García-Yi, Jaqueline

Conference Paper

Heterogeneous Motivations of Household - Level Coca Growing Areas: The Case of an Indigenous Community in Peru

Proceedings of the German Development Economics Conference, Hannover 2010, No. 23

Provided in cooperation with:
Verein für Socialpolitik

Suggested citation: García-Yi, Jaqueline (2010) : Heterogeneous Motivations of Household - Level Coca Growing Areas: The Case of an Indigenous Community in Peru, Proceedings of the German Development Economics Conference, Hannover 2010, No. 23, http://hdl.handle.net/10419/40012

HETEROGENEOUS MOTIVATIONS OF HOUSEHOLD - LEVEL COCA GROWING AREAS: THE CASE OF AN INDIGENOUS COMMUNITY IN PERU

Jaqueline Garcia - Yi

Abstract

There is a great deal of heterogeneity among coca growers in Peru, a fact that the national organizations and international co-operation have recognized, but has not been able to address property in anti-drug policy design. In this paper, we investigate the joint decision to grow coca and the decision of the quantity of coca bushes to cultivate, first under a homogeneity assumption, and then relaxing this assumption to allow for heterogeneity. Our research results support the notion of coca grower heterogeneity, identify the differences between groups of coca growers, and suggest different anti-drug policies, based on their effects in each group.

1. Introduction

Coca is a native bush from the Amazon rainforest in South America. In Peru and Bolivia, the leaves of this bush have been traditionally used for many purposes since around 3000 B.C. (Rivera *et al.*, 2005) until today. Those traditional uses include coca chewing and coca tea drinking to overcome fatigue, hunger and thirst, and to relieve "altitude sickness" and stomachache symptoms, respectively (Rospigliosi, 2004). Since the 1970s, however, coca cultivation skyrocketed to be used as raw material for the production of cocaine, an illegal drug, first in Peru and Bolivia, and then in Colombia (Caulkins *et al.*, 2005; Dietz *et al.*, 2001). Currently, Colombia's coca areas represent 48%, Peru's 34%, and Bolivia's 18% of the total extension under cultivation worldwide, amounting to 167,600 hectares (UNODC, 2009). In general, growing coca for narcotrafficking business is a profitable activity. The farm income of a coca growing farmer has been calculated to be 54% higher than the income of a non coca growing farmer (Davalos, Bejarano and Correa, 2008).

Consequently, coca-related research became oriented towards evaluating the profitability of coca versus other cash crops (see, e.g. Gibson and Godoy, 1993; Torrico, Pohlan, and Janssens, 2005). Different attempts were made to replace coca by alternative crops, but it has been generally established that crop substitution as anti-drug policy has been a failure (UNODC, 2001). There is not an economic uni-causal explanation of coca cultivation. Many households have been found to abandon coca growing despite their reported unassailable

profitability and many other have not even after getting access to relatively equal income opportunities (Mansfield, 1999). In reality, farmers' rationality is broader and more complex than a simple comparison of the current or potential crops' income (Bedoya, 2003). Decision makers and researchers have recognized that there could exist other relevant determinants of coca growing beyond economic profitability such as social capital, saving account functions, financial reserve for large expenses, availability of labor, ecological degradation, and law enforcement perceptions (Bedoya, 2003; Mansfield, 1999; Mansfield, 2006; Thoumi, 2003).

There has been a lack of research aimed at identifying the multiple conditions and priorities that farmers take into account when making decisions about their involvement in coca cultivation (Mansfield, 2006). The temptation has too often been to pursue significant reductions in coca cultivation without any clear understanding of how this might best be achieved (*ibid*). Consequently, many anti-drug programs fail, but not because of mismanagement or miscalculation; rather, due to the little understanding on the part of policy-makers of the motivations of coca farmers and the reasons behind their dependence on coca cultivation (Lupu, 2004). Indeed, the needs and priorities of coca growers, and the disparate factors that influence household coca cultivation have not been adequately accounted in anti-drug project design (Office of Technology Assessment, 1993).

In Peru, as well as in Bolivia, the study of the motivations underneath coca cultivation gets additionally complex because of the dichotomy coca and cocaine. Coca has become an important focal symbol in the indigenous struggle for self-determination (Office of Technology Assessment, 1993). Coca "yes", cocaine "no" constitutes the slogan of indigenous people to fight this struggle (Henman, 1990). This formulation is of great political attraction, given that it tries to clearly separate traditional uses ("coca") from narcotrafficking ("cocaine"). Traditional uses such as coca chewing are ethnicity symbols (Allen, 1981) and their persistence could be related to nationalism feelings in Peru (Henman, 1990). Hence, coca growing *per se* is not illegitimate in Peru, as a result of the social awareness and acceptance of traditional uses of this plant (UNODC, 2001) [1].

[1] In contrast, coca cultivation is illegal in Colombia, which reflects the lack of traditional uses in this country. Bolivia presents a joint situation in which the legality of coca cultivation is not generic and is restricted to few traditional areas. On the other hand, the trade of cocaine, a coca leaf derivative, is forbidden by law in all those three countries (UNODC, 2001).

This dichotomy has implications for the formulation and implementation of anti-drug policies and raises concerns about to the unintended consequences that those policies could have on traditional users. For example, politicians who are in favor of "zero coca cultivation" policies have been subject of a strong opposition by social intellectuals interested in indigenous reality (Henman, 1990). Certainly, one of the most important things to recognize is that coca growers are not a homogenous group. Their motivations, their economic and social status could vary enormously (Gerhardus, 2003), particularly in regions where traditional (mostly self consumption) and commercial (larger scale) coca growers coexist like in Peru. Consequently, anti-drug policies need to be aware of this differentiation and target their initiatives accordingly. An ideal anti-drug policy would show respect to traditional oriented coca cultivation, but would enforce non coca production for narcotraffic business. The main limitation is that in most cases it is not possible to know a – priori the final destination of the coca planted by the farmers. Consequently, most of the time anti-drug policies have been uniform and are supposed to target a "representative" coca grower.

This paper investigates farmers' motivations to grow coca, first considering them as homogenous group. The homogenous evaluation consists on a standard probit model and a double hurdle or Cragg model for the joint modelling of the decision to grow coca and the decision of the quantity of coca bushes to cultivate. Then, the homogeneity assumption is relaxed with a latent class specification model. The latter approach provides an opportunity to include unobserved heterogeneity in the study by separating farmers in two groups, and to allow the assessment of potential impacts of anti-drug programs on different types of coca growers.

The structure of the paper is as follows: literature review about coca growing in Peru, the theoretical economic frameworks used for explaining coca growing decisions, and our main hypotheses are presented in section 2; the study area, data, and methodology are described in section 3; econometric results and policy recommendations are indicated in section 4; and section 5 concludes.

