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YERBA MATE (*ILEX PARAGUARIENSIS*) PRODUCTION, AGRICULTURAL  
CHANGE, AND LIVELIHOOD SECURITY IN SOUTHEASTERN PARAGUAY

By

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Professional Paper

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Yerba Mate (*Ilex paraguariensis*) Production, Agricultural Change, and Livelihood Security in Southeastern Paraguay

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Smallholders in Southeastern Paraguay are threatened by the advance of mechanized farming, environmental degradation, and limited access to credit and inputs. Agroforestry initiatives have been proposed as a way to increase smallholder livelihood security in the face of such vulnerability. Yerba mate (*Ilex paraguariensis*) is a tree crop native to Paraguay that may be grown in agroforestry systems. While prices paid to farmers for yerba mate have increased in recent years, spurring interest and adoption of yerba mate production among some farmers, to this date, there have been no analyses of the effects that yerba mate production may have on livelihoods. This study, which was conducted April-July 2013 in the community of Libertad del Sur in Southeastern Paraguay, addresses this lack of research on yerba mate and livelihoods. Interviews were conducted with 23 households interested in cultivating yerba mate and six key informants on current livelihood strategies in Libertad del Sur and the potential effects of yerba mate production. Yerba mate production was found to be a profitable option for reducing certain sources of vulnerability, but the ability of households to invest in it was limited by several factors including high initial costs and lack of credit.

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## Contents

1. Introduction/problem statement.....	2
2. Literature review.....	3
Livelihood Security.....	3
Risk, Vulnerability, and Agricultural Investment .....	5
Diversification and Livelihoods .....	9
Agroforestry and livelihoods.....	10
Background on Yerba Mate .....	12
Alternative yerba mate marketing strategies.....	15
3. Research Questions.....	16
4. Description of Study Site.....	18
5. Methods .....	23
6. Results & Discussion.....	31
Current livelihood strategies.....	31
Cash crops .....	32
Subsistence crops.....	40
Livestock.....	42
Leasing land.....	46
Outside work.....	47
Land.....	50
A. Yerba mate production and vulnerability .....	52
Positives .....	52
Negatives.....	57
Participant plans for yerba mate production.....	61
7. Conclusion.....	73
8. References cited.....	76
9. Appendix A – Map of Paraguay showing study site .....	84
10. Appendix B – Interview guide.....	85
11. Appendix C – Codes.....	89

## 1. Introduction/problem statement

Smallholders in Latin America and across the developing world face many challenges in establishing secure livelihoods, including limited access to inputs and markets, unfavorable biophysical conditions (Hazell, 2004), and inadequate access to land (Kay, 2006). Livelihood insecurity limits the ability of households to invest in new livelihood strategies (Barret, Bezuneh, & Aboud, 2001), often making it necessary for them to pursue coping strategies that allow them to get by in the short term but limit their long-term prospects (Dercon, 2002). Poverty traps like these have negative effects that reach beyond rural households. For example, one option for rural smallholders with insecure livelihoods is to migrate to cities but, while there may be greater economic opportunity in urban areas, migration has been found to have negative social (Dufour & Piperata, 2004) and environmental impacts (DeFries, Rudel, Uriarte & Hansen, 2010).

Diversification through the adoption of tree crops in agroforestry systems is one strategy smallholders may use for increasing livelihood security and avoiding poverty traps.

Agroforestry systems practiced by smallholders have been proposed as a way to increase livelihood security by generating income, building assets, and preventing environmental degradation (Garrity, 2004). In many cases, however, this promise has not been realized, as smallholders have been found to face numerous difficulties in adopting agroforestry systems.

Among the smallholders in my research site, Libertad del Sur, Paraguay (see Appendix A for a map of Paraguay), yerba mate (*Ilex paraguarensis*) is a tree crop that can be grown in agroforestry systems. In this area of Paraguay, soy has been the primary cash crop of smallholders for the past several decades, but changing biophysical and economic conditions have prompted farmers to begin looking for alternatives. Like smallholders in many areas of the developing world, farmers in this area are challenged by the advance of mechanized agriculture

(Brown & Weisberg, 2007) and limited access to credit (C. Duarte, personal communication, June 15, 2013), and many have migrated to urban centers in Paraguay and Argentina (Mario, Silva-Leander, & Carter, 2004; Parrado & Cerruti, 2003). Yerba mate grown as a component of agroforestry systems may have the potential to increase livelihood security among these smallholders and prevent further outmigration. Production of yerba mate has been shown to be more profitable for Paraguayan smallholders than soy (Frey, 2005), but to this date, the broader livelihood impacts of yerba mate production and the opportunities and challenges associated with its adoption have not been studied. In this study, I address this knowledge gap by exploring the potential effects of yerba mate production on livelihood security in Libertad del Sur.

## 2. Literature review

This study was motivated by a desire to understand the influences of agroforestry systems on the livelihood security of smallholder households. To approach this topic, I needed a way of conceptualizing household livelihood security. Livelihoods frameworks, as originally elucidated by Chambers and Conway (1992), provide a useful basis for thinking about livelihood security at household scales.

### Livelihood Security

One widely used definition of a livelihood came from a working paper written by Chambers and Conway (Scoones, 2009). According to Chambers and Conway (1992):

A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its

capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term. (p. 6)

It seems that the terms “livelihood security” and “sustainable livelihoods” have been used somewhat interchangeably in the literature since this definition was written. I will use “livelihood security” in this paper.

Chambers and Conway (1992) explain that a livelihood is made up of the following components: people, tangible assets such as stores and resources, intangible assets such as claims and access, and gains. Because this framework takes the household as the unit of analysis (Chambers & Conway, 1992), the people of concern are the members of that household. Stores and resources may be interchangeable, comprising assets such as livestock, food stores, valuable goods, cash savings, land, and trees. Likewise, claims and access are not completely distinct, constituting the requests or entitlements a household may claim as well as the rights or privileges to make use of the resources proffered by these claims. In this way, claims and access directly influence the stores and resources a household may possess. Gains are the outputs of livelihood activities or, essentially, income. Income may be broken down into farm, off-farm, and non-farm, where farm income is the total of crops and livestock harvested, off-farm is usually work with compensation on others’ farms, and non-farm is non-agricultural paid work, income from selling or leasing property, and remittances (Ellis, 1998).

In this framework, the security of household livelihoods is determined by their intangible and tangible assets, as described above, and vulnerability, which is the sum of stresses and shocks experienced by households and their coping capabilities (Chambers & Conway, 1992). Stresses are threats to assets and livelihood activities which are predictable, continuous, and

cumulative, such as seasonal fluctuations in income or food availability or declining soil fertility (Chambers & Conway, 1992). Shocks, meanwhile are threats which are unpredictable and sudden, such as natural disasters, commodity price crashes, or pest epidemics (Chambers & Conway, 1992). The ability to cope effectively with stresses and shocks is central to livelihood security.

Taking from the sustainable livelihoods framework of Ashley and Carney (1999), I place institutions as mediating forces between households and the vulnerability they experience, the claims they can make, and the outcomes of the livelihood strategies they undertake. In this case, I am using the broad definition of Agrawal and Gibson (1999), in which institutions are, "...sets of formal and informal rules that shape interactions of humans with others and nature" (p. 637). Examples of such institutions include commodity markets, law, and local cultural norms.

In Libertad del Sur, institutions such as the market for yerba mate and local culture interact with household vulnerabilities and assets to shape decisions about investment in yerba mate. One of the goals of this project is to explore these interactions between livelihood components and use them to assess the potential effects of yerba mate production on household livelihood security.

### **Risk, Vulnerability, and Agricultural Investment**

As discussed above, vulnerability is an important component of livelihood security. One question I have tried to answer in this study is how stresses and shocks experienced by Libertad del Sur households relate to their plans regarding yerba mate production. The ways that households respond to such sources of vulnerability depend in part on their perception of risk, and risk management is another important piece in livelihood security. In the following section, I

will review the literature on risk, vulnerability, and agricultural investment among smallholders, with the goal outlining a set of ideas with which to analyze the livelihood strategies of Libertad del Sur households

Anderson (as cited in Ellis, 1998, p.12) describes risk as, “the subjective probability attached by individuals or by the household towards the outcomes of the various income generating activities in which they are engaged.” The income risk experienced by farmers is primarily due to uncertainty in yields and prices expected for a given crop (Moschini & Hennesy, 2001). This uncertainty arises because of the influence of weather and markets, and it means that farmers cannot expect a consistent relationship between inputs and yields or between yields and the payments they receive. Instances where yields or prices for a given crop are much lower than expected increase the vulnerability of agricultural households and, if drastic enough, may constitute shocks to the livelihoods of these households.

Livelihood shocks due to price crashes or weather-related events are a common occurrence among farmers in developing countries (Bacon, 2005). Severe price fluctuations are common in commodity crops, and these may be magnified in slow-maturing crops such as coffee and yerba mate because the lag time between planting and harvest creates market inefficiencies (Ponte, 2002). Price crashes can have disastrous effects on smallholders dependent on production of commodity crops. A sustained drastic reduction in coffee prices during the late 1990’s and earlier 2000’s, known as the coffee crisis, led to increased malnutrition, outmigration, and poverty among Central American coffee farmers (Bacon, 2005). In the Argentinean yerba mate sector, a similar price crash occurred following the deregulation of yerba mate production, which was done in accordance with neoliberal economic policies in the early 1990s (Lawson,

2009). Like the coffee crisis, this price crash led to increasing outmigration to cities and economic marginalization of small to mid-sized producers and farm workers (Lawson, 2009).

Rural agricultural households are also vulnerable to the effects of natural disasters and climatic shocks, such as drought and flooding. The negative effects of price crashes during the coffee crisis were magnified by a series of natural disasters that lowered coffee yields (Bacon, 2005). Meanwhile, the Interior Atlantic Forest region of Paraguay, within which Libertad del Sur is located, is prone to drought and extreme summer temperatures, as well as occasional frosts, all of which may put yerba mate producers at risk (Lawson, 2009). The effects of climate change in Paraguay, which are expected to be increased temperatures and greater incidence of sustained droughts (Christensen, 2010), may serve to further increase the vulnerability of yerba mate producers. Research describing the effects of environmental variability on yerba mate yields is scant, but in one study, a prolonged drought lowered yields by approximately 40% (Burtnik, 2006).

Another environmental source of vulnerability is seasonality. Seasonal stresses result from the variable nature of rural income sources coupled with constant resource needs, and they are an aspect of all rural livelihoods (Ellis, 1998). As an example, yerba mate is harvested in the winter so a household solely dependent on its production would be without any sources of income during the spring, summer, and fall.

Rural households employ a variety of strategies to reduce their vulnerability to climatic or economic stresses and shocks. Chambers and Conway (1992) organize strategies for reducing vulnerability into seven general categories. These are as follows: 1. Reducing consumption; 2. Accumulating food and other assets; 3. Preserving existing asset base; 4. Using stored food or selling assets; 5. Diversifying production of food or income generation; 6. Exercising claims on

others; and 7. Dispersing family members or livestock. Using ideas outlined by Ellis (1998), I will use the terms risk management and coping mechanisms to describe, respectively, proactive strategies used to minimize risk in anticipation of shocks and reactive strategies used to maintain household well-being in response to shocks. Depending on the specific action undertaken by a household, each of the general strategies above may be used as a risk management or coping activity.

Among the variety of strategies used by smallholder households to reduce vulnerability, I will focus on diversification, implementation of agroforestry systems, and alternative marketing or production schemes. These will each be discussed in more detail in the following sections. Implementation of any one of these by a household represents an investment in change to its agricultural systems, and such an investment involves risk. Smallholders are commonly understood to be risk-averse (Shiferaw, Okello, & Reddy, 2009), and there are several factors which have been found to be important in smallholder decisions to undertake risky activities such as agricultural change. Assets such as land tenure (Arellanes & Lee, 2003), access to credit, and the general ability to wait for a return on investments have been found to increase the likelihood of agricultural investment, as have institutional factors such market opportunities, institutional support, and agricultural policies (Shiferaw et al., 2009). Meanwhile, poorer households with smaller farms and a higher percentage of land devoted toward subsistence production tend to be less likely to invest in agricultural change (Holden & Yohannes, 2002). It follows, then, that resource poor farms would be less likely or able to adopt perennial crops such as yerba mate, and, while there has not been work on yerba mate to this date, this conclusion is supported by the literature on other perennial crops (Bandiera, 2007; Belsky, 1993).

## Diversification and Livelihoods

In the following section, I will discuss the role of diversification in the efforts of rural households to establish secure livelihoods. Diversification is important in this study because it is one means that Libertad del Sur farmers may employ to improve their situation, and for many, yerba mate production would be a form of diversification. Ellis (1998) defines diversification as, “the process by which rural families construct a diverse portfolio of activities and social support capabilities in their struggle for survival and in order to improve their standards of living.” (p.4) This definition refers to both income diversification, which is typified by investment in additional income generating activities, as well as livelihood diversification, in which investment is made in broader asset-generating activities (Ellis, 1998). This broader view includes income diversification but could also include activities such as fortifying social ties to increase claims or trying to change institutions to increase access to assets. In this study, I focus more on income, meaning that I will be primarily referring to income diversification.

Traditional views on income diversification among rural households conceptualized it as a risk avoidance strategy which sacrificed greater income potential for more security (Ellis, 1998). Contemporary scholars have challenged this notion, pointing out the existence of complementarity between certain crops or land uses, which may make diversified farm incomes more profitable than non-diversified incomes (Ellis, 1998). In either case, diversification is theorized to lower risk in marginal households by making poor returns on any one livelihood activity less deleterious to livelihood security, but, in the more contemporary perspective, diversification may also be viewed as both, risk avoidance and a proactive, income-generating strategy (Niehof, 2004). Along these lines, Ellis (1998) distinguishes between push factors -

conditions that compel a household to diversify reactively -and pull factors - opportunities that allow a household to diversify proactively.

Diversification may serve as either a risk management or coping strategy. Diversification as a risk management strategy may be thought of in terms of income smoothing, which refers to making income sources less risky (Dercon, 2002). Effective income smoothing is rare among marginal households because of the assets necessary to diversify (Dercon, 2002). Pull factors, such as access to credit or stores of assets, that give households the ability to generate income through diversification tend to be absent for the most vulnerable households. Instead, diversification among the most vulnerable households is often used as a coping strategy, through which these households diversify to minimize risk at the expense of returns (Barret, Bezuneh, & Aboud, 2001).

