pro-poor development in low income countries: Food, agriculture, trade, and environment" 25-27 October 2007 Montpellier, France.

Dorfman, R. (1951). Applications of linear programming to the theory of the firm. University of California Press, Berkley, CA.

Durán Carmona, V. and Sevilla Palacios, F. (2003) Altas del Estado de Michoacán, Segunda Edición. Secretaría del Estado de Michoacán, Universidad Michoacana de San Nicolas de Hidalgo Editora y Distribuidora EDDISA, S.A. de C.V. Morelia, Michoacan, Mexico.

Durning, A.T. (1992). Guardians of the land: indigenous peoples and the health of the earth. *Worldwatch Paper* vol. 112, Worldwatch Institute, Washington, D.C., USA.

Ellis, F. (1998) Household strategies and rural livelihood diversification. Journal of Development Studies Vol. 35 No. 1 pp. 1-38

Esquivel, G. and Rodríguez-López, J.A. (2003) Technology, trade, and wage inequality in Mexico before and after NAFTA. El Colegio de México, Camino al Ajusco 20 Pedregal de Santa Teresa, C.P., Mexico D.F. 10740, Mexico University of California, Berkeley, CA, USA

Faux, P. (2003) How NAFTA failed Mexico. American Prospect Vol. 14 No. 3 Jul-Aug pp. 35-37.

Fiallo, EA and Jacobson, SK (1995). Local communities and protected areas: Attitudes of rural residents towards conservation and Machalilla National Park, Ecuador. Environmental Conservation Vol. 22, No. 3, pp. 241-249. 1995.

Fitchen, J.M. (1990). How do you know what to ask if you haven't listened first?: Using anthropological methods to prepare for survey research. The Rural Sociologist Vol. 10 pp. 15-22.

Forsyth, T; Leach, M; and Scoones, I. (1998) Poverty and environment priorities for research and policy: an overview study (Prepared for the United Nations Development Programme and European Commission). Institute of Development Studies. Falmer Sussex, UK.

Francis, E. 2002. Gender, migration and multiple livelihoods: cases from eastern and southernAfrica. The Journal of Development Studies Vol. 38 pp. 167-190.

Frati, A.C.; Jiménez, E. and Ariza, C.R. (1990). Hypoglycemic effect of *Opuntia ficus indica* in non insulin-dependent diabetes mellitus patients. Phytotherapy Research Volume 4, Issue 5 , pp. 195-197

Frumkin, H; Hernández-Avila, M; Espinosa Torres, F. (1995) Maquiladoras : a case study of free trade zones. International Journal of Occupational and Environmental Health; 1(2): p.96-109, Apr.-Jun.1995.

Godoy, R., D. Wilkie, H. Overman, A. Cubas, G. Cubas, J. Denmer, K. McSweeney, and N. Brokaw. (2000). Valuation of consumption and sale of forest goods from a Central American rain forest. Nature 406 pp.62-63.

Gomez, S. (1993) Environmental risks related to the *maquiladora* industry and the likely environmental impact of NAFTA. Berkley La Raza Law Journal Vol. 6 p.174-203

González Tirado (2004). Feather Creations. Materials, Production and Circulation. New York, Hispanic Society-Institute of Fine Arts 17-19 June 2008.

Heady, E.O. (1958). Linear programming methods. Iowa State College Pres, Ames, Iowa.

Heilbroner, R. (2004). Economics as universal science. Social Research Vol. 71 No.3 pp.615-632

Hildebrand. P.E. (1981) Combining disciplines in rapid appraisal: The Sondeo approach. Agricultural Administration Vol. 8 pp. 423-432.

Hildebrand, P.E., N.E. Breuer, V.E. Cabrera, and A.J. Sullivan. (2003) Modeling diverse livelihood strategies in rural livelihood systems using ethnographic linear programming.Food and Resource Economics Department, Univ. of Florida, Gainesville.

Hildebrand, P.E., and M. Schmink. (2004). Agroforestry for improved livelihoods and food security for diverse smallholders in Latin America and the Caribbean. First World Agroforestry Congress. Food and Resource Economics Department, Univ. of Florida,Gainesville.

Hildebrand, P.E., and A.J. Sullivan. (2002). Small farm livelihood systems and food security:Addressing diversity. Food and Resource Economics Department, Univ. of Florida,Gainesville.