2. Literature Review

This literature review focuses on the background information about traditional coca uses in Peru, which is of particular interest in the context of this article. Then, the theoretical models and related empirical studies which reflect the main motivations for coca growing are

presented, along with our hypotheses related to coca growing for traditional and commercial – oriented coca cultivation.

2.1 Background Information about Traditional Coca Uses in Peru

There are two main reasons for growing coca in Peru. The first one is for traditional uses, and the second one is to supply narcotraffic business[2] (FONANPE, 2005). Even though traditional users account for 20% of the Peruvian population above 12 years old (Rospigliosi, 2004), the percentage of coca derived to them is believed to be 10% of the quantity of coca leaves produced in Peru – a total of 122,300 metric tons (FONANPE, 2005; UNODC, 2009). One of the reasons for this divergence is that the cocaine content on coca leaves is normally below 1%, ranging between 0.13 to 0.86% (Holmstedt *et al.*, 1977). Consequently, narcotraffickers need very large quantities of those leaves to be able to obtain enough of the alkaloid to commercialize it in the illegal market.

In particular, traditional uses refer to the customary consumption or utilization of coca leaves. In Peru, coca chewing is the main traditional use (Rospigliosi, 2004). Coca chewing is almost exclusively done by indigenous populations, who suggest physiological reasons underneath this custom such as (Bolton, 1976): (1) providing energy for work and reducing fatigue, (2) keeping them warm, and (3) helping to alleviate hunger. On the other hand, there is empirical evidence of non euphoric effects or addictive symptoms among coca chewers (Hanna, 1974; Bolton, 1976; South, 1977). This is indirectly supported by the Sauvain *et al.* (1997) who found that coca chewers' preference for "sweet" coca leaves is not related with their cocaine content. Moreover, traditional users do not consume coca leaves in quantities sufficient enough to extract the amount of cocaine that could generate negative psychological effects (Weil, 1981).

Additional traditional coca uses include elaborating coca leaf powder or tea to combat toothache, stomach ulcers, rheumatism, asthma, and malaria. In particular, coca tea is a home-made remedy for the nausea, dizziness, and headache of soroche or altitude sickness. The juice from the chewed leaf can also be applied to eye to soothe irritation, or gargled for sore throat (Grinspoon and Bakalar, 1981). Coca tea is drunk by urban and rural population of different ethnic backgrounds and social classes in Peru. In industrial form, coca tea is often packaged in individual servings as tea bags which contain approximately 1g of dried coca leaf

[2] Industrial uses (for example coca tea bag elaboration) could be considered a third reason for growing coca, but these uses represent a very small percentage (0.18%) of the total coca leaf production (FONANPE, 2005).

(Jenkins *et al.*, 1996). Unfortunately, well controlled experiments on the metabolic effects of coca leaves are practically non existent (Burczynski *et al.*, 1986).

In total, all traditional users consume an estimated of 6550 metric tons of dried coca leaves per year. Coca chewing users and coca tea consumers are 64% and 31% of the total consumers, respectively. Other coca users (e.g. people who use coca leaves as offering to Gods during indigenous religious ceremonies and divination) account for the remaining 5% (Rospigliosi, 2004) (See Table 1).

Table 1: Distribution of Traditional Coca Uses in Peru

Traditional use	Number of coca users		Kg of coca consumed		Kilograms per person per year
	Total	Percentage	Total	Percentage	
Coca chewing	2019574	64.0	6362341	97.1	3.15
Coca tea	964776	30.6	165020	2.5	0.17
Other uses	169538	5.4	23654	0.4	0.14

Own elaboration. Source: Rospigliosi (2004)

Actually, it terms of total quantity, it is only a small percentage of the Peruvian population (5%) who use most of the amount of coca (78%). Those are the habitual coca chewers, who use the leaves between 1 to 7 times per week. Ten percent of the population is occasional chewers and employs 19% of coca leaf, while 5% of the population utilizes 3% of the coca in tea and in the other traditional uses mentioned above (Rospigliosi, 2004).

In addition, according to the results of a survey conducted at national level, the majority of traditional coca users are mainly people who live in the Andes (77% of the total traditional users) with a low level of education (52% only have elementary education), and of indigenous ascent (50% speaks Quechua or Aymara versus 16% of the non coca users) (DEVIDA, 2004).

2.2 Economic Theory Frameworks explaining Farmer Decisions

Common indigenous farmers' rationale is to construct a diversification portfolio which consists on a dominant cash crop such as coffee, and other additional cash crops of secondary importance. Those later cash crops are used as insurance in case of low prices or temporal productivity problems on the dominant crop (Camino, 1984). Thus, coca is never mono-cropped, despites its economic relevance as part of farmers' income. Even in the VRAE, one

of the main coca growing regions in Peru, farmers have a portfolio of agricultural products, including other cash crops. Farmers' strategy consists on maintaining small coca areas while increasing legal crop extensions (Bedoya, 2003; Rodriguez, 2003). In this region, 84.3% of the farmers had coca areas between 0.1 and 0.5 Hectares. Even in this small extension, coca provides 42% of the farmer's income (Rodriguez, 2003).

On the other hand, indigenous farmers have highly elaborated family and fictive kinship networks, which help them e.g. to gather large amounts of reciprocal labor (*Ayni*) when the resources of an individual domestic unit are not sufficient to perform particular agricultural tasks (Collins, 1984). The current inhabitants of coca growing regions in the rainforest are mostly migrants from the highlands of Peru. In the highlands or sierra, indigenous farmers are generally agro-pastoralists who rely on exchange patterns and support networks organized by community ties for obtaining goods and labor (Collins, 1986). This typical Sierra community's social organization has its roots in pre-Columbian times and has proved to be very resistance to change, even after over 400 years of European influence (Brush, 1976). Many of those who immigrate to coca growing regions tend to maintain the same type of social structures and mechanisms that they have learned in the Sierra (Bedoya, 1987).

Thus, it is expected that the farmers based their choice to grow coca or not and the corresponding extension of coca areas on frameworks that combine agricultural producer, consumer and labor decisions such as agricultural household models. At the same time, indigenous people decisions seem to be at least partially influenced by pro – social behaviors, given their acts that demonstrate senses of empathy and cooperation inside their community. Pro-social preference models try to explain those particular behaviors. Coca growing is not illegal in Peru, but farmers could be subject of forced eradication programs. At such, coca growing could be a risky activity to the farmer. Models of crime and punishment focus on analyze those conducts. The three types of theoretical models considered in our research – agricultural household models, pro – social behaviors, and crime models - and related empirical research are explained below. The explanation is followed by our main hypotheses in this research.