In addition to differences between households, there are intra-household differences in the opportunities diversification offers. Women in rural households typically have fewer opportunities than men to benefit from diversification (Niehof, 2004). This has been shown to be especially true where new crops are grown for cash rather than subsistence purposes, as with tree crops used for timber rather than fuelwood (Scherr, 1995). Yerba mate, given its extensive processing requirements (Lawson, 2009), is probably more likely to be grown sale than for subsistence. Accordingly, men in Libertad del Sur may stand to benefit more than women from its production, which could result in different perspectives within households on its adoption.

### **Agroforestry and livelihoods**

One form of diversification that may have the potential to increase livelihood security in Libertad del Sur is the implementation of agroforestry systems. Agroforestry has been

considered in development circles as a tool for poverty alleviation and conservation since the late 1970's (Lundgren & Raintree, 1983). Interest in agroforestry stemmed from recognition of the limited participation by poor farmers in the Green Revolution set against the backdrop of increasing deforestation rates (Nair, 1993). As defined by Lundgren and Raintree (1983):

Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. In agroforestry systems there are both ecological and economical interactions between the different components. (p. 2)

According to this definition, yerba mate systems incorporating annual crops or trees qualify as agroforestry systems. In this section, I will discuss the literature on agroforestry and livelihoods with the goal of building towards an understanding of the ways that yerba mate agroforestry systems may affect livelihood security in Libertad del Sur.

The World Agroforestry Center claims that agroforestry practices may contribute to secure livelihoods for the rural poor by alleviating poverty and food insecurity, conserving biodiversity, and protecting watersheds (Garrity, 2004). The livelihood benefits to smallholders of agroforestry systems include increased provision of income, fuelwood, and food (Mendez, Bacon, Olson, Morris, & Shattuck, 2010). In addition to these socioeconomic benefits, agroforestry systems have been found to increase biodiversity on agricultural lands in the case of coffee (Philpott et al., 2008), cacao (Rice & Greenberg, 2000), and yerba mate in the Atlantic Forest regions of Paraguay and Argentina (Montagnini, Eibl & Fernandez, 2005; Cockle, Leonard, & Bodrati, 2005).

Agroforestry systems have the potential to be beneficial for smallholders, but substantial obstacles to their adoption have been found. Some of the challenges that smallholders may face in adopting tree cultivation systems are insecure land tenure, the time lag between planting and harvest, competition between tree and annual crops, market access (Sanchez, 1995), lacking experience and/or training, and risks associated with price and yield fluctuations, as discussed above (Mercer, 2004). In general, households with the most endowments and assets are those most likely to be able to adopt agroforestry systems (Mercer, 2004). This trend, if it holds true in Libertad del Sur, has important implications on the types of households that may benefit from yerba mate production.

There is a lack of research on the livelihood benefits of yerba mate agroforestry systems, but there has been at least one study on the profitability of yerba mate production among smallholders. In this study, Frey (2005) compared financial benefits of monocropped yerba mate, shade grown yerba mate with native timber species, and soy. He found that the shade grown yerba mate grossed the most in all cases, but that monocropped yerba mate and soy were in the middle or the worst depending on how one forecasts yerba mate prices in coming years. Shade grown yerba mate, however, has a substantial delay until it is profitable because of the slow growth of the timber species which account for much of the system's revenue. Therefore, if yerba mate prices are low and a farmer needs more short-term profits, shade grown yerba mate may not be so beneficial. It should be noted, however, that the prices for yerba mate assumed by Frey (2005), are substantially lower than current prices, and that his analysis did not factor in differences in the potential for subsistence intercropping in the different systems.

## Background on Yerba Mate

The research on yerba mate suggests that its production would be profitable for those households in Libertad del Sur able to invest in it, but profitability is only one factor that these households might consider in their decisions about livelihood strategies. Decisions about livelihood strategies are also informed by culture (Ashley & Carney, 1999), which indicates that the cultural significance of yerba mate production may impact the effects it has on livelihoods in Libertad del Sur. In order to explore the cultural context of yerba mate production, in the following section I briefly describe the background and current status of yerba mate as a beverage and a crop in Paraguay.

Yerba mate is native to the Interior Atlantic Forest of Eastern Paraguay, Northeastern Argentina, and Southeastern Brazil (Burtnik, 2006). The green leaves and stems, dried and roasted, are used to make a type of tea that has been consumed in the area since pre-Columbian times. This tea, known in Paraguay as *mate* when hot and *tereré* when cold, is primarily consumed in the Southern Cone nations of Argentina, Brazil, Uruguay, Paraguay, and to a lesser extent Bolivia and Chile. According to Burtnik (2006), until the Jesuits settled in Northern Argentina and Southern Paraguay, all yerba mate was harvested from wild sources. The Jesuits managed to domesticate the plant but, with their expulsion from the Americas in 1767, their production methods were lost (Folch, 2010). Around the turn of the 20<sup>th</sup> century, cultivation of yerba mate began again in Argentina and later in Paraguay and Brazil.

In Paraguay, yerba mate consumption is an important cultural activity. The tea, in hot and cold form, is consumed several times a day, and decorum requires that visitors be offered to participate in a drinking circle except in the most informal of circumstances (C. Duarte, personal communication, June 15, 2013). The yerba mate drinking ritual is infused with social meaning (Folch, 2010), but consumption has tangible benefits as well. Traditional medicine in Paraguay

is often consumed by making infusions with yerba mate and drinking it (Millman, 2012), and during my time in Paraguay, I was instructed on the correct herbs to mix with yerba mate for ailments ranging from diabetes and high blood pressure to stomach upset and the common cold.

Yerba mate requires deep and fertile red clay soils, and performs best in newly cleared forest or long-fallowed soils (Burtnik, 2006). It is a heavy feeder with regards to nitrogen, and recommendations for its production include the use of green manures or chemical fertilizer (Burtnik, 2006). In large scale operations, areas for planting are typically planted or tilled with a tractor, but among smallholders it is common to prepare the land with a hoe. Similar to coffee, wild yerba mate grows under shade, and as a crop it can be grown in either shade or sun systems (G. Arevalos, personal communication, June 12, 2013). The traditional planting density is 2,220 plants/ha, planted in rows 3 meters apart (G. Arevalos, personal communication, June 12, 2013). At this spacing, yerba mate may be intercropped with annual subsistence crops or widely spaced trees.

The ability to plant yerba mate with trees for fuelwood or crops for household consumption may make it an attractive option for smallholders, but rising prices are also a strong incentive. A period of low prices combined with the soy boom convinced many Paraguayan producers to abandon yerba mate production in favor of soy, which has led to a current scarcity (Territorio Digital, 2013). Because of this scarcity, prices received by farmers have increased dramatically over the past five years, and many farmers have begun planting it again. One yerba producer in this study explained that over the past five years, the price he received for his harvest has increased from approximately \$0.09/kg to \$0.37/kg. Meanwhile, a study in a nearby region of Paraguay (Frey, 2005) reported that prices in 2003 were only \$0.03/kg, indicating a ten-fold increase over a period of ten years.

## Alternative yerba mate marketing strategies

Strategies such as fair trade certification, organic certification, or local processing may be options to make yerba mate production more profitable and sustainable in Libertad del Sur. Fair trade is a movement that aims to use market forces to make the trade of commodities socially just for producers and consumers (Jaffee, 2012). This movement includes traders, producers, consumers, activists, non-governmental organizations and certifying bodies. Through a system of voluntary certification and baseline wages that keep producers above the poverty line, fair trade advocates hold that the movement can alleviate poverty and provide an alternative to the status quo of unjust trade relationships (Raynolds, Murray, & Taylor, 2004).

Coffee was the first fair trade commodity, but the movement has expanded to include hundreds of products (Jaffee, 2012). The list of commodities that can be purchased fair trade certified includes yerba mate. The only fair trade certified yerba mate produced in Paraguay that I am aware of is sourced by a company called Guayakí from an indigenous community in the department of Canindeyú (Fair for Life, 2012). Guayakí yerba mate is certified as Fair for Life by the Institute for Marketecology (IMO), and was the first fair trade certified yerba mate company in the world (Guayakí, 2013).

In addition to being certified Fair for Life, Guayakí's yerba mate is also certified as organic by the United States Department of Agriculture (Guayakí, 2013). Another company, Lauro Raatz, markets certified organic yerba mate under the brand name "Pajarito." While none of the households in Libertad del Sur produce organic yerba mate now, there could be opportunity for it in the future. This is especially true because several households in Libertad del Sur have made connections with Lauro Raatz in recent years to get yerba mate seedlings on loans in exchange for a certain quantity of the harvest in the future (C. Duarte, personal

communication, June 15, 2013). Yerba mate certified as organic and/or fair trade has a substantial price premium, with farmers receiving as much as two or three times the price of conventional yerba mate (Montagnini, Eibl, & Barth, 2011).

Another variant of alternative marketing strategies, local processing, may provide a strategy for Libertad del Sur residents to make their yerba mate more profitable. Following the harvest, yerba mate leaves and stems are sent to processing mills to undergo the process which will turn them into the commodity that is sold in grocery stores, city markets, and tiny country stores across Paraguay. The first step in this process is a method of quick drying called *sapecado*, in which the leaves and stems are exposed to open flame for an instant (Burtnik, 2006). From there, the partially dried leaves and stems are fully dried with either hot air or smoke from a fire, and then ground up into smaller pieces to facilitate transport. This *yerba canchada* is aged for six months, and then milled, bagged and shipped to stores to be sold (Lawson, 2009).

Because of how energy intensive it is to process yerba mate, small farmers have difficulty selling anything other than the raw leaves and stems (Lawson, 2009), but there are cases in Paraguay of small communities processing yerba mate locally to take advantage of niche markets (M. Mieres personal communication, May 16, 2013). Apparently, there is some precedence for such an arrangement in Libertad del Sur. It is common for food processing equipment to be shared among households (especially small grain mills), and there have been projects in the past in Libertad del Sur featuring community ownership of processing facilities for animal feed (C. Duarte, personal communication, June 15, 2013).

### 3. Research Questions

Smallholder households like those in Libertad del Sur face well-documented challenges in their efforts to establish secure livelihoods. Sources of vulnerability discussed in the literature on smallholder livelihoods include environmental and economic shocks and seasonal shortages of income. Diversification through the establishment of agroforestry systems has been proposed as a strategy for mitigating vulnerability for smallholders in many areas of the developing world. In Southeastern Paraguay, yerba mate production in agroforestry systems has been shown to be profitable for smallholders, but, to this date, there has been no research on the broader livelihood effects of its adoption. In order to address this gap in the knowledge, this study assesses the potential of yerba mate production to increase livelihood security by answering the following questions:

- **What are the positive and negative aspects of yerba mate production as a livelihood strategy for smallholders?** What are participants' current livelihood strategies, and what vulnerabilities do they experience? Does yerba mate production contribute to or mitigate the vulnerability experienced by study participants? How does yerba mate production compare to other livelihood strategies in Libertad del Sur?
- **What methods and scales of yerba mate production are most beneficial to smallholders?** Will participants use agroforestry systems by intercropping yerba mate with subsistence crops and/or timber? At what scale do they want to produce it? What is the rationale behind these preferences?
- **What are the constraints and opportunities associated with investment in yerba mate production?** What factors influence participants' willingness and ability to invest? How have participants overcome constraints to investment? Are there alternative production or

marketing strategies that could increase participants' ability to invest in yerba mate or the benefits they receive from it?

#### 4. Description of Study Site

Libertad del Sur was an ideal location to study the above questions about the livelihood effects of yerba mate production. In their struggle to establish secure livelihoods, households in Libertad del Sur are similar to smallholders across the developing world. At the same time, however, they have advantages that may allow them to benefit from yerba mate production, including their location in one of the only yerba mate-growing regions in the world. In this section, I will provide a brief introduction to Paraguay and Libertad del Sur to further demonstrate why they were suitable locations to study yerba mate and livelihoods.

Paraguay is a land-locked nation in central South America bordered by Bolivia, Brazil, and Argentina. The eastern half of the country is characterized by a subtropical climate with relatively even rainfall throughout the year (Library of Congress, 2005). Summer, from October to March is hot and winter, from May to August is cool, with temperatures occasionally dropping below freezing. The southeastern region of Paraguay where Libertad del Sur is located is cooler and wetter than the rest of the country, averaging 1700mm of precipitation annually, with no pronounced wet or dry seasons (Florentín Peñalva, Calegari, & Derpsch, 2010).

Paraguay has relatively low population density, with a total population of under seven million people and a land area similar to California. This population is located predominantly in the eastern half of the country, and is largely agrarian with some of the highest incidences of poverty in South America (Mario et al., 2004). Smallholders suffer from severe inequalities, as Paraguay has the highest inequality in land distribution in South America and is second only to

Brazil in the inequality of its income distribution (Library of Congress, 2005). Approximately 85% of the land is owned by 2.5% of the population, and 85% of the large landowners are foreign (Library of Congress, 2005). Paraguay's economy is heavily dependent on agriculture, and the primary export crops are soy and cotton, with sugar cane, wheat, and sesame among the export crops of secondary importance (Library of Congress, 2005). The primary subsistence crops are manioc, corn, beans, and peanuts.

The Paraguayan economy has grown significantly in the past 40 years, largely driven by export agriculture, but the benefits of this growth have been confined to urban areas and large landowners, and the situation of the rural poor has been static or worsened over the same time period (Morley & Vos, 1997). While large farms producing soy or wheat have earned enormous profits, much of Paraguay's rural economy is still characterized by the *minifundia* system, in which smallholders practice intensive agricultural production on plots of ten hectares or less (Parrado & Cerrutti, 2003). Because of the limited productive capacity of such small pieces of land, these smallholders must rely on outmigration (Parrado & Cerrutti, 2003) or off-farm employment (Danielsen, 2009) to increase the security of their precarious livelihoods. Smallholders pursuing livelihoods based on the production of export crops often depend on *patrones*, local plantation owners, for the seeds, inputs, and sale of their crops (Nagel, 1991). In this way, rural households overcome limitations in access to capital, but these patron-client relationships may sacrifice potential income as well limiting the potential for cooperative action within communities (Sondrol, 1997).