Howard, P. (1998) The history of ecological marginalization in Chiapas. Environmental History Vol. 3 No. 3 July 1998 pp. 357-377

Hufbauer, G.C. and Schott, J. (2005) NAFTA Revisited: achievements and challenges. Institute for International Economics. Washington D.C. USA. October 2005.

IDS. 2006. Livelihoods connect: What are livelihoods? [Online]. www.livelihoods.org/SLdefn.html 1 Nov. 2006

Kati, V.; Devillers, P.; Dufrente, M; Lekakis, A; Voukou, D and Lebrun, P. (2004). Testing the Value of Six Taxonomic Groups as Biodiversity Indicators at a Local Scale. Conservation Biology Vol. 18 No. 3 pp. 667–675.

Kotoleon and Swanson (2003). Willingness to pay for property rights for the Giant Panda: Can a charismatic species be an instrument for nature conservation? Land Economics Vol. 79 No. 4 (Nov. 2003) pp.483-499

Kearns, C.A., Inouye, D.W. & Waser, N.M. (1998). Endangered mutualism: the conservation of plant-pollinator interactions. *Annual Review of Ecology and Systematics* 29: 83-112.

Koopowitz, H. (2001). Orchids and their conservation. Timber Press, Inc. Portland, Oregon, U.S.A.

Krueger, A.O.(1999). Trade creation and trade diversion under NAFTA. Working Paper 7429 National Bureau of Economic Research, Cambridge, MA, December 1999 www.nber.org/papers/w7429 9 November 2007.

Kuyvenhoven, A. (2004) Creating and enabling environment: policy conditions for less favored areas. Food Policy Vol. 29 pp. 407-429

Laurance, W.F. (1998). A crisis in the making: responses of Amazonian forests to land use and climate change. Trends in Ecology & Evolution Vol. 13, Issue 10, 1 October, pp. 411-415

Leakey, R.R.B. & Simmons, A.J. (1998). The domestication and commercialization of indigenous trees in agroforestry for poverty alleviation. Agroforestry systems Vol. 38. pp. 165-176.

Litow, P.A. (2000). Food security and household livelihood strategies in the Maya Biosphere Reserve: The importance of milpa in the community of Uaxactún, Petén, Guatemala.M.S. Thesis. Univ. of Florida, Gainesville.

Ludwig, D.; Hilborn R.and Walters, C. (1993) Uncertainty, resource exploitation, and conservation: lessons from history. *Science*(April 2, 1993) Vol. 17 No. 2.

Marshall, E., Schreckenberg, K. and Newton, A.C. (eds) (2006). Commercialization of Non-timber Forest Products: Factors Influencing Success. Lessons Learned from Mexico and

Bolivia and Policy Implications for Decision-makers. UNEP World Conservation Monitoring Centre, Cambridge, UK.

Maxwell, A. and Tomlin, B. (2000). The making of NAFTA: How the deal was done. Cornell University Press. 2000.

McllVaines-Newsad, H.L. (2000). Tied to the land: Livelihood systems in northwestern Ecuador.Ph.D. Dissertation. Univ. of Florida, Gainesville.

McSweeny, K. (2004). Tropical forests product sale as natural insurance: The effects of household characteristics and the nature of shock in Eastern Honduras. Society and Natural Resources, Vol. 17 pp. 39–45.

Mesera, O., Astier, M. & Lopez-Ridaura, S. (2000). *Sostentabilidad y manejo de recursos naturales. Mundi-Prensa Mexico S.A. de C.V. Mexico.*

Narendran, I.K. Murthy, H.S. Suresh, H.S. Dattaraja, N.H. Ravindranath and R. Sukumar (2001) Nontimber forest product extraction, utilisation and valuation: a case study from the Nilgiri Biosphere Reserve, southern India, Economic Botany. Vol. 55 pp. 528–538.

Odum, E.P. 1997. Ecology: A bridge between science and society. Sinauer Associates, Inc.,Sunderland, MA.

O'Meagher, B.; du Pisani, L. G.; and White, D. H. (2001) Evolution of drought policy and related science in Australia and South Africa. Agricultural Systems Vol. 57, No. 3, July 1998, Pages 231-258.