2.2.1 Agricultural Household Decisions

In a simplified agricultural household model (Singh, Squire, and Strauss; 1986), households make a joint decision about consumption, production, and labor. A given household maximizes the following utility function:

$$U = U(Xa, Xm, Xl) \quad (1)$$

where the commodities are the agricultural staple (Xa), a market purchased good (Xm), and leisure (Xl). Utility is maximized subject to a cash income (I) constraint:

$$I = pmXm = pa(Q-Xa) - w(L-F) \quad (2)$$

where Pm and Pa are the prices of the market-purchased commodity and staples, respectively; Q is the household's production of agricultural staples, and thus, (Q-Xa) is the marketed surplus; w is the market wage; L is total labour input; and F is family labour input.

The basic model can be extended to allow a multi-crop household production (Singh and Subramanian, 1986). The multi-crop model allows to consider the trade-offs among different types of crops (in our case, coffee, coca, and staples). In this extended model, farmers are assumed to maximize its utility function subject to a land constraint by quality or type (for example, lowland, upland) and a combined income and time constraint. In general, under this type of models, farmers base their agricultural decisions on agricultural production and consumption, family and external labour, and land characteristics. In our research, it is hypothesized that farmers with smaller total and coffee land areas, lower quality of land (measured as perceived soil quality and land slope), less availability of labor, lower quality or price of coffee (non organic versus organic), and located further to the road (higher transaction costs) will be more likely to grow coca.

2.2.2 Pro – Social Behavior

Pro – social behavior economic theory models try to explain why people no behave according to narrow self – interest. For instance, most people pay their taxes or vote in elections, and many preserve common pool resources, actions that can not be explained by strict economic self – interest axioms (see e.g. Anesi, 2008; Ostrom, 1990). In our case, even if the probability of eradication is low, many farmers located in coca growing regions do not cultivate coca. Differences in risk aversion could surely play a role in those decisions (see, e.g. Ibanez and Carlsson, 2009), but in indigenous communities with close social relationship ties, this fact could be also partially explained by pro-social behavior.

Meier (2006) indicates that there are three important sets of pro-social behavior theories: outcome – based pro – social preference models, approaches that focus on the relevance of self – identity, and theories based on norms of reciprocity. The first group of theories is an extended version of the self-interested model. For example, donations may be driven by a desire to signal wealth (e.g. Harbaugh, 1998). Under those theories, people behave pro-socially to get an external reward. The other two sets of theories are explained as follows:

a) Identity

Identity or the people's conception of who they are, and of who they choose to be, might affect economic outcomes. Akerlof and Kranton (2000) argue that identity is the missing element that helps to explain why people - facing the same economic and social incentives - make different choices. In every cultural context, people have a notion of who they are, which is associated with beliefs about how they and others are supposed to behave. These notions play important roles in the representation of their economic decisions and tastes. Violating the prescriptions evokes anxiety and discomfort.

In our case study, coca chewing is governed by clearly defined rules of etiquette for handling and sharing. As this etiquette is prescribed by indigenous cultural tradition, adherence to it implies the presentation of oneself as a participant in this tradition. Thus, the act of chewing coca leaves is an unequivocal statement of cultural loyalties. Coca chewing identifies one as an indigenous person (Allen, 1981). Coca chewing should be approached as a core part of the indigenous society and, therefore, as a symbol of ethnic identity. In Peru, where social stratification and upwards mobility exist, coca chewing is viewed as a symbol of "inferior" social standing (Negrete, 1978). According to Mayer (2004), given that chewing coca is a stigma, indigenous people use it to openly challenge discrimination. In this way, they recognize the solidarity and brotherhood links among indigenous populations. Therefore, coca chewing is a powerful symbol of identity and separates clearly who is indigenous person and who is not.

Identity markers, such as coca chewing, could help to explain coca growing only for self-consumption or traditional uses among the group of farmers who identify themselves as indigenous, but not among the commercial oriented coca growers. Other related markers that could negative influence coca growing include identification of the farmers as coffee growers in contrast to as coca growers (measurable as proud of being coffee farmer) and being born

inside the community district, which could be associated to a sense of belonging to the community.

b) Reciprocity

This set of theories is concerned with intentions that lead other people to their choices (Meier, 2006). Reciprocity in this context occurs when individuals act in a pro-social manner in response to friendly behaviors of others and in an antagonistic way in response to unfriendly behaviors. In a research study by Fong (2001), people preferred more redistribution to the poor if they believed that their individual level poverty was caused by circumstances beyond their control. In contrast, people who believed that the poor did little to escape poverty were more likely against redistribution. This could reflect partially the respondents' reciprocity sense of fairness: if the poor don't give or try to give their share to society, they should not receive aid. Other empirical research provides evidence that reciprocity affects economic outcomes, such as the studies of voluntary contributions in national parks (Alpizar, Carlsson and Johansson-Stenmann, 2008), adoption of conservation practices by farmers (Marshall, 2009), and quality performance of markets for goods (Huck and Tyran, 2007).

In our case study, indigenous farmers have social mechanisms inside their communities which include *Ayni* (exchange of labour days) and *Minka* (a meal or goods in exchange for a labour day). Those systems are heavily based on reciprocity (Larme, 1998). *Ayni* is a straight exchange of labor, while *Minka* involves a purely nonmonetary payment. In fact, some hired agricultural workers receive a substantial fraction of their daily remuneration in goods or services (Jacoby, 1992). In both activities, coca is offered to their guesses or it is used as monetary payment (Instituto Indigenista Interamericano, 1989). These networks of exchange could help to explain coca cultivation for traditional uses. Farmers who are involve in *Ayni* and *Minka* could be more prone to grow coca to offer it to their guesses to facilitate this exchange. Hence, coca is a "lubricant" that easy interactions in any social activity among indigenous population (Bolton, 1976). Consequently, *Ayni* and farmer's sense of obligation to offer coca to their guesses could be used to as indicators of pro-social behaviour, and those participants in these traditions could be also less oriented to commercial coca growing as a reflection of their reciprocity with other members of the community.