The soy and wheat boom in Paraguay has had negative effects on both the availability of employment and access to land in rural Paraguay (Carter, Barham, & Mesbah, 1998). In 2005, 40% of agricultural land in Paraguay was devoted to transgenic soy, and 75% of this soy is

destined for export (Domínguez & Sabatino, 2010). Because transgenic soy requires very little labor and is most efficient at large scales of production, smallholders trying to produce it are at a competitive disadvantage, and are unable to leverage one of their primary endowments, the availability of free household labor, to their advantage (Carter et al., 1998). Smallholders are less able to acquire more land because of capital constraints, locking them into this competitive disadvantage, and as a result, many have sold their land and out-migrated.

While the use of transgenic seeds was formally begun in Paraguay in 1999 (Domínguez & Sabatino, 2010), participants in this study claimed that they were used for several years prior to that by large land owners while authorities feigned ignorance. In addition to narrow effects on income security, which will be considered in this paper, this expansion of transgenic soy has brought severe problems of health and injustices in access to land (Domínguez & Sabatino, 2010). Cases of birth defects and water contamination due to agrochemicals associated with the production of transgenic soy have been registered in the immediate surroundings of Libertad del Sur (Domínguez & Sabatino, 2010). Libertad del Sur is bordered on one side by a large soy and wheat farm, and many of the participants in this study were concerned about the health risks of agrochemical use on this farm.

Libertad del Sur is a community comprised of approximately 240 households and 1450 people (Secretaría de Acción Social, 2010). The community is divided among four parallel dirt roads, one kilometer away from each other. A waterway, called the Mbo'i Ka'e, cuts the community in half. The half of the community that I lived in, the eastern half, is commonly known as Libertad del Sur Cuarta Linea, and is home to approximately 70 households (from here on, I will simply refer to it as Libertad del Sur unless specification is necessary).

The department within which Libertad del Sur is located, Itapúa, has one of the lowest incidences of poverty in Paraguay, but this relative affluence does not necessarily extend to the smallholders in Libertad del Sur. According to the national census of 2002 (Dirección General de Estadística, Encuestas y Censos [DGEEC], 2005), Libertad del Sur's district was ranked worst in Itapúa with 45% of households having inadequate dwellings, 46% having inadequate sanitation infrastructure, and 44% having inadequate access to education. It was also in the bottom half of districts with 20% of households having inadequate access to food, and all-told, ranks as one of the most poverty-stricken districts in the country (DGEEC, 2005).

The area is predominantly rural, with 96% of its population residing outside of urban zones, and the population is declining because of outmigration (Secretaría de Acción Social, 2010). While 88% of people in the area are farmers, there is some industry, with two yerba mate processing facilities and one sugar cane processor (Secretaría de Acción Social, 2010). These yerba mate processing facilities were used by some participants in this study, but only indirectly, as it was necessary for them to sell first to intermediaries who provide harvest teams and transport to the facility.

Like many parts of Paraguay where legal titles among smallholders are rare and property is a major source of strife and contestation (Library of Congress, 2005; Hetherington, 2009), there are not any households in Libertad del Sur with title to their land (C. Duarte, personal communication, June 15, 2013), and in the district as a whole, 30% of properties lack title (Secretaría de Acción Social, 2010). According to participants in this study, the community was born through the dissolution and parcelization of a charcoal-making enterprise. Many community members purchased their land from an employee of this charcoal company, who sold the land without approval from the owner. When the landowner realized what had happened, the

settlers were confronted by police at his urging. They were not evicted, however, and a deal was worked out to transfer the land to Paraguay's land titling agency, which would then give out titles to settlers. Official measurements have since been done by surveyors, but the titles have not been distributed to community members.

In their insecure land tenure and the other challenges they face, households in Libertad del Sur are similar to smallholders in many areas of Latin America. While they have these challenges, residents of Libertad del Sur also have some advantages, as they tend to have larger land-holdings with more fertile soil than people in many parts of Paraguay. According to participants in this study, land in the community was originally given out in 10 hectare parcels, though many properties have become subdivided over time resulting in somewhat smaller average farm sizes. The soils are red clay alfisols derived from basalt, known locally as "tierra colorada" (Florentín Peñalva et al., 2010), and are some of the most fertile in Paraguay (G. Arevalo, personal communication, June 12, 2013), and the average farm size of the 23 participants in this study was 6.8 hectares. The median farm size for the eastern half of Paraguay is less than five hectares (Carter & Olinto, 2003), and these farms often have variable soil quality (Finnis, Benítez, Romero, & Meza, 2012; Fletschner & Zepeda, 2002). The distribution of farm sizes among participants included more small farms than did the district as a whole, however. In the district within which Libertad del Sur is located, 30% of farms are less than 10ha, 45% are between 10 and 20 hectares, and the rest are larger than 20 hectares (Secretaría de Acción Social, 2010). In this study, 65% of households had farms less than 10 hectares and the rest were between 10 and 20 hectares.

In addition to natural endowments such as land and soil, households in Libertad del Sur have had access to resources through conservation and development projects. The community

sits within the buffer zone of San Rafael National Park, which is one of the largest intact tracts of Atlantic Forest remaining in Paraguay (Huang et al., 2007). Because of this proximity to an important protected area, Libertad del Sur has attracted interest from conservation and development organizations including the World Wildlife Federation, the United States Peace Corps, and several Paraguayan NGOs (M. Mieres personal communication, May 16, 2013). In several cases, these projects have resulted in the infusion of tangible resources into the community, including equipment for processing animal feed and raising chickens, material for the establishment of home gardens and a community nursery, and yerba mate seedlings.

The resources brought by these development projects as well as endowments in good soils and sufficient land may have left households in Libertad del Sur more able to invest in livelihood change than smallholders in other parts of Paraguay. This ability to invest is another reason that Libertad del Sur was a good place to study yerba mate's potential effects on livelihoods. 30 of the 70 households in the community have planted yerba mate in the past five years, primarily through the development projects mentioned above, and three households planted earlier than that, meaning that they have already begun harvesting their yerba mate. The presence of these earlier adopters allowed for the study of the actual benefits of producing yerba mate. Meanwhile, the presence of other households who have demonstrated interest in producing yerba mate by participating in planting projects but who have still not devoted substantial land or money to it allowed for the study of the important factors in household decisions about whether or not to invest in it.

## 5. Methods

The primary aim of this study was to investigate the potential effects of yerba mate production on livelihood security. In order to answer this question, I used a case-study approach featuring interviews with smallholders in Libertad del Sur and key informants. These interviews were conducted with the dual aims of discussing yerba mate production and learning about current livelihood strategies in Libertad del Sur.

It was necessary to learn about current livelihoods so that I could begin to understand the areas of vulnerability and opportunity that these households experience. From there, in order to understand how yerba mate production may mitigate or contribute to vulnerability, I needed to understand the specific nature of it as a livelihood strategy, including its income generating potential, the amount of inputs it requires, and its susceptibility to environmental or economic shocks. An important component of this question is the production strategies that households will pursue. As stated above, yerba mate can be grown in a variety of systems, intercropped with trees or subsistence crops or grown in monocultures, and each of these systems has different costs and benefits, so in order to fully understand the livelihood effects of yerba mate, I needed to learn what production methods participants planned to use and why. Finally, in order to understand the actual potential of yerba mate to affect livelihoods, I needed to understand the likelihood that it will be adopted on larger scales by Libertad del Sur households. This question assumes an understanding of some of the constraints and opportunities to investment in yerba mate, and the assets or claims that households may leverage to invest.

In order to answer these questions, my original research plan was to conduct interviews with a member of all the households in Libertad del Sur who had planted yerba mate. I also wanted to gauge the feasibility of alternative production strategies to make yerba mate more profitable for community members. Then, I would interview key informants to learn more about

these alternative production schemes and, as a way to attempt to make the project beneficial to community members, hold a community meeting to share the results of my study.

When I arrived in Libertad del Sur to begin answering my research questions, I realized that the project would not go exactly as planned. First, the Peace Corps Volunteer (PCV) who took my place had left the community in search of another, less isolated, assignment in Paraguay, and many community members believed that I was simply returning to fill once again the recently vacated position. Perhaps because they thought I was still a PCV, several community members sought me out within my first days back in the community to ask if I was going to acquire yerba mate seedlings for the community, and to say that they were interested in participating if there was a project. Then, when I explained my research plans to my primary contact in the community, he expressed concern that some community members might not be willing to talk with me if I did not provide them with some form of compensation.

According to my primary community contact, many people had been expecting me to organize and implement another yerba mate planting project, like the one that the previous PCV had undertaken, and they might feel deceived if I just wanted to talk to them about yerba mate, rather than providing seedlings. They had many reasons to think I would be providing yerba mate. First, the previous PCV was the first volunteer in the community, and some community members may have simply believed that yerba mate projects were part of the Peace Corps mission. Second, this previous PCV told community members who left out of first yerba mate project because of limited project funds that I might be able to provide them with yerba mate plants. Third, during my Peace Corps service I applied for funding from the Paraguayan division of the UN's Development Programme for a yerba mate and reforestation project. While I tried to downplay the chances of getting the funding, it was necessary to discuss the project idea with a

number of community members in order to gauge the level of interest, and I think this process created the expectation of another project. I was never given a response, positive or negative, with regards to the application, and because of the unexpected nature of my return to the US, I did not have the chance to explain to people in the community that the project would not be happening. Finally, in the months following my initial exit from Paraguay, an agricultural extensionist assigned to work in Libertad del Sur heightened expectations of another project among some community members. He encouraged people to plant native tree seedlings in expectation of the opportunity to receive yerba mate seedlings, presumably because the previous project and my funding proposal had included native tree planting as a requirement for receiving yerba mate seedlings.

During this time period, I discovered that the Peace Corps office in Paraguay was holding a small sum of money for me, which had been mine as a Volunteer and was meant to be spent in Libertad del Sur. After speaking with a few of my closer friends in the community, I decided that this money would be best spent by carrying out a small yerba mate planting project. This planting project fit into my research plans by providing me with compensation to offer participants who may have otherwise been resistant to doing interviews. Furthermore, the provision of seedlings to participants would give me a direct way to ask about how participants would incorporate yerba mate production into their livelihood strategies.

In order to choose participants, I identified households who had planted yerba mate in the previous planting project and were within walking distance from my house. This yielded 14 households, all of whom agreed to participate. As news of the project went around the community, nine other community members approached me to ask if they could receive seedlings and, when I was sure that there would be sufficient seedlings, I agreed, resulting in 23

total participant households. These 23 households represented approximately 33% of all Libertad del Sur households. I visited each of these 23 households to inform them of how to retrieve their seedlings and ask if an adult member of the household would be willing to participate in an interview. In all cases, a household member agreed to do an interview.

Reflecting the composition of the community as whole, my sample was almost entirely made up of farmers. Of the 23 participant households, 22 earned income from crops or livestock on their farms in Libertad del Sur. The exception was the principal of the local school. Their farms ranged in size from one-tenth of a hectare to 15 hectares, averaging approximately seven hectares. Five of the 23 interviews were conducted with women. Two of the five women were heads of households with no males present, and the other three offered to do an interview because their husbands were away from home working or otherwise unavailable. Additionally, there was a participant whose primary residence was in a neighboring community, but who owned a small plot of land and a house in Libertad del Sur in order to spend time away from his adult children. He did, however, sell crops grown on this parcel to generate income. This man and the school principal both had plots of land of one hectare or smaller. Finally, two young participants had lived their entire lives in the community, and the rest had resided there between five and 21 years.

I conducted in-depth semi-structured interviews with each of these household heads in either Spanish or a mix of Guaraní and Spanish using an interview guide (see Appendix B for an English version). Participants chose the location and times of the interviews. These interviews were tape-recorded and later translated and transcribed by me with the assistance of a Guaraní language instructor. To ensure participants' confidentiality, I chose a language instructor who was not acquainted with the community nor any of the study participants, and was not likely to

visit Libertad del Sur in the future. Furthermore, I assigned each participant a code name and did not identify participants by name in any of my project files.

In addition to the 23 interviews with project participants, I conducted unstructured interviews with six key informants. Three of these key informants were people I knew well and trusted in the community, including a teacher at the local school and two local farmers who were citrus producers active in community organizations. I used these interviews to get information on what constituted secure livelihoods and the history of development projects and community organization in Libertad del Sur. The remaining three key informants were: 1. A representative of WWF in Paraguay who had experience in Libertad del Sur; 2. An agricultural extensionist from Paraguay's Ministry of Agriculture and Livestock (MAG) assigned to the region; and 3. An established yerba mate producer in Libertad del Sur. In these interviews, I asked about the opportunities and constraints associated with yerba mate production in the community. I conducted these interviews in Spanish, with the exception of the interview with the established yerba mate producer, which was conducted primarily in Guaraní. These interviews were also tape recorded but were not transcribed. In place of transcribing, I took extensive notes while listening to them closely several times.

I began the process of analysis when I conducted my first interview. To do this, I kept a field journal, in which I wrote observations during interviews and my thoughts immediately afterward. These field notes were used to identify further questions for participants, which I asked by making return visits to participants' houses.

Following transcription, I coded the 23 participant interviews. I began generating ideas for coding while still in the field and refined these ideas through a close listening of five interviews. Refer to Appendix C for a list of codes used. Using Nvivo software, I coded the

transcribed interviews based on theory and emergent phenomenon, meaning that I generated codes through close reading and analysis of the data, rather than using pre-assigned codes. My notes from the key informant interviews were also coded to aid in the organization process. After the interviews were coded, I continued the analytical process by comparing coded text between interviews to see the variety of ways in which participants talked about certain topics. I used this further analysis to generate themes, which formed the foundation of the results section of this paper. While the major part of the results section of this paper is my interpretation of the data, I have retained the original text from interviews to lend support to my analysis. It should be noted, however, that even these direct quotations are presented in an interpreted manner because they required translation from Spanish or Guaraní to English.

My study design had limitations in the representativeness of the research sample, including a lack of women's perspectives and biases in the types of households that were included. The inclusion of more women's voices would have been preferable because they may have had different views on yerba mate than men and different perceptions of the vulnerabilities and opportunities experienced by their households. Furthermore, in my discussion of results, I will often refer to household assets, but it is important to note that there may have been intra-household differences in access to assets and resources enjoyed by men and women. Because of cultural gender norms, it was not feasible for me, as a man, to interview many women. Therefore, I was not well-suited to explore gender dynamics related to the livelihood strategies and yerba mate production.