Raja, R.; C. E. Sooriamoorthi ; P. Kanniappan ; T. Ramachandran. 1997. Energy planning and optimization model for rural development. International Journal of Energy Research Vol. 21 No.6 pp. 527-547

Ramirez, C. (2007). Ethnobotany and the loss of traditional knowledge in the 21st century. Ethnobotany Research & Applications Vol. 5 pp. 245-247

Rittershausen, Brian and Wilma (2003). Growing Orchids. Hermes House and Anness Publishing Limited, London UK.

Roe, D. (2004). The millennium development goals and conservation. Managing nature's wealth for society's health. London: International Institute for Environment and Development (IIED). London, UK.

Rojas Zamorano, A. (editor) (2002) *Aportes al Proyecto Pátzcuaro: estudios, propuestas y avances para la restauración de la cuenca del Lago de Pátzcuaro. Secretaría de Medio Ambiente, Recursos Naturales y Pesca, Dirección Ejecutiva del proyecto Pátzcuaro y el Fondo Mexicano para la Conservación de la Naturaleza Morelia, Mexico.*

Ruiz, E. (1978). *Michoacán: paisajes, tradiciones y leyendas. Cosmos. Mundi-Prensa Mexico S.A. de C.V. Mexico.*

Salvador, R. J. (2003). "What Do Mexicans Celebrate On The Day Of The Dead?", John D. Morgan and Pittu Laungani: Death and Bereavement Around the World: Death and Bereavement in the Americas, Death, Value and Meaning Series, Vol. II. Amityville, New York: Baywood Publishing Company, p. 75-76.

Sawaya, W.N; Khalil, J.K. and Al-Mohammad M.M. (2005) Nutritive value of prickly pear seeds, *Opuntia ficus-indica.* Plant Foods for Human Nutrition (Formerly Qualitas Plantarum) Vol. 33, No. 1 pp.91-97

Schmink, M. (1984) Household economic strategies: review and research agenda. Latin American Review Vo. 19 pp. 87-101.

Scoones, I. (1998). Sustainable rural livelihoods: A framework for analysis. Institute of Development Studies, Brighton, UK. 1998

Shackleton, S; Campbell, B; Lotz-Sisitka, H and Shackleton, C. (2007). Links between the local trade in natural products, livelihoods and poverty alleviation in a semi-arid region of South Africa. World Development Vol. 36, No. 3, pp. 505–526, 2007

Shaner, W.W.; P.F. Phillip, and W.R. Schmehl. 1982. Farming systems research and development: Guidelines for developing countries. Westview Press, Boulder, CO. 1982

Scherr, S. (2000). A downward spiral? Research evidence on the relationship between poverty and natural resource degradation. Food Policy Vol. 25 pp. 479–498

Scherr, S., White, A. and Kaimowitz, D. (2002) Making markets work for forest communities. Forest Trends, Washington, D.C., USA. 2002

Sheehan, T. and Sheehan, M. 1994. An Illustrated Survey of Orchid Genera. Timber Press, Inc. Portland, Oregon. 1994 pp.383

Stransky, Jaime (1996) *Los dioses más ligeros del mundo: el arte purépecha de fabricar esculturas con pasta de caña de maíz.* México Desconocido No. 234 Agosto Mexico D.F., Mexico 1996

Takasaki, Y., Barham, B. L., & Coomes, O. T. (2004) Risk coping strategies in tropical forests: Floods, illnesses, and resource extraction. Environment and Development Economics, Vol. 9 pp.203–224.

Taylor, J. Edward. (1999) "The new economics of Labour Migration and the Role of Remittances in the Migration Process" International Migration

Quarterly Review Vol 37 No. 1. 1999

Thangata, P.H.; Mudhara, M.; Grier, C. and Hildebrand, P.E. (2007). Potential for Agroforestry Adoption in Southern Africa: A comparative study of improved fallow and green manure adoption in Malawi, Zambia and Zimbabwe Ethnobotany Research & Applications Vol. 5:067-075

Toledo, V. (2002) Ethnoecology: a conceptual framework for the study of indigenous knowledge on nature. In: J.R. Stepp, E.S. Wyndham and R. Zarger, Editors, *Ethnobiology and Biocultural Diversity*, International Society of Ethnobiology, University of Georgia Press, USA 2002, pp. 511–522.