2.2.3 Crime and Punishment Model

The Crime and Punishment model (Becker, 1968; Ehrlich, 1973) is a standard economic model of choice under uncertainty between legal and illegal activities. A farmer would choose between them by comparing the expecting utility associated with each one. In this model, the optimal allocation mix allows for varying degrees of participation in legal and illegitimate activities. Following Ehrlich (1973), the farmer participates in two market activities: *i* a (*pseudo*) illegal one (coca growing) and *l* a legal one (coffee cultivation). Coffee cultivation (*l*) is safe. Its net returns are given with certainty, by the function $W_l(t_l)$, where t is the time input. On the other hand, coca growing (*i*) is risky. Its net returns are conditional to two states of the world: (a) eradication at the end of the period, with subjective probability p*i*; and (b) not being eradicated, with probability 1 – p*i*. If coca is eradicated, the farmers net returns are reduced by an amount $F_i(t_i)$. Thus, in the state of the world (a), where the farmer's coca is eradicated, the earnings are:

$$Xa=W'+W_i(t_i)-F_i(t_i)+W_l(t_l)$$

with probability pi. On the other hand, in the state of the world (b), where the farmer gets lucky and his coca is not eradicated, the earnings are:

$$Xb=W'+W_i(t_i)+W_l(t_l)$$

where W' is the market value of the farmer's assets.

The model of choice between legal and illegal activities can be formulated within the framework of the economic theory of choice under uncertainty. The farmer's expected utility is given by:

$$EU(X_s, t_c) = (1-p_i)U(X_b,t_c)+p_iU(X_a,t_c)$$

Thus, under this theoretical framework, farmer's participation in coca cultivation is explained by the opportunity cost of the illicit activity (earnings from coffee), factors that influence the returns to coca cultivation (the probability of forced eradication), and by tastes and preferences for the illegal activity. Risk aversion is also central in the economic models of criminal choice. For example, if the farmer is risk averse then he will respond more to the changes in the chances of forced eradication than less risk adverse farmers.

Extensions of the basic economic model of crime include social capital as important predictors of criminal behavior (see e.g. Williams and Sickles, 2002). In the particular case of coca growing, Ibanez and Carlsson (2009) extended the crime and punishment model suggesting that morality or the intrinsic motivation to do the "right thing" help to explain why some farmers decide not grow coca in the Putumayo region in Colombia. Deviating from

what is considered to be right creates a sense of sinfulness or guilt and could be included as arguments in farmers' utility functions, after weighting it according to individual moral concerns (Eisenhauer, 2004). In addition, they considered that for some individuals no respecting the law or authorities could create an internal sense of disappointment (see Tyler, 1990). Thus, compliance with no coca growing law in Colombia could depend on legitimacy or acceptance of related laws and authorities by the farmers. In their study, Ibanez and Carlsson (2009) found that farmers with a high degree of acceptance of the authorities and the law were less likely to cultivate coca. On the other hand, the level of moral development was not significant in explaining the likelihood to cultivate coca.

Our hypotheses are that risk aversion, perceived probability of eradication, importance to obey the law, and morality have a negative effect on coca growing for the commercial coca farmers. With respect to morality this aspect was measured by:
a) Religious beliefs. This characteristic provides a system of internal moral monitoring that encourages individuals to behave in way that benefit society (Owen and Videras, 2007)
b) Frequency to attendance to religious meetings. Involvement in a church group was found to be positively and strongly correlated with for example tax morale (Torgler, 2006)
a) A constructed index of morality based on three parameters: degree of believed damage of coca growing to the community; degree of believed damage of coca growing to the overall society; and believing that coca growing is morally incorrect. Each of them was calculated on a scale from 0 (low) to 2 (high).

2.2.4 Additional Factors Beyond the Profit Maximization Rationale

Additional potential motivations for coca growing that need consideration are related to production diversification portfolio, coca ability to function as a saving account crop and a financial resource for large expenses, and social capital. Those potential causes are explained below.

a) Production Diversification Portfolio and Risk Aversion

Some farmers seem to find that including coca in their agricultural production diversification portfolio can reduce their overall income insecurity. Coca can be harvested several times per year (among 1 to 5 times). If the farmer loses one harvest due to pests or climatic conditions, one of the following harvests in the same year can surely provide income (Mansfield, 1999). In contrast, coffee and cacao, the main alternative crops in Peru, can only be harvested once

per year. If they lose their legal crop due to one of the many agricultural uncertainties, they could face very strong money shortages and even famine. Perhaps not other single crop rather than coca can provide farmers with a continue supply of income along the year (Lupu, 2004).

Thus, contrary to what the crime and punishment model would predict with respect to risk aversion (see above) –risk adverse people showing low propensity to get involved in illegal activities (Becker, 1968) - , it could be the case that farmers who are risk adverse are more prone to grow coca. In addition, Revilla (1993) suggests that growing coca is less risky than growing legal crops. The uncertainty related with being able to sell the final product to good prices gets reduced. We hypothesize that coca growing could be therefore appealing for risk adverse farmers but for the traditional coca group.

b) Inter-temporal Transactions

Farmers need money to finance future foreseeable and not foreseeable events. In coca growing areas, in general, there are no financial institutions that could lend cash to them. It is belief that coca is important for farmers to obtain the needed economic resources for inter-temporal events. Thus, coca plays two specific inter-temporal roles:

- Saving Account for Small Monetary Emergencies

Coca income is used when farmers urgently need cash during an emergency (for example accidents or diseases which are common in the upper rainforest areas). Given that coca is a perennial evergreen bush, it is possible to harvest it any time farmers urgently need to supplement their income, although the yields and prices might vary according to the season. In this sense, coca represents the farmers' "cash box", and it functions as a saving account to face small monetary emergencies (Bedoya, 2003; Cabieses, 2005).

- Financial Reserve for Large Expenses

Indigenous farmers have social obligations that require significant cash expenditures. Those obligations include such as sponsoring a *fiesta* or holding large wedding festivities (Painter, 1984). It is believed that farmers plan ahead their extension of coca to obtain the income they need to finance those large expenses. In particular occasions, the income from coca is also used to finance the increment of legal crop areas such as coffee (Bedoya, 2003).

Thus, we hypothesized that planning to extent coffee areas, having debt, and having hold a compulsory celebration positively influence coca growing.

c) Social Capital

Social capital refers to the "(individual) ability to obtain resources through networks and other social structures" (Portes and Landolt, 2000: 534). Thoumi (2003) suggest that social capital could influence coca related decisions, but he indicates that social capital of some groups can be detrimental to others. Perverse social capital could be present in the Colombian society which perpetuates reward systems that inspire rent-seeking or criminal behavior.

Ibanez and Carlsson (2008) researched the determinants for coca growing in Colombia. They argue that the regions where coca is cultivated in Colombia have a recent history of colonization, which can imply weak social networks and mechanisms of social control. They found that social capital (measured as trust and participation in communitarian organizations) has no clear effect on the decision to grow coca. Trust has a positive and participation in communitarian organizations has a negative effect, but neither is significant in explaining individual–level coca cultivation decisions. On the other hand, Balbin (2002) evaluated coca growers who received alternative development assistance in Peru. The data was collected by the Governmental organization DEVIDA that provided the assistance during the years 1998-2001. His results suggest that participation in communal activities had a significantly positive influence on the likelihood to abandon coca cultivation during the year 1998. His results for the years 1999 to 2001 indicate that this variable had a positive but not significant influence.