Another limitation of my study design was that the research sample was not representative of the broader community. By only interviewing households with a demonstrated interest in planting yerba mate, my findings are likely skewed toward more positive assessments

of the effects of yerba mate production on livelihoods. Furthermore, by only including households able to invest land and time in yerba mate production, my sample may be biased toward farms with more land and labor available for yerba mate production. It is difficult to assess the extent of this bias, however, because I did not collect data on farm size or assets from non-participants.

The bias in my sample toward households with more land and labor is reflected by the absence of households who do not earn income from their own farm, whether through cash crops or livestock sales. Through informal participant observation, I learned of at least three households in the community of this type, whose primary source of income was off-farm employment and whose land was too small for cash crops or livestock. Aside from these households without farms, participants and non-participants seemed to have similarly sized farms, but, according to key informants, study participants were less likely to be renting out their farms to other farmers than other households. Many participants claimed that households renting out their farms were the poorest and most likely to outmigrate, which indicates that this study may have failed to include some of the most marginal households in the community.

Meanwhile, my use of key informants may have introduced additional biases to my results. In the general sense, assuming that the perspectives of individuals may be representative of the community as a whole on issues such as livelihood security goes against recent thinking on the heterogeneity of rural communities (as discussed in Agrawal & Gibson, 1999). In addition, my choices of key informants reflected my earlier experience in Libertad del Sur as a Peace Corps Volunteer. I was assigned to work on environmental education and promotion of diversification, organic agricultural practices, and, if possible, agroforestry initiatives. Given this

previous experience, my closer contacts, and therefore, my key informants, likely tended to be households with greater willingness or ability adopt the practices I was promoting.

While there were significant limitations imposed by my sampling methods, I nevertheless managed to include perspectives from a substantial portion of households in Libertad del Sur on a subject that is relevant to approximately half of all households. Between participants and key informants, I interviewed approximately 36% of households, and approximately 47% of households have planted yerba mate meaning that, although my findings may only be applicable to a certain subset of community members, this subset is sizeable. My findings should be viewed accordingly; they are neither generalizable to the community or region as a whole nor are they only relevant to a small segment of the community's population.

## 6. Results & Discussion

I will begin the following chapter with a description of current livelihood strategies pursued by the households of study participants and a discussion of the livelihood context, including assets, vulnerabilities and relevant institutions, in which these strategies are pursued. I will continue with a consideration of the benefits and challenges of yerba mate production informed by the livelihood context in the community. The results chapter will conclude with a description of participant plans for yerba mate production and their opportunities for investment in view of these benefits and challenges.

### Current livelihood strategies

In the following section, I describe the current livelihood strategies of participants. I asked participants about their current livelihood strategies in order to gain an understanding of the security of their livelihoods and the ways that yerba mate production may increase or

decrease livelihood security. To this end, I analyze these livelihood strategies with a focus on livelihood assets, vulnerability, and institutions. My focus is on tangible assets but I do discuss claims and access in some cases where they were especially crucial in determining livelihood security.

The income-generating strategies practiced by participants may be roughly broken down into production of cash crops, production of subsistence crops, raising livestock, leasing land, and doing off-farm labor. By cash crops, I am referring to those crops grown primarily for the purpose of sale. Functionally, there was not a clear distinction between cash crops and subsistence crops, which I consider crops grown primarily for the purpose of household consumption or provision of livestock feed. Several of the crops I consider cash crops were used on occasion in the household, and some subsistence crops were occasionally sold. There was a clear distinction made in speaking by participants, however, between what they referred to as industrial crops versus subsistence crops. Industrial crops were those sold outside of the community, including soy, cotton, citrus, tung, yerba mate, wheat. Subsistence crops were crops grown for household consumption or sale within the community, including among others manioc, corn, beans, and peanuts. I will be following this division in my analysis.

### Cash crops

Cash crops grown by participants included soy, cotton, citrus, tung (*Vernicia fordii*), yerba mate, and several subsistence crops that could be sold including onions, peanuts, corn, sugar cane, and beans. Of the 23 total participants, 21 reported growing crops for sale on their property, and 19 grew one of the industrial crops. The 21 participants with crops for sale averaged 2.1 total different cash crops. The following figure displays the number of participants who reported growing each industrial crop, the average number of hectares they

produced of that crop, the percentage of their total farm area that crop occupied, as well as the average number of types of cash crops those producers grew. I did not include any subsistence crops grown for sale in the figure because they were more commonly grown for the purpose of household consumption and only sold occasionally by households pursuing other cash crops as primary income sources. There was one participant, however, who grew subsistence crops specifically for sale, and did not produce any industrial crops.

	Soy	Yerba mate <sup>1</sup>	Citrus	Tung	Cotton
Total producers	12	6	4	7	2
Avg. crop ha.	3.8	1.4	0.9	1.8	1.0
Avg. farm ha.	7.8	7.3	4.6	6.6	7.3
Avg. farm %	51%	23%	19%	27%	14%
Avg. cash crops	1.8	2.7	3.3	3.0	3.5

As the table shows, soy was the most commonly grown cash crop with 12 producers among 23 participants, followed by tung, yerba mate, citrus, and cotton. If all participants who have planted yerba mate in the past are included, however, yerba mate becomes the most common cash crop, with 19 total producers. The average area of soy produced was more than twice as much as any other crop, at 3.8 ha, compared to 1.8ha for tung, 1.4ha for yerba mate, 1.0 for cotton, and 0.9ha for citrus. Meanwhile, the average farm size of soy producers was

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<sup>1</sup> Unlike, soy, citrus, tung, and cotton producers, the majority of those growing yerba mate planted it in the past three years, and saw the majority of their seedlings die because of drought, which makes this analysis less straightforward. Only 3 of the 23 participants had yerba mate mature enough to be harvested, but an additional 16 participants had planted yerba that was either not yet ready to be harvested or that had all died. Of the 19 participants who had planted yerba mate on their land previously, 6 reported that all the plants died, 7 reported that anywhere between 2 and 50 plants remained, and 6 reported that they had parcels of yerba mate ranging from 0.5 to 2.5ha in area. The table shows values for these 6 producers with relatively large parcels of yerba mate.

larger than the average farm of the producers of any other crop, and soy occupied the greatest percentage of producers' farms. Finally, the two participants growing cotton averaged the greatest diversity of cash crops, with 3.5, followed by producers of citrus (3.3), tung (3.0), yerba mate (2.7), and soy (1.8).

The utility of any of these industrial crops as livelihood strategies depends on many factors, including their profitability and reliability, their seasonality, and the other opportunities that may come with their production. In the following figure, I calculate revenue ranges (yield\*price) from the five most common cash crops, along with rough estimates of input requirements, the season of harvest, the suitability for intercropping associated, and the length of time between planting and harvest associated with each. Although participants grew both grapefruit and oranges, I only consider grapefruit in the following chart because it was grown by two more participants than oranges were, and I was not able to get data on revenues expected for oranges because of uncertainty about yields and prices due to a pest outbreak.

	Range of revenue <sup>2</sup> (\$/ha)	Inputs	Harvest	Intercrop w/subsistence	Years till harvest
Soy	\$200-\$927	High	Summer	No	0.3

<sup>2</sup> Revenue values assumed a conversion rate of 4450gs:\$1.00. For soy, I assumed a price of \$0.08-0.37/kg and yield of 2500kg/ha, for grapefruit \$0.07/kg and 27,500kg/ha, for tung \$0.067-0.16/kg and 4000kg/ha, for yerba mate \$0.033-0.37/kg and 10,000kg/ha, and for cotton, I assumed price and yield of \$0.41-\$1.12/kg and 2100kg/ha. Bottom end prices for soy and yerba mate came from Frey (2005). The remainder of price and yield values was based on information from key informants and participants, and yield values were compared with historical yield data sets for each crop for the Department of Itapúa (Dirección de Censos y Estadísticas Agropecuarias, 2014). Input classifications were based on participant and key informant statements about the amount of work, pesticides, and fertilizer needed for the various crops. The harvest column simply refers to the season of harvest, and by 'Intercrop w/subsistence', I mean whether or not participants mentioned subsistence crops being grown in the same area as the cash crop of interest, whether in spatial or temporal arrangements. Finally, the 'Years till Harvest' column indicates the length of time between seeding and harvesting of each crop.

Yerba mate	\$330-\$3,708	Medium	Winter	Yes	5
Tung	\$268-\$629	Low	Winter	No	5
Grapefruit	\$1,978	Medium	Winter	No	5
Cotton	\$849-\$2,352	High	Summer	Yes	0.3

As shown in the figure, yerba mate has by far the highest top end revenue, 37% higher than the next cash crop, cotton, and 400% or more than soy and tung, but it also had the most extreme price variability. It should be noted that top end revenue for yerba mate is based on current prices, while that of cotton is based on prices from three to five years ago. Bottom end revenue was highest for cotton, followed by yerba mate, tung, then soy. I do not have range estimates for grapefruit because of lacking information on past prices. Of course, revenue is not meaningful without a consideration of inputs, which I am using to refer to seeds, labor, fertilizer, and pesticides. I did not attempt to determine financial value of inputs because of considerable variation in inputs used across different households to produce the same crop. Instead, I relied on qualitative assessments made by participants on the extent of inputs necessary for producing each crop. Yerba mate has the highest top end revenue coupled with medium input costs. Participants described it as needing relatively low fertilizer, pesticide, and labor inputs, but with a very high cost of seeds, or seedlings in this case. In addition to the high cost of seedlings, there are lost opportunity costs incurred during the first five years of its production when it does not yield anything. Grapefruit has similar input requirements but unlike yerba mate, it is not typically intercropped with subsistence crops. Tung has extremely low input requirements, but does not yield much revenue and it cannot be grown with subsistence crops. Tung has the added disadvantage that, similar to cotton, the crop has no food value.

Both soy and cotton have high input costs. Participants explained that the soy grown in the community is a transgenic, herbicide-resistant variety, meaning that most of the weeding is done with expensive herbicides rather than with a hoe. Soy may be produced largely by hand or with machines, though even in manual harvest a tractor with a rake implement is needed to collect the plants after they are cut with a machete. Manually produced soy requires hiring a lot of labor, while mechanized soy requires very little labor but it is necessary to own or rent a tractor to seed, spray, and harvest. Cotton, meanwhile, requires heavy application of pesticides and fertilizer and extremely high labor inputs. The advantages of both of these crops, however, are that they have a much shorter planting to harvest wait time than yerba mate, citrus, or tung, and that the area where they are grown may be used for something else during the rest of the year, such as planting pasture grasses or even wheat.

Among industrial crops, soy tended to occupy a greater total percentage of the farms where it is produced, and it is produced with the lowest number of other cash crops. These findings should be approached with some skepticism due to very small sample sizes, but it makes sense that soy producing households would try to maximize the area devoted to soy given the greater efficiency of soy at larger scales of production (Carter et al., 1998). This issue of efficiency was alluded to many times by participants, many of whom discussed the difficulty of growing soy because of the high costs of production or because their farms were not large enough for it to be profitable. The difficulty of manual soy production for smallholders is captured well in this quote from a soy producing participant: “For me, the soy does not work anymore for small farmers like us. Because we plant it and then use workers to cut it, to rake it, and to transport it, and then there is nothing left over.” Mechanized soy, meanwhile, was described as being risky because of the high cost of renting equipment but

several participants felt that growing it was a good option because of its minimal manual labor requirements, and because when yields are high, it is profitable.

As described above, there was diversity in the cash crops that participants preferred or were able to cultivate. All participants, however, indicated that having diversity in income sources and other livelihood assets was important. One form of diversification valued by participants was having cash crops distributed throughout the year. As shown by the figure above, soy and cotton are both harvested during the summer months, while yerba mate, citrus, and tung are all harvested during the winter. Meanwhile, all of the subsistence crops that are sometimes sold, such as corn, beans, and manioc, are harvested in the summer. Of the 20 households producing crops for sale off of their land in Libertad del Sur, 9 lacked a crop with a harvest in winter and 4 lacked a summer harvest crop. The unequal seasonal distribution of income represents a source of livelihood stress for households, increasing their vulnerability during certain times the year.

Seasonality is just one of the many areas of vulnerability experienced by participants. Others include drought, debt, price crashes, ecological change, and political marginality. The primary effects of drought discussed by participants were decreases in crop yields or complete crop failures. These included both industrial and subsistence crops, but crops differed in their susceptibility to drought. Participants reported that soy was greatly affected by drought, while citrus, tung, and yerba mate were not affected as much.

The susceptibility of soy to drought is especially problematic because of its high input costs. With lower input crops, like yerba mate, citrus, and tung, participants explained that a farmer will almost always earn something, even in the case of drastically lower yields, but this is not true with soy. Several participants estimated that they accrue approximately \$450 in debt

to pay for the input costs of each hectare of soy. With this level of inputs, and assuming a price of \$0.37/kg, it was necessary for them to harvest at least 1200kg/ha to break even. Using these same numbers, a farm with a 3.75ha parcel of soy, the average soy parcel size in the community, would need to produce at least 1700kg/ha to provide the household with an income of \$2/day. Meanwhile, according to participants, in drought years soy yields may drop below 1,000kg/ha, meaning that farmers would be unable to even cover the costs of inputs. In the following excerpt, one former soy producer explains that this vulnerability in times of drought, and the increasing incidence of drought, has led many people to abandon soy production.

*A lot have figured that they won't plant the soy anymore...because for the fields, the forecast is for drought. And if the drought comes, it's a disaster.*

In the worst of droughts, subsistence crops may be largely affected as well, increasing vulnerability for farmers. One participant explained that the combination of decreased yields of subsistence and industrial crops during the drought of three years ago was a problem because farmers use subsistence crops to provide food in times of income shortages. There was a shortage of income because of the failures of industrial crops, and subsistence crops did not produce enough to cover that shortage.

Debt, meanwhile, often has its origins in other vulnerabilities, such as drought or price crashes, but in Libertad del Sur it seems to have become something like a fact of life. When talking about debt, participants described a vicious circle in which the only way to get the yearly capital needed to plant soy or cotton was to take out credit on unfriendly terms, which led to the accumulation of substantial debts when the harvest was small or the prices were low. Then, in good years, they had to use all the extra income to pay back their debts, meaning that, once again, the only way to get the capital to plant was to take out credit on unfriendly terms.