Toledo, V.M. (2001) Indigenous knowledge and biodiversity. In: S.A. Levin, Editor, *Encyclopedia of Biodiversity*, Academic Press, San Diego, USA 2001, pp. 451–463. Abstract

Toledo, V.M.; B. Ortiz-Espejel; L. Cortés; P. M. and Ordóñez , M.D.J. (1999) The multiple use of tropical forests by indigenous peoples in Mexico: a case of adaptive management, *Conservation Ecology* Vol. 7 No. 3

Toledo, V.M. & Argueta, A. (1990). *Naturaleza, producción y cultura en una región indígena de Mexico: las lecciones de Patzcuaro. Instituto Nacional Indigenista Mexico.*

Toledo, V.M.& Caballero, J., Mapes, C., Barrera, N., Argueta, A. & Nunez, M. (1980). *Los Purépechas de Patzcuaro: una aproximación ecológica. América Indígena. Enero-Marzo, Vol. XI No.1 19-55*

Toledo, V.M., Caballero, J., Mapes, C. & Barrera, N. (1987). *Naturaleza y sociedad en Pátzcuaro: una década de investigación interdisciplinaria en una región indígena en México. Tecnologías Tradiciones e Interdisciplinaria, E. Leff (ed.) 1988 (en prensa) México D.F., México. pp. 1-43*

Tornell, A and Esquivel, G. (1997). A. The political economy of Mexico's entry to NAFTA. In: T. Ito and A.O. Krueger, Editors, Regionalism Versus Multilateral Trade ArrangementsNBER-East Asia Seminar on Economics Vol. 6, University of Chicago Press, Chicago, IL 1997, pp. 25–56.

Tuck, J. (2002) "Vasco de Quiroga- Notes on a Practical Utopian". Mexico Connect. Mexico November 2002 *http://www.mexconnect.com/mxc404.html* 12 September 2007.

Turner, BJ, Chikumbo, O and Davey, SM. (2002). Optimization modeling of sustainable forest management at the regional level: an Australian example. *Ecological Modelling* No.15 Vol. 3: 157-179

Turner, I.M. (1996). Species loss in segments of tropical rainforest: a review of the evidence. Journal of Applied Ecology Vol. 33 pp.200-209.

Weintraub, S. (2004) NAFTA's Impact on North America: The First Decade. Center for Strategic and International Studies, Washington D.C. Significant Issue Series Vol. 26 No. 5. Washington, D.C. 2004

Wiggins, S., N. Keilbach, K. Preibisch, S. Proctor, G.R. Herrejón, and G.R. Muñoz. 2002. Agricultural policy and reform and rural livelihoods in Central Mexico. The Journal of Development Studies 38:179:202.

WRI (2005). World Resources 2005. The wealth of the poor. Managing ecosystems to fight poverty. World Resources Institute, UNDP, UNEP and World Bank. Washington, DC: World Resources Institute (WRI).

Wunder, S. (2001). Poverty alleviation and tropical forests-- What scope for synergies? World Development Vol. 29 No.11 pp.1817-1833 2001.

BIOGRAPHICAL SKETCH

Miramanni Maringola Mishkin was born in Connecticut and received her undergraduate degree at Central Washington University. She came to the University of Florida after working in Michoacán for approximately a decade looking for bridges between conservation and development in conjunction with other scientists from the University of Michoacán and UNAM.

After receiving her Master of Science in interdisciplinary ecology with a concentration in tropical conservation and development in August of 2008, she will continue on to a PhD at the University of Florida to continue looking for bridges between conservation and development in rural communities.

LOOKING FOR BRIDGES: DOVETAILING CONSERVATION AND DEVELOPMENT IN A RURAL MEXICAN COMMUNITY.

Miramanni Maringola Mishkin
352-392-9230
SNRE
Dr. Hugh Popenoe
Master of Science
June 2008

This thesis contributes to the greater body of scientific knowledge in relation to conservation and development as human beings learn to coexist more harmoniously with the natural environment. It supports the research that natural product trade activities have great potential to aid in poverty alleviation, as well as increased economic stability and resilience for rural communities. It also demonstrates the importance of considering social factors when seeking conservation plans with a greater likelihood of long-term success.