3. Study Area, Data, and Methodology

This section starts with a description of the study area, as well as the procedures for data collection and sample representativeness evaluation. Finally, the econometric methodologies used in the evaluation are explained.

3.1 Study Area

The research area is located in the Upper Tambopata valley, one of the most remote and difficult to access Amazon rainforest areas in Peru (UNODC Office in Peru, 1999). The entire population of the upper Tambopata valley is composed of immigrants, especially descendants from the Aymara indigenous population. Aymara is a native ethnic group originally from the Andes and Altiplano regions of South America. At the beginning, most of the farmers were

seasonal immigrants who used to leave their Sierra subsistence plots for only three to six months every year, and make the 320 km journey to the upper Tambopata valley to produce coffee as cash crop on their individually owned agricultural plots (Collins, 1984). Over time, farmers have become mostly permanent settlers in the upper Tambopata valley (*ibid*).

Before 1989, coca cultivation in the upper Tambopata valley was very limited. Small–scale coca production was aimed at self consumption or was restricted to minor sales for traditional uses to Andean farmers and miners. After 1989, coca cultivation was intensified, but mostly in the neighboring upper Inambari valley, that did not respond to any changes in demand by own or external traditional users (UNODC Office in Peru, 1999). Coca from those valleys has lower acceptance for traditional chewing than coca from Cuzco region due to its bitterness (Caballero *et al.*, 1998). In particular, the potential increase of coca cultivation specifically in the upper Tambopata valley was observed by Malaga (2003) who reported about the expressed willingness of some farmers in this valley to intensify their coca production although they knew this crop represents a very insecure alternative. Bonnard and David (2004) mentioned that farmers have started to produce coca due to coffee price variability and permanent settlers' almost unique dependency on coffee as cash crop. During the last years, large increases in coca cultivation in the upper Tambopata valley have been consistently reported by the United Nations (UN), as observed in Table 1. The percentage variation per year in the upper Tambopata valley is above the annual change of around 4% at national level.

Table 2: Coca Cultivation in the Upper Tambopata Valley (2005-2008)

Year	Hectares	Percentage of variation in relation to previous year
2005	253	-
2006	377	49.0
2007	863	128.9
2008	940	8.9

Source: Own calculation using data from UNODC (2009b)

It is believed that the coca provided by the upper Tambopata valley and upper Inambari valley supplies cross boarding trade associations between Peruvian and Bolivian narcotraffickers. Bolivia remains the world's third largest producer of cocaine, and it is a significant transit zone for Peruvian-origin cocaine (US Department of State, 2009). In this sense, those valleys constitute a strategic coca production area for both Peruvian and Bolivian narcotraffickers due to their proximity to an external exit route (UNODC Office in Peru, 1999). Coca leaves are

not transformed into cocaine in the agricultural plots. Narcotraffickers take advantage of the fact that large quantity of coca leaves are transported to major cities apparently to be sold to traditional users by informal marketers. So, they buy part of this coca and process it in hidden places in major cities near the border to Bolivia. In this way, they diversify their risk of being caught. From Bolivia, cocaine is dispatched to Brazil and Europe (Garcia and Antezana, 2009).

3.2 Data

A feasibility study to test if farmers would answer coca-related questions was conducted in December, 2007. The pilot study for the designed questionnaire took place during May, 2008, and the final survey was conducted during June to August, 2008. The feasibility and pilot studies and the final survey were addressed to the farmers located in San Pedro de Putina Punco (SPPP), the district inside the upper Tambopata valley which is located in the deepest rainforest. All the farmers in the research area produce coffee as cash crop and some supplement their income with coca cultivation. There are five coffee co-operatives in SPPP. Farmers have to become a member in one of those co-operatives in order to be able to sell their coffee, because restrictions to coffee intermediaries are in place. The final survey was conducted only among the members of four of those co-operatives because most of the members of the remaining co-operative are based in San Juan del Oro, a district not considered in the scope of the research.

A convenience sampling was applied, although at the end of the survey, we asked the farmers for their co-operative registration number to be able to infer the sampling representativeness from the co-operative registration lists. To guarantee anonymity, the co-operative registration number provided by the farmer was written on another piece of paper and was not attached to the respondent's questionnaire. The number of valid questionnaires was 477, which represents around 15% of the population under study. In a simple random sample without replacement, after the sample size has been calculated, each farmer has the same probability to be selected from the co-operative member lists. Thus, the co-operative registration numbers obtained from the survey's sample were compared with the ones selected from a simple random sample obtained using the co-operative lists. If the two groups do not show statistical differences in their distribution functions, then the survey sample would be equivalent to a simple random sample.

Two types of tests were used for the comparison: a two-sample Wilcoxon rank-sum (Mann-Whitney) test and a two-sample Kolmogorov-Smirnov test for equality of distribution functions. The first test assesses how probable it is that the two groups come from the same distribution, and that differences observed are caused by chance fluctuation. The second test is similar to the first one, but in addition it is sensitive to differences in both, location and shape of the empirical cumulative distribution functions of the two groups. The results of both tests failed to reject the null hypothesis of equality of distribution between the survey sample and random sample at a significance level of 0.05%.

3.3 Methodology

3.3.1 Standard Probit Model

The farmer's decision to grow coca can be represented as a binary variable, labeled for convenience y=1 and y=0, where the former refers to the decision of growing and the later to the decision of non growing coca. There is a set of measurable covariates, Xs, which explain the occurrence of one outcome or the other. The parameters to be estimated with the model are labeled βs.

The farmers derive utility:

$U_0 = \beta_0'X + e_0$ from choice 0, and $U_1 = \beta_1'X + e_1$ from choice 1

where e_0 and e_1 are the individual specific, random components of the individual's utility that are unaccounted for by the covariates Xs. If farmers decides to grow coca (y=1), it reveals that $U_1 > U_0$ or

$$e_0 - e_1 < \beta_0'X - \beta_1'X$$

Let $e = e_0 - e_1$ and $\beta'X = \beta_0'X - \beta_1'X$. Then, the binary choice model applies to the probability that $e < \beta'X$.

3.3.2 Cragg Model

In this paper, we model the joint decision to participate in coca growing activities and the amount of land dedicated to this crop. The later decision could be subject to sample selection bias if it is analyzed independently. Sample selection bias refers to the error that arises when the selection of those participating in coca growing is not done randomly, but by the participants themselves (see Heckman, 1979). In general, there are three methods for

correcting sample selection bias (Breen, 1996): tobit, cragg and Heckman or sample selection models. Those models are related but imply different statistical assumptions. Under the tobit model the same set of variables with the same coefficients explain both the decision to participate and the extension of coca area cultivated. The cragg model relaxes this assumption allowing different coefficients for the two joint decisions. The heckman or sample selection models extend the cragg model by assuming that the errors of those joint decisions are correlated (*ibid*).