The difficulties of this position are captured well in this excerpt from a participant.

*We owe the bank. If the crop does well, we pay. If it doesn't do well, if we are left to suffer, they raise the interest rate...And so the majority, all the settlements, all the poor, they can't get out of poverty. Owing to their situation, they won't get ahead, they won't have a way to get of poverty. And so we suffer.*

One common outcome of this cycle of debt, according to participants, is bankruptcy, in which a farmer is no longer able to pay debts so all sources of credit are cut off. One participant claimed that a majority of farmers in the community are in this state of bankruptcy, which severely curtails their ability to search for sources of capital to invest in their farms, but does not result in the seizure of their farms because they do not have legal ownership of the land. Many participants described credit with low interest rates as being unobtainable for smallholders, regardless of whether a farmer was bankrupt or not. Credit was available from *patrones* for planting soy. These short-term loans are meant to be paid back at the end of the growing season with the harvest, but in sub-optimal growing years, farmers may have had trouble covering all these costs, and the interest rates charged by the *patrones* were 18-25%, leading to rapid accumulation of debt.

When participants talked about debt, they often mentioned declining prices for crops as one of the causes of that debt. Low prices were one of the factors that made cotton production unsustainable and led many to accumulate debts. A crash in tung prices has also caused many participants to consider replacing their tung plantations, and several participants mentioned being afraid of yerba mate prices falling in the future because of the rash of farmers planting it now.

While low prices on their own may limit profitability of certain crops, there are also environmental factors that may create further vulnerability for farmers. Participants described several such environmental factors in Libertad del Sur, including drought as discussed above, decreasing soil fertility, increased erosion and soil compaction, bigger problems with pests and weeds, pollution from pesticide use, and a hotter and drier climate. In the case of cotton, increasing pest pressure was a stress for farmers that either decreased yields or forced them to spend more on pesticides. In either case, cotton production was less profitable, and farmers were more vulnerable when prices later plummeted. Noxious weeds were another common problem discussed by many participants, and some soy producers mentioned that some of these weeds have become resistant to herbicides. Because of these resistant weeds, soy producers have to hoe their fields in addition to spraying, which adds to labor costs.

Production of cash crops is an inherently risky proposition due to the sources of vulnerability discussed above. The industrial cash crops grown in Libertad del Sur are not all equal in their riskiness or in their potential for profit. Soy and cotton were discussed by participants as the riskiest and among the least profitable, while yerba mate and citrus were discussed as the least risky and most profitable. Both yerba mate and citrus, however, had high initial investment costs, perhaps limiting the ability of farmers to adopt their production as livelihood strategies.

#### Subsistence crops

As mentioned above, diversification of cash crops was one way that households in Libertad del Sur manage risk and cope with sources of vulnerability. Other forms of diversification used were production of subsistence crops, livestock, leasing land, and work off the farm.

All participants reported growing crops for subsistence purposes. The average area of subsistence production reported by participants was 1.2ha, constituting on average 22% of participants' total land. Participants reported growing manioc, several types of corn and beans, peanuts, sweet potatoes, sugar cane, onions, and several types of garden vegetables. Manioc, sugar cane, and corn were grown also as feed for animals.

Growing subsistence crops was discussed by many participants as an important component of a secure livelihood. Subsistence crop consumption was discussed as a way to cope during seasonal shortages of income, as well as during shocks, such as income shortages resulting from the effects of drought on cash crops. Subsistence crops were described as the basis for the diet of the community, especially manioc, which one participant called the "Paraguayan bread" because it is eaten with every meal.

In addition to the being a tangible resource, subsistence crops were discussed as an important part of Paraguayan identity. In the following excerpt, a participant explains the importance of these food sources to the "strength" of Paraguayans:

*Here, the Paraguayans are strong because we eat beans, corn, squash, etc...Like pigs, the people eat manioc.*

Subsistence crops play the dual role of also serving as a primary food source for livestock. Pigs are fed with manioc and corn, and the diets of chickens and pigs are supplemented by corn, beans and other agricultural crops. In this way, direct consumption of subsistence crops forms the basis of the diet, and consumption and sale of animals fed with subsistence crop provide important income and dietary inputs.

## Livestock

Like production of subsistence crops, possession of livestock was discussed by participants and key informants as a critical component of livelihoods in Libertad del Sur. Livestock served the dual purpose of providing for subsistence consumption and income generation. The primary three animals raised by participants were cows, chickens, and pigs but some others had goats, sheep, ducks, and guinea hens. Participants owned 5.6 cows on average, ranging from 0 to 15. Of the 20 participants who owned cattle, 18 had fenced in pasture for their cows (another participant who did not own cattle had pasture for goats and sheep). The pastures averaged 2.5ha in size. Participants owned an average of 5.5 pigs, ranging from 0 to 20, and all of the 18 participants who owned pigs also owned a pig pen for raising them. All participants reported owning chickens, but I did not collect data on total numbers as many participants seemed uncertain. 20 of the 23 participants reported owning a chicken coop. Two participants also owned sheep, with 5 apiece, and one of these participants also owned 20 goats. Two additional participants owned guinea hens and four owned ducks.

According to participants cattle can be sold for \$1.46/kg on the hoof, or \$2.70/kg of butchered meat. The price of pork is also \$2.70/kg, and a suckling pig can be sold for approximately \$12.35. Meanwhile, ducks could be sold for approximately \$6.20 apiece, and chickens a little bit less, around \$4.50. Animals were mentioned to be especially important to small farmers because animals do not have a long growth period before they are harvestable, and they do not require high investment costs. In the following excerpt, a key informant describes how these features of livestock production set it apart yerba mate as a livelihood strategy.

*It is true that raising animals (is the most important thing for people in the community) ... To invest in crops, yerba for example, this takes three or four years of waiting. A cow costs two million, and within one year, I can have a cow with milk, and it will give me this milk to eat for 1 year, and I am still left with this cow. To buy 1,000-2,000 plants of yerba, one has to wait three or four years, and there is nothing to eat.*

This issue of the long wait time associated with yerba mate production will be discussed later. In the following excerpt, one participant explains that animals are the only thing that can be sold “in an instant,” and because of that, many farmers are focusing more on livestock production.

*It's a sure sale, this animal. It is the only thing that is sold in an instant. Any other thing, I can't sell like that, and for that reason, there are many who are little by little focusing on raising animals. So I tell you that if you have a small farm, the animals are appropriate. Because if you grow soy and you have a small farm, this for me is not positive.*

The same participant went on to explain that in addition to being able to sell animals quickly, a farmer in Libertad del Sur can also sell them in any season, which distinguishes livestock production from other income sources, such as cash crops, which all have seasonal harvest schedules.

*These (animals) don't have days or hours, that's how it is. With these there is not a certain day or hour to sell. When you want it, it's there.*

While the majority of participants indicated similar views, two participants held the opinion that animals are not always such a profitable livelihood strategy. In the following excerpt, one of these participants explains that, although cattle are not risky because they will not die in drought, they are not always profitable because it can be difficult to sell them.

*The cow, in a drought, will only get skinny, it won't die. Only animals, but to live on only animals isn't possible because when you want to sell them, there's no market for animals. This is the problem. You aren't going to lose when you have a lot of cows but it doesn't make things so much better either.*

The other participant discussed the primary use of animals being for subsistence consumption. In the following excerpt, he explains animal production as his primary farm management strategy in order to provide food, but not income.

*For me it's better to feed and raise animals. That's my management. The animals, you butcher them and you put them in the freezer, in order to eat, in order not to lack. Because if you sell them for a little money, it doesn't yield much.*

Many participants discussed the greater importance of livestock production during times of vulnerability. Selling cows or pigs or using them for household consumption was discussed as a way to cope with periods of scarcity. Participants emphasized the importance of livestock in cases of illness, during scarce times of the year, and in drought years. In the following excerpt, a participant humorously explains the role that cattle serve during times of vulnerability.

*Yes, when necessity comes the cow becomes very ugly. If there is no necessity, the cow is really nice looking. If necessity comes it becomes, "this old ugly cow!...It does not have any milk...To the butcher!"*

In addition to the vulnerabilities presented by drought and lack of paid work, animals may also be used in times of seasonal vulnerability, when there is no money from cash crops. This excerpt from a soy producer demonstrates how investment in animals might get a household through difficult seasons.

*The only thing to do is the investment in animals when there is some extra income. Buy animals, and eat them in winter.*

In addition to possession of animals, possession of facilities for livestock production was discussed by participants as important to livelihoods in Libertad del Sur. Not all participants and key informants agreed on these points, but the majority indicated that pig pens, chicken coops and pasture for cows were extremely important in animal raising. Pig pens were seen as important to prevent pigs from damaging crops. Chicken coops were necessary to ensure the successful hatching of eggs and raising of chicks. Fenced-in pasture greatly reduced the work required to raise cattle by allowing cows to seek out their own food and water.

There were differences in the way that participants discussed utilizing different animals in livelihood strategies. One key informant explained that chickens are easy to raise and do not require many inputs, as they can essentially fend for themselves. He said that all poor families should have large numbers of them, at least 20-30, to ensure they would have enough food to eat. Meanwhile, both pigs and cows require more work but can give greater benefits. This key informant explained that raising large numbers of pigs is very difficult for anyone with a small farm because pigs require so much food, largely corn and manioc, which must be grown on the farm.

*(The most important thing for raising animals is) corn, and to have some manioc. If you are going to have anywhere between 2 and 5 pigs, you need as a minimum 1ha of corn, and also 0.5ha of manioc. Otherwise you won't have pigs.*

Perhaps for this reason, many participants kept only one or two fully grown pigs in pig pens, but would often have several smaller ones running loose. Cattle, similarly, need large areas of a farm devoted to pasture to feed themselves, or need to be fed large quantities of corn

and grasses. If a household did not have sufficient space for pasture, raising cattle involved a lot of work. Pigs and cows were both seen as beneficial, because they supplied a household with food and a source of income, but these benefits were most attainable for those with larger farms.

#### Leasing land

Another form of income diversification practiced by farmers in Libertad del Sur was leasing land. Six participants generated income by leasing their land to one of the large farms that surrounds the community. There were two systems of payment for leasing land reported by participants. Payment could be given in the form of cash, or in the form of the tilling, seeding, spraying, and harvesting of a crop of soy or wheat. The four participants receiving cash for their land reported that the price could be \$225/ha or \$337/ha, depending on the quality of the land. Land more suitable for mechanization brings a higher price. Meanwhile, the other two participants traded leased land for the production costs of a soy or wheat crop. One of these participants leased 6ha of land for the wheat growing season in exchange for the planting and production expenses of 6ha of soy on the same space. The other participant leased 6ha of land for growing wheat, and also 3ha of land for soy production, for the cost of planting and spraying his 3ha of soy.

While leasing land was not described as very lucrative, some participants felt that it was a better option for their farms than cash crops. Unlike cash crop production, there is no uncertainty in the amount of income generated by leasing land, nor are there inputs or labor associated with it. As a source of guaranteed income, leasing land was discussed as crucial during recent drought years in preventing households from accumulating too much debt.

Not all participants shared the opinion that leasing land is a low-risk livelihood strategy. In the following excerpt, a soy producer explains that leasing land leaves a household without the ability to keep animals, and may eventually lead to outmigration.

*The advantage here is that the people do not lease their land out. They still work their land. They have pigs and chickens and cows. They have milk. But the people, if they rent out all their land, there is no way out. They have to leave to look for work.*

It should be noted that this participant was talking about leasing all of one's farm, and none of the six participants leasing land leased more than 50% of their farm. Furthermore, each of these households had farms of 10ha or larger, meaning that they had much more land available than many participants. Households leasing land devoted smaller percentages of their farms to subsistence than non-leasers, 12% vs 25%, but this difference is due to the much larger farms sizes of households leasing land. In terms of total area devoted to subsistence production, leasers averaged 1.4 hectares versus 1.1 hectares for non-leasers. For these households with larger farms, leasing may indeed be a low-risk source of income, but for those with small farms, leasing may take away land from production of subsistence crops or animals. Moreover, if a household is leasing rather than working their land, they are not leveraging their own labor, which, especially for younger households, is one of the most important assets that smallholders have.

#### Outside work

Off farm employment has been found to be a strategy for low resource households to compensate for lacking farm incomes (Barret et al., 2001). In this study, paid work outside of the house was another important aspect of the livelihoods of participants. In Libertad del Sur, this outside work could be work on the farm of another smallholder in the community (called

“*changa*”), work on the estate of one of the large producers whose properties surround the community (“*ajeno*”), or skilled work in or outside of the community (carpentry, electrical, or mechanic, or construction work). *Changa* is temporary in nature and is primarily provided by other small farmers within the community. *Ajeno* is permanent work on the farms of the large land-owners. It can be full-time, part-time, or seasonal. Unlike *changa* and skilled work, which seemed mostly to be used as a source of extra income, *ajeno* was the basis of several household livelihoods. Participants described *ajeno* as a fairly lucrative and secure way to make a living, because it was available all year and provided guaranteed income. *Changa* opportunities, on the other hand, varied by season and weather conditions, and had declined drastically since the introduction of transgenic soy. Neither it nor skilled work were described as secure ways to make a living.

Each of these types of work were done primarily by men. One key informant explained that it is very unusual for women to do paid work outside of the house in the community. Apparently it was more common in the past, with women doing the *changa* alongside men, but as it became more and more common for young women to leave the community searching for work, women were left without daughters to help with housework, meaning that they had to stay in the house more.

Four participants had *ajeno* work, and one worked as the principal of the local school. Of the remaining 18 participants, four reported that they never did work off of the farm, two reported that they only did *changa* when neighbors needed the extra help, three reported that they rarely did *changa*, and the other nine did *changa* regularly or when it was available. Daily pay for *changa* reported by participants varied between \$9.00 and \$15.75. One participant with *ajeno* work reported making \$10.25 per day, while another reported being paid in a piece work

system, in which he and his employers agreed on a set price for a particular task and pay was the same regardless of how much time it took to complete. Two participants with *ajeno* work reported doing this work about 60% of the time, one 50% of the time, and the other explained that he worked for his employer just about every day with good weather.

Outside work was discussed by the majority of participants as a way to cope with vulnerability caused by drought and seasonal fluctuations in income. By taking advantage of their access to household labor, outside work provided participants with a source of income requiring no financial investment or risk. Similar to income from production of livestock, this income from off-farm work was not strictly tied to seasonal harvest schedules, though there were certainly seasons when participants described greater or lesser access to off-farm work. There were a small number of participants who saw off farm work as less positive. Among these, some said that it did not pay well and others explained that if one did too much outside work, it was difficult to find time to work one's own farm.

Most participants described a decline in opportunities for work tied to the rise in mechanized farming and the introduction of transgenic soy in Paraguay. Unlike in the past, farmers could no longer find enough work to cover loss of income due to seasonal fluctuations or drought. For this reason, livestock production was seen as even more important as a way to manage risk imposed by these sources of vulnerability.

Participants described the dispersal of household members as another response to the decline in work opportunities. In some cases, these household members sent remittance money back to Libertad del Sur, bolstering household incomes. Key informants described dispersing household members as an unreliable because the amounts of money sent are small and irregular, and it is occasionally necessary to send money back to those who have moved away.

The national data on Paraguay shows that only five percent of all households receive remittances, but that number climbs to 60% when only considering the poorest fifth of all households (Acosta, Fajnzylber, & López, 2008). Unlike other areas of Latin America, according to participants, the primary source of remittances in Libertad del Sur is another developing country, Argentina, whose proximity may allow greater access to poor households. At the same time, however, the prospects for financial returns from remittances from Argentina are likely lower than they would be from the United States or other developed nations (Acosta et al., 2008), perhaps limiting their impact on household economies.

#### Land

In addition to the aforementioned livelihood strategies and sources of vulnerability, land was an endowment frequently discussed by participants and key informants as a key to livelihood security. Land was the primary reason that participants came to Libertad del Sur, with 18 of the 23 participants reporting that they came to the community to acquire a piece of land. Among these participants, eight explained that they had never owned land before coming to Libertad del Sur. Farm size was an issue that came up repeatedly as participants and key informants discussed the requirements for secure livelihoods in Libertad del Sur. Most identified five to ten hectares as the minimum farm size for having enough to feed a family and live comfortably. As one key informant explained, a family could eat with three to five hectares, but if any of the children were to pursue a high school or college education, the family should have more in the range of ten hectares.

*To live in a state of equilibrium...a person should have 10ha well cultivated...(A family needs) between 3-5ha, just to eat, and 4-5ha to make some money, and that means that we can*

*have students. If we have less land than this, we can have students until 9th grade, but nothing more than that.*

Another participant mentioned that having five to ten hectares and growing several crops is the key to living well in Paraguay.

*You have to have land. Five to ten ha. You will live without worries. You will have the pasture, the milk cow, the farm fields, 1ha of yerba, and 1 other crop, could be the mechanized soy, also.*

This quote relates to the above discussion of diversification. According to this participant, sufficient land allows a household to diversify and have a secure livelihood. This idea is in line with the discussion of diversification in the literature review, which found that diversification may be difficult among the most marginalized households. Farm size was described as an important factor in the types of cash crops that could be grown profitably, with participants describing yerba mate, citrus, and tung as profitable and soy as disastrous for those with small farms. Farm size was also a determinant in the quantity of livestock that could be kept and the area of subsistence crops that could be produced, meaning that those with the smallest farms would have fewer resources to fall back in the case of stresses or shocks. As discussed above, farm size was also important in deciding who could benefit from leasing land. Outside work was the only livelihood asset discussed above that was not positively associated with farm size. In fact, those with smaller farms were both more dependent on and more able to take advantage of outside work opportunities because of less need for labor on their own farms. For this reason, the rise of mechanized transgenic soy and the resulting reduction in outside work opportunities was especially damaging to those with the smallest farms.

These marginal households, with limited capacity to keep livestock and limited income opportunities, are those for whom agroforestry crops, such as yerba mate, could be the most beneficial. As one key informant explained, “[*For those with small farms*] it is necessary to think hard about agroforestry, that is where the solution would be. To have trees and crops below... and also to have 1 or 2 milk cows. But this is not easy.” The status quo for these households - production of soy and cotton - is risky with relatively low income potential, but, as the above quote indicates, transitioning to more secure income strategies is not simple. First, it is necessary to have a thorough understanding of the effects of potential alternative strategies. To this end, in the following section, I will discuss in detail the benefits and challenges of yerba mate production systems among the smallholders in Libertad del Sur.

#### A. Yerba mate production and vulnerability

As discussed in the literature review and the discussion of livelihood strategies in Libertad del Sur, livelihood diversification may mitigate vulnerability and provide additional income. The above discussion of indicates that diversification in the form of yerba mate production has the potential to earn more income for households, but the more general effect on livelihoods may depend in large part on the way that participants choose to produce their yerba mate. In this section, I first discuss in more detail the positive and negative effects that yerba mate production may have on Libertad del Sur households. Then, I analyze participant plans for yerba mate production, with the goal of detailing the strategies that participants will use to maximize the benefits and minimize the costs of adoption of yerba mate.

##### Positives

The primary benefits of growing yerba mate mentioned by participants were its profitability, the ability to intercrop it with subsistence crops, the timing in winter of its harvest, the previous experience many households have with its production, its suitability for the local environment, and its relatively minimal environmental impacts. Profitability has been identified as one of the most important criteria for successful implementation of agroforestry systems (Sanchez, 1995), and for the adoption of new crops, in general (Mercer, 2004). Profitability was commonly discussed by participants as their reason for choosing to produce yerba mate. In the following excerpt, one participant compares yerba mate to soy to demonstrate its profitability.

*I planted yerba because, if the yerba produces 10,000kg/ha around there, or maybe a little more, but we will surely get 8000-9000kg/ha. And now the price is between \$0.34 and \$0.40/kg. This profits more than 5ha of soy. 1ha of yerba is more profitable than 5ha of soy.*

This farmer's assessment of the profitability of yerba mate is supported by my earlier estimates of top end revenue and input costs, and it highlights the beneficial aspects of yerba mate production for small farmers at current prices. By these estimates, a yerba mate-producing household with a three hectare farm could have a more secure livelihood than a soy-producing household with a seven hectare farm. If each household devoted two hectares of their farm to subsistence crops and pasture, the yerba mate producing household would earn more off of the remaining hectare than the soy producing household would off of five hectares.

In fact, the yerba mate producing household in the above example may have advantages beyond just income because of the ability to intercrop yerba mate with subsistence crops or trees. The ability to grow preferred subsistence crops, like manioc, within yerba mate plantations is especially important in light of research that has found adoption of agroforestry

systems to be limited in cases where it would interfere with subsistence production (Belsky, 1993). This added advantage was consistently discussed by participants as one the most attractive features of yerba mate production. By intercropping with subsistence crops, yerba mate producers give themselves insurance against crop failures or price crashes. Meanwhile, by growing yerba mate under trees, farmers ensure access to fuelwood and create a potential source of income in the future. Manioc, corn, or beans grown in yerba mate plots would provide households with food or fodder for livestock if their incomes were lacking. As discussed earlier, these crops may also be sold in certain cases, giving yerba mate producers alternative sources of income. Timber species grown over yerba mate could greatly increase the income expected from a plot of land after the trees are large enough to be harvested. Similar to its profitability, the potential for intercropping is another feature that may make yerba mate production especially attractive to households with small farms, because of the added food or income they could obtain from a given piece of land.

It should be noted, however, that research is lacking on the effects of intercropping on yerba mate yields. That said, there has been one study (Eibl et al., 2000) that found equal production on a per plant basis for yerba mate grown in monocultures versus in agroforestry systems with timber species and subsistence crops. While individual plants were not adversely affected, yerba mate yields per hectare were 50% less in the agroforestry systems because of lower plant densities.

Seasonality is another important source of stress to small holders, as mentioned above, and the winter harvest season of yerba mate would reduce this stress for farmers growing soy or cotton, which are both harvested in the summer. One soy-producing participant alludes to this benefit of yerba mate in the following excerpt.

*(I want to plant yerba) so that I will have two harvests, winter and summer, because if not, it is tough. There is no changa. Because it is all mechanized, there is nothing manual for changa. The soy is all transgenic and mechanized. The work is fast, and because of that there is no more changa.*

As this farmer explains, having winter crops is especially important because the increased mechanization of soy has decreased the amount of temporary paid work (*changa*) to be had on others' farms. In this way, yerba mate production could be used to mitigate the negative effects of the introduction of transgenic soy.

Participants and key informants also discussed the high degree of knowledge and previous experience with yerba mate production in the community as an important advantage. This is potentially significant because previous experience or training in agroforestry systems are important predictors of adoption (Pattanayak, Mercer, Sills & Yang, 2003). 20 of the 23 participants worked in yerba mate production in the past, usually as paid employees on other farms or on the farms of their parents. Many also explained that they received formal training in yerba mate cultivation through previous projects in the community or learned by observing other yerba producers, and one participant received extensive training at an agricultural school. According to one key informant, this degree of experience sets yerba mate apart from other perennial crops, such as citrus, with which community members did not have previous experience.

Another beneficial aspect of yerba mate production discussed by participants was its suitability for local climatic conditions and soils. These claims were backed up by the agricultural extensionist who served as a key informant (G. Arevalos personal communication, June 12, 2013). Suitability is important because research has shown biophysical factors to be

an important factor in adoption and implementation of agroforestry systems (Mercer, 2004).

While the community is located in a good area for yerba mate production, there were differences among participants in the topography of their land that may affect their ability to adopt yerba mate production. The land in the community can be thought of as occupying three zones: a relatively flat elevated plateau, a west-facing slope that starts at the edge of this plateau, and a flat area of bottoms extending from this slope to the Mboi Ka'e River. Participants described the plateau zone as the best area for agriculture, but it is mostly owned by a large soy producer. Most of the land owned by community members is situated on the slope or in the bottoms, both of which may constrain yerba mate production. Soils in this region are susceptible to erosion (Ilany, Ashton, Montagnini, & Martinez, 2010) and participants stated that erosion was a problem in sloping areas, and that soil fertility had declined in these areas as well. The bottomlands, on the other hand, were described by participants as having poor drainage and more susceptibility to frosts, both of which negatively affect yerba mate (Burtnik, 2006).

While environmental changes such as erosion may limit the productivity of yerba mate, they were described by many participants as sources of vulnerability that may be mitigated or managed through yerba mate production. Biophysical factors such as soil quality can have either negative or positive effects on the likelihood of households to adopt agroforestry systems (Mercer, 2004). In general, declining soil fertility is positively associated with agroforestry adoption, but research has shown that after a certain point, soils may be so unproductive that adoption is not feasible (Mercer, 2004). While I do not have data on the soil quality of farms in Libertad del Sur, the generally positive participant assessments and relatively high yields of yerba mate and other crops suggest that soils are suitable for agroforestry systems.

In Libertad del Sur, planting yerba mate was described as a way to prevent soil erosion and further losses in soil fertility. Key informants explained that this was true because yerba mate grows best with ground cover. Also, while yields are less under drought conditions (Burtnik, 2006), mortality is not an issue in established plantations, according to participants, which means that yerba mate may be a good crop in the context of adaptation to climate change. Finally, one other environmental change of concern was the increase in pollution from agrochemicals primarily used in the production of soy. As noted in the literature, there have been cases of contamination of drinking water and birth defects resulting from the use of these agrochemicals near Libertad del Sur. Many participants expressed concern about such health effects, and they saw transition from soy to yerba mate production as a way to limit the use of these chemicals on their own farms.

### Negatives

While yerba mate production was seen as largely positive, there were negative consequences participants associated with its adoption. Two negative aspects of yerba mate production relevant to all participants were the long waiting period between planting and harvest and the high costs of initial investment. Other challenges faced by only certain participants were labor requirements and the timing of the harvest in winter. Additionally, as mentioned earlier, a small number of participants speculated about the possibility of a price crash in the future.

Yerba mate production has high initial costs because seedlings are expensive. For my planting project, I paid \$0.18/seedling, and I received a small discount because of the volume of plants I purchased. To put that number in perspective, yerba mate producers in this study had, on average, approximately 3,100 total plants. With seedlings at \$0.18 apiece, those plants

would cost approximately \$560. Because of the high cost and the difficulty of obtaining credit, many participants explained that they simply could not invest in yerba mate production themselves. They hoped that more opportunities would come to get free seedlings because they wanted to grow yerba mate, but they did not expect to have any disposable income with which to purchase it.

The high costs of investment in yerba mate were magnified by the long period before a household could expect to see any return on this investment. This time lag has been identified as an important constraint to the adoption of agroforestry systems (Sanchez, 1995). During the five years that yerba mate needs to reach maturity, a household must have other sources of income and enough land or available labor to generate this income. Marginal households would be the least likely to overcome this challenge, given their meager endowments, even while they would stand to gain the most from investment in yerba mate.

Meanwhile, for participants with significant demands on their time outside of the farm the need for labor was one of the challenges of producing yerba mate. There were five participants with regular outside work, four of whom indicated that labor requirements were one of their concerns in planting yerba mate. One participant said that her husband would have to hire workers to care for his yerba during times when he was working away from home often. Hiring workers is a significant cost for these small farmers, especially in the first years before their yerba mate reaches maturity, adding another expense to the high costs of investment.

In another disadvantage of yerba mate production for some, the timing of the harvest was not beneficial for all participants. As one key informant mentioned, those generating income through citrus or tung production already have income in the winter. Instead, if they do

not also grow soy or cotton, they lack a summer income. The following quote from a participant explains this dilemma.

*I planted yerba mate, tung, and oranges, but they are all for winter. You should have something for summer, but what is there for summer? Orange, winter, grapefruit, winter, tung, winter, yerba, winter. So then when summer comes, there is nothing.*

This uneven seasonal distribution of income is especially challenging for households in Libertad del Sur because of the difficulty of saving money. The closest banks are far away, and one participant explained that it is risky to keep money in one's house because of the chance that it might get stolen. While this worry about theft did not seem to be universal, I asked each participant what he or she thought was the best thing to do with extra income, and only two mentioned saving it for later. Every other response involved spending the money rather quickly, often to purchase animals or improve pasture. If households are unable to hold on to income, the difficulties posed by having only cash crops with winter harvests are magnified and, as discussed above, many households used livestock production as a way mitigate these difficulties.