In a preliminary analysis, we found that the cragg model was preferred to the tobit (with p=0.000) and to the heckman or sample selection model (lambda with a p=0.245). This result is not very unusual, and cragg models have been used in studies related to farmer decisions on agricultural programs (Thurow *et al.*, 2001) and off – labour allocation decisions (Matshe and Young, 2004). Following Greene (2007), in the Cragg model the decision of the amount of land dedicated to coca (y) is:

$f(y|\ x)$ $= f(y^*|\ x)$ if $y^*>0$

where x is a set of measurable covariates, but

Prob ($y^*>0|x$) $=$ Prob ($\beta'x+\varepsilon>0$), $\varepsilon \sim N[0,\sigma^2]$

$=$ Prob ($\varepsilon>-\beta'x$)

$=\Phi[\beta'x/\sigma]$

Therefore, $f[y|x]$ $=(1/\sigma)\phi[(y-\beta'x)/\sigma]/\Phi[\beta'x/\sigma]$

Latent Class Approach

As mentioned before, it is very likely that farmers have different preferences related to coca growing decisions (traditional versus commercial – oriented coca growers), and to some extent this preference heterogeneity is related to unobservable individual characteristics. Ignoring this fact induces bias and reduces the realism of the models (Heckman and Singer, 1984). Latent class models extend the standard models by allowing the coefficients to vary between respondents. The latent class approach assumes there are latent classes or segments in the population each of which is associated with a different parameter estimates. A latent class model simultaneously assigns individuals to segments and infers different parameters for each segment. The advantage of such an approach is that hidden structures of the sample are thus revealed to allow an objective understanding of preference heterogeneity across the population under study (Hope, 2006). Thus, by modeling membership of these latent classes jointly with the model of interest, it is possible to reduce bias from unobserved heterogeneity.

A model for a latent sorting of y_i into J classes allows for heterogeneity as follows (Greene, 2007: E):

The density of the observed y_i given that the regime j applied is

$f(i|j) = f(y_i|x_i,j)$

where the density is now specific to the group. The analyst does not observe directly which class, $j=1,\ldots,J$ generated observation $y_i|j$, and class membership must be estimated. This would produce the model

$f(i|j) = f(y_i, \beta' x_i + \delta_j)$, Prob[class=$j$] = F_j

This approximation more generally is,

$f(i|j) = f[y_i|\beta' x_i+\delta_j' x_i,\sigma_j]$,

$F_j = \exp(\theta_j)/\Sigma_j \exp(\theta_j)$, with $\theta_j=0$

In this formulation, each group has its own parameter vector, $(\beta_j',\sigma_j)=(\beta+\delta_j,\sigma_j)$.

Note that latent class models are theoretically identified with cross sectional data, but they may be difficult to estimate. Identification of the unobserved heterogeneity is weak when the researcher has only cross-sectional information (Greene, 2007). In our case, it was possible to estimate a latent class cragg model, but not a latent class probit model. This could be related with the linear specification of the former model in contrast to the later model.

4. Results and Policy Recommendations

In the following, the description of the variables used in the models is presented and main descriptive statistics differences between coca and non coca growers are mentioned. Then, the econometric models results are shown, our hypotheses are tested and discussed, and finally policy recommendations are suggested.

4.1 Descriptive Statistics

The description of the variables used in the models is presented in Table 3. Coca growers represent 64% of the sample. They grow in average 3100 coca bushes, which would be the equivalent of 0.1 hectares, if we considered a conventional coca growing density of around 35000 bushes per hectare (UNODC, 2001). This average coca area is around the range found in VRAE, one of the main coca growing regions in Peru, where most of the farmers self-reported coca areas between 0.1 to 0.5 hectares (Rodriguez, 2003). For the same region, Bedoya (2003) indicated that the self – reported coca areas were of around 0.4 hectares for

Santa Rosa community and 0.25 hectares for Palmapampa. In our case, SPPP is a relative new coca growing area for narcotraffic business (UNODC Office in Peru, 1999), and it is expected that some farmers are only growing coca for traditional self-consumption[3].

Table 3: Description of Variables

Variable	Description	Mean	Std.Dev.
Dependent variables			
Coca	=1 if self reported to cultivate coca	0.64	0.48
Coca bushes	Natural log plus one of the number of self reported coca bushes	3.17	3.27
Socio – Economic Characteristics			
Age	Respondent age in years	42.30	12.42
Male	=1 if respondent is male	0.93	0.23
Education	Respondent number of years of education	8.32	3.30
Aymara	=1 if respondent is Aymara	0.82	0.38
Agricultural Household Characteristics			
Coffee area	Natural log of coffee area in hectares	4.24	0.26
Total area	Natural log of total area in hectares	6.73	4.71
Number of children	Number of children	2.93	1.99
Organic	=1 if respondent participates in the coffee organic program	0.57	0.49
Soil quality	From 1=very low to 5=very high perception of quality of soil for coffee production	2.82	0.55
Slope	From 1= if terrain is flat to 3= if terrain is sharp	2.19	0.52
Location middle	=1 if plot is located in the middle region of valley	0.40	0.48
Time to road	Time from agricultural plot to road in walking minutes	81.58	62.93
Identity Characteristics			
Born in SPPP	=1 if respondent was born in SPPP	0.25	0.43
Proud of being coffee farmer	From 1=very low to 3=very high self reported being proud to be coffee farmer	2.53	0.71
Chewing coca	=1 if farmer chews coca	0.67	0.47
Reciprocity Behavior			
Easy to obtain reciprocal labor	From 1=difficult to 3=easy to find to find reciprocal labor	1.86	0.91
Obligation to offer coca	=1 if the farmer feels the obligation to offer coca leaves to agricultural or labor guesses	0.78	0.42
Crime and Punishment			
Risk aversion [(a)]	From 1= low to 3=high degree of risk aversion	2.12	0.68
Law obedience	From 1=low opinion to 3=high opinion about the importance to obey the law	2.81	0.50
Index of morality	From 1=very low to 3=very high index of morality	2.04	1.05
Catholic	=1 if respondent is catholic	0.58	0.49
Religious attendance	=1 if respondent attends religious meetings	0.56	0.50
Fear to eradication	From 1=very low to 5=very high fear about the implementation of eradication programs five years ago	2.72	1.01
Inter – Temporal Transactions			

[3] Still, there are reasons to believe that many farmers underreported their extension of coca areas, behavior that is predictable anytime people are asked about sensitive topics (see e.g. Tourangeau and Yan, 2007). Therefore, as in any other research that deals with sensitive topics, the results should be treated with cautiousness.