Finally, a price crash would negatively affect all yerba mate producing households. Several participants speculated that prices could decline in the future because so many people are planting seedlings currently. The following excerpt from a yerba mate producer captures this process well, *"The price [of yerba mate] has gone up because before there were lots of yerba plants but they cut them all down because it did not have a good price. And now they have started to plant, many people, because the price went up. I think that it will go down again, in time.*

As discussed in the literature review, yerba mate may be especially prone to these price crashes because of the long lag between planting and harvest. I do not have data on long-term price trends, but prices have increased from \$0.03 (Frey, 2005) to \$0.37 in the past ten years. While the market for yerba mate has expanded with increasing consumption in North America and Europe (Folch, 2010), the hike in prices was largely a result of the expansion of transgenic soy in the traditional areas of yerba mate cultivation (Territorio Digital, 2013). Anecdotal evidence suggests that many yerba mate plantations were cleared to make room for soy cultivation (Frey, 2005). The fear of some farmers in this study was that high prices will convince many to plant yerba mate, and after those new plantations come into production, prices will plummet once again.

A return to those lower prices could have extremely negative effects on households who convert large parts of their farms to yerba mate production. During the coffee crisis, coffee producers in Nicaragua suffered from food insecurity and many had to pull children out of school or migrate as coping mechanisms (Bacon, 2004). These effects were felt the most by smallholders with farms of 14 hectares or less. Given that yerba mate has been shown to be susceptible to price crashes (Lawson, 2009), price variability would seem to be a significant constraint to smallholders interested in producing yerba mate.

Along with market demand, market access has been shown to be a constraint in the adoption of new agricultural crops, in general, and agroforestry crops, specifically (Mercer, 2004; Fischer & Vasseur, 2002). At the present time, market access does not seem to be a problem for yerba mate producers in Libertad del Sur. According to one participant:

*You can sell yerba mate right away. You sell it fast. There are lots of buyers. If you have yerba, the buyers come to harvest with workers and everything.*

Other participants gave similarly positive statements about the accessibility of yerba mate markets, but this accessibility may be related to the current high demand for yerba mate. Because producers in Libertad del Sur rely on intermediaries to harvest and transport their crop to processing facilities, their market access depends on prices being high enough for the work of intermediaries to be profitable. If it is not profitable for these intermediaries to collect their harvest, producers may be left without a way to sell their crop. This has already occurred for several participants producing tung. Tung prices declined in recent years from \$0.16/kg to \$0.07/kg, leading intermediaries to refuse to transport tung harvests in the community, or to delay it until a critical mass of harvest was reached.

Limited access to markets, the possibility of price crashes, lower yields in drought years, and the high upfront investment costs all make yerba mate production risky. The magnitude of risk depends on the age of the yerba mate plantation, with youngest, non-producing plantations being at the most risky stage both because they do not contribute to household income and because they are more susceptible to drought-induced mortality than mature plantations. Later, when plantations are mature and contribute to income, the risk to producers is much less because input costs are low and drought-induced mortality is rare. Therefore, producers may earn less income in the case of falling prices or lower yields, but they are not likely to go in debt.

#### Participant plans for yerba mate production

The risk associated with yerba mate production discussed above may be mitigated or emphasized by the systems of production that participants use. In this section, I will analyze participant plans for production with a focus on the ways that these plans interact with the costs and benefits of yerba mate as a livelihood strategy. This analysis will include their ideas on

whether or not to intercrop with subsistence crops and/or native trees, the total area they would like to have planted in yerba mate, how to obtain the capital necessary to invest in yerba mate production, and strategies for adding value to their yerba mate harvests.

*a) Intercropping with trees*

As discussed earlier, producing yerba mate in agroforestry systems with timber species may earn significantly more income than monocropped yerba mate, while also providing a source of fuelwood. In spite of these seemingly positive attributes, participants had mixed opinions on the wisdom of intercropping with trees. Six participants were in favor of and/or planning to grow trees in their yerba fields. Fifteen participants were not in favor of and/or not planning to grow trees in their yerba fields, and two did not respond to the question or their responses were unclear.

The participants who wanted to intercrop with trees discussed it primarily as a way to improve the health of their yerba mate rather than as a way to gain fuelwood or income through timber sales. Many wanted to provide shade in their yerba plantations to make the yerba mate less susceptible to drought. One current yerba producer explained that he likes to plant the trees 10x10m within his yerba field, and that at that spacing the trees only provide partial shade and do not affect production of the yerba. Several participants explained that certain tree species are better than others to plant with yerba. Specifically, trees that are tall, have thin leaves, and do not have a wide crown were believed to be best, as they would not provide too much shade. Participants mentioned the following species as preferable: *Parapiptadenia rigida*, *Handroanthus heptaphyllus*, and *Balfourodendron riedelianum* (known locally as kurupa'y ra, lapacho negro, and guatambú, respectively). Meanwhile, at least two participants planted their yerba mate in tung fields, which have substantial shade. According to these

participants, the shade would be good for the yerba saplings as they grew, and then, when the yerba was several years old, the tung would be cut down to provide full sun for better harvests.

For these participants, intercropping yerba mate with trees was primarily a risk management strategy, rather than an income enhancing strategy. None of these participants planned to sell the trees they planted in their yerba mate plantations. In fact, many participants explained that harvesting trees from a yerba mate field was not possible because it would damage the yerba. Beyond this practical difficulty, there are institutional barriers to harvesting timber in Paraguay. A law aiming to prevent deforestation has made it illegal to harvest native trees for sale without a forest management plan approved by the Paraguayan National Forest Institute (M. Mieres, personal communication, May 16, 2013). Furthermore, access to fuelwood was not mentioned to be important by participants. The majority had woodlots on their property and several had gas stoves.

An additional challenge mentioned by many participants was that intercropping with trees creates a problem for growing subsistence crops in a yerba mate field. While yerba mate may be shade tolerant, the majority of subsistence crops grown in Paraguay are not, meaning that intercropping with trees may take away the opportunity to intercrop with subsistence crops. One participant even explained that, as he understood it, the practice of intercropping with trees was beneficial, and provided for healthier yerba trees, but he would not be doing it, as he was using his yerba field to grow manioc. Some additional reasons participants gave for not intercropping with trees were that the yerba mate harvest will be less, pest infestations may be worse, and the shade provided by trees can have negative effects on neighbors' annual crops if too close to property boundaries.

*b) Intercropping with subsistence*

Unlike participant plans for intercropping yerba mate with trees, the vast majority of participants planned to intercrop with subsistence crops. Of these crops, manioc was the most frequently mentioned. Corn was also mentioned by some participants, though several others explained that corn should not be planted with yerba mate. A key informant mentioned planting cotton and eucalyptus with his yerba mate, and one participant mentioned plans to grow peanuts between rows. I also saw yerba mate grown with sweet potatoes as a ground cover at a key informant's farm. One participant explained that this subsistence intercropping is particularly important during the first five years when the yerba is not harvestable, in order for producers to get some benefit from their yerba parcels. In this way, intercropping with subsistence crops may serve as a way to reduce household vulnerability during these years. It also minimizes the risk of crop failures or price crashes by making these losses of yerba mate income less disastrous to livelihoods as a whole.

Only two participants planned to grow their yerba mate in monocultures, without subsistence crops. They preferred to grow yerba mate in monocultures because they wanted to minimize the space between yerba mate plants, thus maximizing potential profit from their parcels. Both of these participants had much larger farms than average – 12 and 15ha – with larger than average amounts of subsistence crop production, and neither was planning to devote more than 30% of their farm to yerba mate production. This greater endowment of land perhaps allowed these households to take the riskier, but potentially more profitable, option of growing yerba mate in monocultures.

### *c) Scale of production desired*

Decisions about scale are another way for farmers to maximize profitability or minimize risk, and are therefore important in the adoption of agroforestry systems (Mercer, 2004). In

Libertad del Sur, those with at least 0.5ha of yerba mate currently desired to plant a total of 2.3ha of yerba mate on average, while 15 of the 17 of those who did not have yerba mate desired to plant an average of 1.5ha, and the other two were unsure how much they would like to plant. Participants did not indicate any lower or upper limits to the scales of production, with several participants noting that even a few plants in their backyard would provide them with some income.

The majority of participants discussed the importance of not devoting one's entire farm to yerba mate production. While two participants reported wanting to devote their entire farms and another four participants wanted to use at least 60% of their farm, the rest of participants wanted 30% or less of their land in yerba mate. The average farm size of those wanting to devote 60% or more of their land to yerba mate production was 3.5ha, and for those wanting 30% or less in yerba mate average farm size was 8.4ha. The farm sizes of the two participants unsure about how much yerba mate they wanted were ten hectares and one tenth of a hectare.

As the above numbers indicate, the majority of participants preferred to devote relatively small portions of their farm to yerba mate production. The exceptions to that general rule tended to have smaller farms, indicating that perhaps potential for more livelihood diversification was tied to farm size. In the following excerpt, a tung and livestock producer discusses his views on diversification and scale of yerba mate production.

*0.5ha for one family is already enough. It's not going to be a big source of income but it's better than nothing, as they say. If I have 4ha, I cannot fill it all with yerba. This is negative for a family. Because here one needs 5 or 6 years to harvest the yerba...Yes, one needs to have a little bit of everything. And as I told you with the fish, you could have one more*

*resource. The chickens, the fish, ducks, and cows. The yerba, the tung, like this you have, as they say, a Russian salad, all of it together and you go on stockpiling.*

This participant, like many others, found the diversification of income sources important, and for this reason, advocated minimal devotion to yerba mate. This quote indicates that one reason for the importance of this diversification is the length of time yerba takes to be harvestable. In addition to this idea of diversification, several participants talked about planting yerba mate gradually rather than all in one year. In some cases, this seemed to be important because of the high cost and difficulty of obtaining large numbers of seedlings. In other cases, however, participants discussed it as a strategy for overcoming the difficulties posed by having to wait for five years for the yerba to be harvestable. In the following excerpt, a soy producer who recently planted 0.5 hectares of yerba mate explains the need to plant gradually:

*“I, for example, would like to plant up to two hectares. But it is not possible to plant it all in one year, not even if you get the plants, because you will lack for income...Little by little one has to plant.”*

By planting the yerba mate gradually, farmers distribute the costs of their investment over several years and minimize the risk associated with each year of planting. Such gradual adoption has been documented in other situations where farmers are adopting new, potentially risky production systems (Scherr, 1995). The susceptibility of yerba mate seedlings to drought makes such risk management approaches important.

In addition to these strategies for adapting to high initial costs of investment in yerba mate, participants used several strategies to minimize these costs. These strategies included the establishment of household yerba mate nurseries, and leveraging membership in organizations to get access to low cost or free seedlings. At the time of the interviews, none of the

participants had functioning household nurseries but one participant was trying to establish one and three others had experience and interest in starting one. According to a key informant, these nurseries are labor intensive because the plants need watered as often as twice a day, but the financial costs are minimal. Therefore, nurseries may be beneficial for households with greater availability of household labor, such as those with grown children not in school and with access to a good water source.

Another way of adapting to high investment costs discussed by participants was obtaining credit to buy seedlings. This strategy was discussed by many participants as only available to bigger or richer farms. As mentioned in the discussion of current livelihood strategies, the majority of households in Libertad del Sur are unable to get credit because of being deeply in debt or bankrupt. Another factor that limits farmers' access to credit in Libertad del Sur is the lack of land titles. According to key informants, lending agencies are hesitant to offer loans to those without title to their land because they cannot offer the deed to their property as collateral.

Risk associated with insecure land tenure has been shown to be a critical factor in the likelihood of farmers to adopt agroforestry practices (Pattanayak et al., 2003). As participants in this study experienced, insecure land tenure in Paraguay limits household access to formal credit because many lending agencies require legal titles as a prerequisite for offering loans (Hetherington, 2009). Instead, households interested in using credit to invest in agroforestry crops must obtain money through informal channels, often large landowners like the *patrones* discussed in this paper. These informal lenders often charge extremely high interest rates, adding to the risks that smallholders incur by investing in agroforestry crops (Southgate & Runge, 1990). Yerba mate production was mentioned by several participants as a remedy in

the future to this situation, because lenders see yerba mate parcels as a dependable enough resource to serve as collateral for loans. These would still likely be informal lenders, however, and the credit would only be offered once the yerba mate is mature enough to be harvested, which means that it would not be accessible to farmers looking to establish yerba mate plantations. Until that point, farmers have few means of accessing credit, meaning that they have little possibility of investing in yerba mate.

Tenure insecurity also serves to exacerbate the risk that high investment costs and the time lag impose by increasing the possibility that farmers will not be allowed to stay on their land long enough to obtain a return on those investments. Participants did not explicitly mention fears that they would be forced off of their land but given their lack of titles and the increasing land conflicts associated with the expansion of transgenic soy in Paraguay (Hetherington, 2009), it seems fair to characterize their tenure as insecure. If farmers consider it possible that they will not be on their farms in five years, investing in yerba mate would not be an attractive option. Additionally, in Paraguay and other Latin American countries where land tenure has historically been tied to clearing forest (Southgate & Runge, 1990), replacing annual crops with trees may seem risky to households with insecure tenure.

Unfortunately for households in Libertad del Sur, land titles in Paraguay are not always sufficient to gain access to credit or to allow for stable, long-term land ownership. One study found that Paraguayan farms of less than 15 hectares did not gain better access to credit as a result of titling programs due to disadvantages they face in credit markets (Carter & Olinto, 2003). Meanwhile, land titling may have the perverse effect of actually forcing more small farmers off of their land. In Paraguay, land without legal title is considered property of the state and cannot be bought or sold (Hetherington, 2009). In some cases, especially in the soy

growing region in the southeast, when small farmers gain title to their land, they face pressure from large land-owners to sell (Hetherington, 2009). Pressure may come in the form of intimidation and violence from vigilantes or police, but once soy-growers have a foothold in a community, the environmental and health effects of large-scale soy production, stemming from the unregulated use of pesticides, can be enough on their own to force neighboring small farmers to move (Hetherington, 2009).

Membership in organizations or participation in agricultural development projects was one strategy that households used to overcome the high costs of investment in yerba mate and limited access to credit. Three participants were members in a group called the Ecological Farmer's Association, which had obtained a loan of low cost seedlings through a partnership with a yerba mate processing company and a Paraguayan conservation NGO. In another project, a former Peace Corps Volunteer distributed free seedlings in exchange for participation at informational talks on yerba mate production and agroforestry systems. In both of these cases, households used a resource available to them, participation, to decrease the costs of investment in yerba mate.