Planning to increase coffee areas	=1 if respondent is planning to increase their coffee areas in the next two years.	0.68	0.47
Debt	=1 if respondent had debt with the co-operatives during the last two years.	0.10	0.29
Celebrations	=1 if respondent had to spend money in a mandatory celebrations during the last two years	0.23	0.42
Social Capital			
Trust	From 1= low trust to 3= high trust in neighbors five years ago	2.40	0.78
Security	From 1= low sense of security to 3= high sense of security in their community five years ago	2.73	0.60
Communal activities	=1 if farmer participated in communal activities during last year	0.89	0.31

(a) The risk aversion test followed Binswanger (1980) with its setup is presented in Appendix.

There are not statistically significant differences in socio – economic characteristics (age, sex, Aymara ethnic group, and number of children) between coca and non coca growers. Farmers have in average 42 years and 3 children, and 82% identified themselves as Aymara. Most of the respondents were males (93%), because we surveyed the head of the household who happen to be the male. The average years of schooling were 8.3, although the quality of education is very low. Non coca growers have statistically significant more years of schooling than coca growers.

In addition, farmers have in average 8 hectares of land, of which around 2 are dedicated to cultivate coffee. There are not statistically significant differences in the agricultural plot total areas and coffee areas between coca and non coca growers. On the other hand, 57% of the farmers participate in the coffee organic program, and there were statistically significant more organic coffee producers among the coca growers than among the non coca growers. Farmers take in average 82 minutes to reach the road by foot. Coca growers have agricultural plots statistically significant nearer the road than non coca growers, and are located in lower or upper parts in contrast to the middle part of the valley.

There is a statistically significant positive relationship between coca growing and traditional coca uses. A higher percentage of coca growers than non coca growers chew coca (76 versus 53%), and feel the obligation to offer coca to agricultural or labor guesses (87 versus 63%). On the contrary, index of morality and law obedience were significantly larger for non coca growers than coca growers. There are not statistically significant differences in the place of birth, feeling proud of being coffee farmer, difficulty to obtain reciprocal labor, being

catholic, religious attendance, risk aversion, debt, planning to increase coffee areas, trust on neighbors or security between coca and non coca growers.

4.2 Econometric Models

The econometric model results are shown in Table 4. The two first columns present the marginal effects of the probit and cragg models under the homogeneity assumption. The next two columns present the estimates for each of two groups obtained by the latent class cragg model under the heterogeneity assumption. The latent class coefficients that did not show statistical differences over classes as suggested by the Wald test statistics were restricted to be equal (e.g. Sevenant and Antrop, 2009). The econometric model results were robust under different specifications, and the marginal effects were evaluated at the sample mean. For the continuous variables in the probit model, the marginal effect is the marginal increment in the likelihood to grow coca associated with a marginal increment in the corresponding variable. For the dummy variables in the probit model, the marginal effect is the increment in the likelihood to grow coca associated with a discrete change from zero to one. For the cragg model the marginal effects are the partial derivative of the expected value of the natural log of number of coca bushes. The models were calculated using Limdep 9.

Table 4: Econometric Results

Variable	Probit	Cragg Model	Latent Class Cragg Model Coefficients	
			Traditional	Commercial
Age	-0.002 (0.003)	0.008 (0.021)	0.087*** (0.011)	-0.021 (0.024)
Male	-0.161 (0.102)	0.910 (0.867)	0.419 (0.349)	-1.274 (1.285)
Education	-0.017* (0.011)	0.111* (0.067)	-0.191*** (0.049)	0.331*** (0.083)
Aymara	0.029 (0.072)	-1.314*** (0.453)	-0.929*** (0.242)	-0.929*** (0.242)
Catholic	-0.050 (0.055)	-0.219 (0.360)	-2.630*** (0.257)	0.672 (0.474)
Born in SPPP	0.063 (0.063)	0.465 (0.436)	0.935*** (0.284)	1.276** (0.524)
Proud of being coffee farmer	0.005 (0.040)	-0.441* (0.267)	-0.845*** (0.186)	-0.845*** (0.186)
Chewing coca	0.176*** (0.064)	0.375 (0.432)	-0.347 (0.241)	-0.347 (0.241)
Easy to obtain reciprocal labor	-0.032 (0.030)	0.229 (0.193)	0.032 (0.124)	0.032 (0.124)
Obligation to offer coca	0.241*** (0.076)	0.297 (0.529)	-0.211 (0.354)	0.808 (0.636)
Coffee area	-0.208*	0.138	2.873***	-1.909*

	(0.122)	(0.794)	(0.611)	(0.983)
Total area	0.117 (0.107)	1.488** (0.688)	-1.083** (0.443)	3.272*** (0.907)
Number of children	-0.006 (0.018)	-0.176 (0.117)	-0.367*** (0.054)	-0.367*** (0.054)
Organic[(a)]	0.173*** (0.057)	-0.497 (0.381)	1.533*** (0.243)	-1.565*** (0.491)
Trust	0.021 (0.036)	0.209 (0.251)	0.578*** (0.158)	-0.209 (0.339)
Security	-0.005 (0.050)	-0.133 (0.310)	-0.076 (0.250)	-0.076 (0.250)
Communal activities	0.017 (0.092)	0.713 (0.688)	0.113 (0.282)	-0.273 (1.180)
Risk aversion	0.004 (0.039)	-0.585** (0.254)	-0.367* (0.195)	-1.405*** (0.371)
Law obedience	-0.120* (0.068)	-0.201 (0.367)	-0.149 (0.422)	0.100 (0.421)
Religious attendance	0.006 (0.055)	-0.021 (0.359)	0.481** (0.208)	0.481** (0.208)
Index of morality	-0.134*** (0.038)	-0.455* (0.258)	-2.108*** (0.187)	0.264 (0.336)
Fear of eradication	-0.005 (0.029)	0.268 (0.186)	-0.059 (0.111)	-0.059 (0.111)
Location middle	-0.188*** (0.055)	0.285 (0.368)	0.084 (0.225)	0.971* (0.516)
Time to road	-0.001 (0.0006)	-0.008*** (0.003)	0.008*** (0.003)	-0.021*** (0.004)
Planning to increase coffee areas	-0.038 (0.057)	-0.152 (0.389)	-0.388 (0.236)	0.142 (0.521)
Debt	0.211*** (0.068)	1.035* (0.552)	2.395*** (0.277)	-0.918 (0.741)
Celebrations	0.071 (0.061)	0.190 (0.391)	0.451** (0.197)	0.451** (0.197)
Soil quality	-0.073* (0.041)	0.131 (0.282)	-0.450** (0.180)	0.958** (0.388)
Slope	-0.077 (0.053)	0.290 (0.353)	0.770*** (0.217)	-0.226 (0.483)
Constant	1.295** (0.541)	-3.834 (3.900)	0.698 (2.227)	1.024 (5.005)
Sigma	-	2.806*** (0.168)	0.653*** (0.091)	2.172*** (0.174)
Class Probability	-	-	0.351***	0.649***
Log likelihood	-209.236	-571.618	-530.176	
McFadden Pseudo R-squared	0.1817	-	-	
AIC	1.224	3.082	2.166	
BIC	1.528	3.397	2.583	
Percentage of corrected predicted	71.355	-	-	
ROC curve	77.526	-	-	
Number of Observations	391	391	391	