A key informant described these organizational strategies as coping mechanisms for the lack of land titles and the decreased credit opportunities available to community households. These organizations provided community members with a means of gaining access to assistance from external organizations. Some participants felt that they did not have the same access to membership in committees and associations as others in the community. This was due to their location on *Tercera Linea*, a smaller and less-used road than *Cuarta Linea*, where the majority of the community lived. According to these participants, some opportunities did

not reach them because of their location, although a key informant disputed this idea, saying that the associations in the community were open to anybody.

Another deterrent to participation in community organizations was the negative perception many participants held of committees. These participants referenced the challenges of managing distribution of work and resources within committees, the use of committees by the rich or the government to take from the poor, and the time commitments they require. These negative perceptions seemed to stem largely from past experiences with failed community projects. Participants described a long history of these failures in the community, which, in each case served to enrich one or two families and left the rest without any compensation for their work.

Finally, one other option for accumulating the capital necessary to invest in yerba mate production was saving money. Similar to accessing loans, this was another strategy seen as unobtainable by many participants. First, many participants explained that they simply did not have money to save. I did not collect data on debt per household, making comparisons difficult but many explained that because of substantial debts accumulated during drought years, whenever one of their crops was profitable, this money was simply used to chip away at their debt. In addition, one participant explained that it is very difficult to save money because of the worry that someone might steal it. This worry, combined with the community's distance away from any banks, created a situation in which households feel that they must spend their money quickly. Therefore, investment in yerba mate would need utilize other sources of income, such as the harvesting of other cash crops or selling livestock.

*a) Strategies for adding value*

While investment in yerba mate is challenging for many small farming households, options to increase the value of yerba mate harvests may make this investment more feasible. In this project, I considered the potential of value-added certifications, like Fair Trade, Shade Grown, and Organic, as well as local-level processing to increase profits earned by Libertad del Sur yerba mate producers. As mentioned above, there is a Fair Trade, Shade Grown yerba mate exporter that operates in Paraguay called Guayakí. While they might pay higher prices for yerba mate, their focus on shade grown makes it a poor match for Libertad del Sur farmers. Shade-production makes cultivation of subsistence crops impossible, and therefore, it is not a viable option for the majority of Libertad del Sur producers, who are planning to intercrop manioc (and sometimes corn, beans, and peanuts) with their yerba mate.

Similarly, nearly all participants were interested in the idea of producing organic yerba mate, but many did not believe that it was feasible. Several mentioned the lack of buyers, with one noting that, although prices might be better for organic yerba mate, if there are no buyers, better prices are not beneficial to producers. Other participants mentioned that if organic production methods required additional work, it would be a problem because they did not have much extra time. Another point brought up by participants was that, although they had extensive experience with conventional yerba mate production methods, with organic production they would need for technical assistance with organic pest control and nutrient management systems. Some participants explained that they had experience with these organic systems but others said that they would need help from an extensionist to learn.

Several participants, while acknowledging the difficulties with organic production of yerba mate, explained that they would prefer to produce organics for health and environmental reasons. One participant explained that he would consider looking to establish a small group of

local yerba mate producers to explore opportunities with organic production. He felt that it would be best to wait for five years, however, until the newest seedlings became harvestable, so that there would be more yerba ready to be harvested.

Perhaps the most feasible option for adding value to Libertad del Sur's yerba mate harvest would be through the construction of a local drying facility. Two key informants mentioned that the construction of such a drying facility requires either, high-capacity electric lines or extensive quantities of fuelwood. According to one of these key informants, the community does not have enough fuelwood to support such a facility but high-capacity electric lines were recently installed in the community. At the beginning of this project, when I considered the potential benefits of local processing, I was imagining that the processing facilities would be community-owned, thereby ensuring that more money stayed in Libertad del Sur. Through my conversations with key informants, I learned that community ownership of such a facility may not be feasible or desirable. Construction would require significant capital, which simply is not available in the community. Furthermore, while partnerships with NGOs have brought similar resources to the community in the past, these projects always failed and left people with a negative view of this type of community development.

While locally owned processing facilities were not seen as viable, there was an opportunity for a partnership with a yerba mate processing company to construct a drying facility in Libertad del Sur. According to key informants, there is an informal commitment from a yerba mate processing company, Lauro Raatz, to build a dryer in the community when the area in yerba mate production reaches between 50 and 80ha. Lauro Raatz has not begun plans for building the facility due to difficulties in finding financing and the lack of yerba mate currently cultivated in the community.

An additional 50 to 80ha of yerba mate would represent a substantial investment for the community. To put these numbers in perspective, the planting project that I undertook resulted in 2.5 total hectares of yerba mate planted, at a cost of \$1,000 for seedlings alone. I do not have data on the total hectares of yerba mate currently in the community (the total among project participants and key informants was approximately 16ha), but if it is assumed that the community lacks 44ha for a total of 60ha to spur the construction of the drying facility, this would represent an investment of \$17,600 in seedlings at current prices. Spread among the 32 households who have planted yerba mate, this would be an investment of over \$500 per household. Meanwhile, according to one key informant's estimate, the construction of this facility would raise the price Libertad del Sur yerba producers are paid for their crop by \$0.011/kg, which would represent additional earnings of approximately \$110 per hectare of yerba produced, once the plants reached maturity.

## 7. Conclusion

This study described current livelihood strategies among households interested in yerba mate production and explored the potential effects of yerba mate production on their livelihood security. There was significant diversity in the income-generating activities pursued, including cultivation of annual crops destined for export (soy, cotton, and wheat), cultivation of perennial crops, mostly for domestic markets (yerba mate, citrus, and tung), off-farm employment, raising of livestock for sale, and leasing land. The majority of households reported cultivating soy, and all households cultivated subsistence crops and raised animals for household consumption. Although the majority of participants still grew soy, there was widespread agreement that, with the introduction of transgenic varieties, soy production had ceased to be beneficial for

smallholders. According to participants, many households in Libertad del Sur wanted to cultivate alternative cash crops, and yerba mate was one option that the participants in this study were interested in pursuing.

The results of this study suggest that yerba mate production is attractive to some households in Libertad del Sur for reasons including its current profitability, its suitability for intercropping with subsistence crops, the timing of its harvest, its relatively high resistance to drought compared with other crops, and its minimal environmental impacts. At the same time, however, households interested in adopting yerba mate production as a livelihood strategy were found to face substantial obstacles to investment and production. These challenges included the high cost of seedlings and the difficulty of obtaining credit to pay for them, the long time lag to maturity, market price and demand uncertainties, and tradeoffs between yields and intercropping with trees and/or subsistence crops.

In spite of the challenges, participants in this study and approximately 45% of households in Libertad del Sur have made investments, whether in capital or in time and land, in yerba mate production. To better understand the bigger picture regarding yerba mate production, including what role household assets, endowments, and livelihood strategies play in determining household preferences or abilities to produce yerba mate, perspectives from households not willing or able to invest in yerba mate must be included. Research in other perennial crops has shown that land tenure, farm size, labor availability, livestock holdings, and access to credit are critical in determining the likelihood of adoption (Mercer, 2004) but, because this study focused solely on households with interest in yerba mate production, it was not possible to reach any conclusions regarding the effects of these mediating factors on yerba mate adoption. In addition to these widely acknowledged mediating factors, in Libertad del Sur, debt seemed to be an important

constraint on the ability of households to invest in agricultural change. Meanwhile, remittances were not a focus of this study, but they have been found to be a source of income for the majority of poor households in Paraguay (Acosta et al., 2008). This study did not explicitly address debt or remittances, making it difficult to draw conclusions about the role they play in household economies in Libertad del Sur, but these may be two important topics for further research.

In addition to questions about the socioeconomic factors in adoption of yerba production, there is a lack of research into the agronomic features of yerba mate as part of agroforestry systems (Ilany et al., 2010). Further research is needed to determine tradeoffs between yields and intercropping with trees and/or subsistence crops. In this study, as well as previous work on the profitability of yerba mate production (Frey, 2005), much of the presumed benefit of yerba mate production stems from its capacity to be grown with other crops, but research on the effects of intercropping on yerba mate yields is lacking. Additionally, to understand the effects that climate change may have on yerba mate producers, more research is needed to understand how yields are affected by drought and other environmental perturbations.

In view of the beneficial aspects of yerba mate production described by participants in this study, households with the interest and ability to produce it could benefit from long-term programs aimed at facilitating adoption. Efforts to reduce tenure insecurity and to mitigate the negative economic effects of the time lag between planting and harvest have been identified as critical to the implementation of agroforestry initiatives (Sanchez, 1995). However, in the case of Libertad del Sur, interventions have been largely focused on environmental education programs or short-term infusion of resources, such as seedlings. While these programs may cover part of the cost of initial investment in yerba mate, they do not address the vulnerability faced by farmers while they wait for their crop to reach maturity. The outcomes of livelihoods transitions

like those in Libertad del Sur have important social and environmental effects, which necessitates understanding the opportunities, constraints and risks associated with of new cropping systems or practices, particularly among small farmers.

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9. Appendix A – Map of Paraguay showing study site



## 10. Appendix B – Interview guide

### **Introduction:**

Okay, let's go ahead and get started then. First, I'm going to ask you a few questions about your history here.

How long have you lived here?

- *[If they came as adults]* Why did you move here?

What was Libertad del Sur like when you came?

- What was your farm like then?
- What were your neighbors' farms like?

Can you tell me about your farm?

Can you tell me about your family?

Is this a good place to farm?

- In what ways?
- What are the challenges of farming here?

### **Farm/Family:**

Now if you don't mind, we'll move on to some specific questions about your farm.

Which crops do you grow to sell?

- How many hectares of these crops do you grow?
- What is your average income from these crops each year?
- How do yields change from year to year?
- How do prices change from year to year?

Which crops do you grow to feed your family?

- How many hectares of these crops do you grow?
- How many meals per day do you cook your own crops?

Do you have livestock?

*[If yes]* How many cows?

- How many pigs?

- How often do you eat your livestock?
- Do you ever sell them?
- How much money do you get?

[*If no*] Why not?

Do you get your milk from your own cows?

[*If yes*] Are there times when your cows don't produce enough milk?

- Do you sell any milk?

How do yields now compare to when you started farming here?

- Why do you think that is the case?

How has your farm changed since you moved here? What changes have you made in the way you manage it or what crops you grow?

How does the workload change on the farm during different times of the year?

- Do your children work on the farm? (ask how many if they didn't tell you above)
- Do you pay anyone to work your farm? Why/why not?
- What times of year do you hire workers? What times of year can your family do all of the work?

Do you have employment off of the farm?

[*If yes*] How much money do you make doing this?

- Do you sell anything other than livestock or crops?

Are you a member of a committee?

[*If yes*] What is the name of the committee?

- What do you do in the committee?

[*If no*] Why are you not in a committee?

How did last year's drought affect your farm? How did it affect your family?

- What did you do to make it through the drought?
- Which of your crops perform the best in drought?

Do you ever have difficulty feeding your family? If so, when?

- Do you have enough cash to buy groceries or pay bills?

- What are some strategies you use to survive when things are difficult?
- What else would be helpful during hard times?

Do you ever have extra cash? If so, when?

- What do you do with your extra cash?

### **Yerba Mate:**

Okay, now we are going to finish with some questions about yerba mate.

Why did you decide to plant yerba mate originally?

How much acreage of yerba mate did you plant?

- How has your yerba mate performed?
- Have you harvested any?
- How much money did you make?
- How much money do you expect to make?

Now, with our new project, you can plant more yerba mate. How did you find out about this project?

- Why were you interested in participating in this project?
- Did you do anything to be ready to participate in this project?
- What requirements did you expect for participation?
- Would you have planted any seedlings this year if you had to pay for them yourself?

In this project we are providing a relatively small number of seedlings. Do you want to plant more in the future?

- How many total plants/total hectares do you want?
- Will you be able buy the seedlings in the future? If so, how?

How long will it take you to plant the yerba mate seedlings I brought you? Do you have enough time to do it?

- How much work will it be to maintain the plants I've brought?

Are your neighbors interested in planting yerba mate?

- Why do you think that is the case?
- Why do you think some people do not want to plant yerba mate?

Is growing yerba mate good or bad for your land?

- In what ways?
- How well does yerba mate perform in drought?

Does yerba mate require more or less work than your other crops?

Does it require more or less fertilizer and pesticides than your other crops?

- How well does yerba mate grow without fertilizer or pesticides?

What did you have in your yerba mate field before planting yerba mate?

Do you plant subsistence crops with your yerba mate? Why/why not?

Do you plant trees with your yerba mate? Why/why not?

How did you learn how to grow yerba mate?

- Would you like to learn more about growing yerba mate?

How has planting yerba mate affected your family?

- How do you think planting yerba mate will affect your family in the future?

How will you market your yerba mate harvest?

- Will you keep some of it for your family? Why/why not?

Are prices good for yerba mate right now? What are prices right now?

What other options are there for selling your yerba mate? Would you be interested in other ways to sell your yerba mate if they bring a higher price?

- What if they require you to grow it without fertilizers or pesticides?

## **Closing**

Okay, those are all the questions I have. Is there anything else you would like to say about the subjects we have covered?

Is there anything else I should be asking the other people I interview?

Thank you very much for talking with me today. You can stop by my house [*explain where house is*] if you have any questions or anything more you would like to add.

## 11. Appendix C – Codes

### Libertad del Sur Yerba Mate – Codes

1. Adaptive responses
2. Alternative cash crops
3. Animal raising
4. Committees and associations
5. Cotton
6. Credit
7. Early years in Libertad del Sur
8. Ecological change
9. Effects of drought
10. Extra income
11. Field notes
12. Woodlots
13. Household composition
14. Leasing land
15. Other
16. Outside intervention and forces
17. Outside work
18. Participant farm size
19. Quality of life
20. Reasons for moving to Libertad del Sur
21. Socioeconomic and political change
22. Soy (and wheat) production
23. Subsistence crops
24. Time in the community
25. Yerba mate (YM) desired
26. YM experience
27. YM inputs
28. YM negatives
29. YM organic
30. YM positives
31. YM production systems
32. YM projects
33. YM sale and use