* Significant at 0.1, ** significant at 0.05, *** significant at 0.01.

(a) Organic certification participation could be a potential endogenous variable in the decision to grow coca. A series of statistical evaluations were done to test its exogeneity both in the probit model and in the cragg model. The significance of the correlation (ρ) in a recursive bivariate probit model is used to test the exogeneity of a binary variable in the probit model (Greene, 2007). If ρ=0, then the potential endogenous variable and the error of the probit of the dependent variable are uncorrelated. In our case, we fail to reject the hypothesis of exogeneity with prob=0.878. A two – step estimator of an endogenous discrete variable in a truncated model is used to test the exogeneity of organic certification in the Cragg model (following Greene, 2007: R10-44, Cameron, and Trivelli: 595). We fail to reject the null hypothesis of exogeneity with prob =0.369.

4.2.1 Probit results

The probit model results suggest that the likelihood of growing coca significantly decreases with education, but increases with traditional uses of coca such as coca chewing and feeling the obligation to offer coca to guesses. As, expected by the agricultural household models, the larger the coffee area, the lower the probability of growing coca, and the opposite in the case of the perceived quality of soil. Farmers who were more in debt with the coffee co-operative are also more significantly likely to grow coca. This result suggests that financial problems could be one of the reasons for cultivating illegal crops. Law obedience and index of morality have a statistically significant negative influence in the likelihood of growing coca. In addition, location in the middle of the valley also has a negative influence in the likelihood of growing coca. The effect of location could be related to social influence of the neighbors as suggested by Ibanez and Carlsson (2009) or due to the fact that the upper part of the valley has been subject to long term agricultural use, meaning that their productivity has decreased, and the lower part of the valley are areas further away from the major towns and therefore with larger transactions costs, which make farmers less competitive and more prone to coca growing.

Unexpectedly, participation in the organic certification program, an activity promoted and economically and technically supported by international co-operation as an anti-drug policy (see Dietz *et al.*, 2001), seems to positively influence the likelihood of coca growing. One of the reasons for the positive result could be that organic certification requires additional soil conservation activities to be practiced throughout the year, which make difficult for farmers to continue growing crops in the Sierra, motivating their permanent settlement in the rainforest. Subsistence agriculture in the Sierra has customarily acted as insurance in case of coffee cash crop failure in the rainforest (Collins, 1984). Farmers could have substitute agriculture in the Sierra with coca cultivation to act as a refuge crop in case of emergencies. The farmer's use of coca as refuge crop has been suggested by Mansfield (1999) and Bedoya (2003).

Finally, in relation to the probit model results, it is important to recall that it was not possible to apply a latent class specification in this type of model because identification of unobserved heterogeneity is weak when a cross sectional dataset is used as in our case (Greene, 2007). The motivations for growing coca are likely to differ for traditional and commercial coca growers; therefore, it is likely that the standard probit model calculated with pooled data provides biased results, given that it can not take into account two separate distribution functions. There was no manner to separate *a priori* those two types of coca farmers because for obvious reasons, they were not willing to answer questions about the final destination of their coca production.

4.2.2 Cragg model results

For the Cragg model, it was possible to estimate a latent class specification, probably due to the linear specification of this type of model in contrast to the probit model. The latent class model only considers two classes, because with more than two the model failed to converge. Even when identification is weak using cross sectional data, we consider that is better than not addressing the unobserved heterogeneity problem. A comparison of the standard Cragg model with the latent class Cragg specification results, favors the later one, based on the reduction on the value of the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). Both, the AIC and BIC have been used as a tool for model selection under latent class specifications (e.g. Beharry-Borg and Scarpa, 2010; Milon and Scrogin, 2006). The discussion centers on the latent class Cragg model results, which was preferred to the standard Cragg model. In this last model, some variables show different magnitude of estimates and even sign reversals for the traditional and commercial groups. First, we discuss our results in the context of the agricultural household model framework, then in the pro-social behavior set of theories, and finally in the crime and punishment model framework.

a) Agricultural household model decisions

The traditional group results partially support the hypothesis that farmers take their decisions under the rationale proposed in the agricultural household model. Total agricultural plot areas, availability of family labor, quality of land and distance to road have a statistically significantly negative effect on the number of coca bushes for this group. On the contrary, for the commercial group, total agricultural plot area, quality of land, and lower distance to the road have a significant but positive effect on the number of coca bushes. This last result is the

opposite of what it is expected, suggesting that in the case of the commercial group, farmers with more resources for agricultural production will grow more number of coca bushes. Thus, coca growing for this last group seems not to be directly related to poverty associated to agricultural resource scarcity.

On the other hand, coffee area has a statistically significantly positive effect in the number of coca bushes in the traditional group. This could be related to the fact that coca is intercropped with coffee, so larger areas of coffee mean more number of coca bushes, although it could be the case that farmers are not maintaining those coca bushes, and because coca is a weed, the larger number of coca bushes in relation to larger coffee areas is a natural occurrence. The contrary effect is observed in the case of the commercial group: the area of coffee has a negative and significant effect on the number of coca bushes. This result along with the one mentioned in the previous paragraph, suggest that this later group has a more commercial management of their farm by destining the better land to coca production, and balancing their coffee areas according to their extension of coca.

Organic certification most of the time increases the prices of coffee, so it was expected that this variable had a negative effect on the number of coca bushes. This variable has the expected effect on the commercial group but not in the traditional group. This could be related to the fact mentioned before: organic certification requires additional soil conservation activities to be practiced throughout the year, which make difficult for farmers to continue growing crops in the Sierra, motivating their permanent settlement in the rainforest. Subsistence agriculture in the Sierra has customarily acted as insurance in case of coffee cash crop failure in the rainforest (Collins, 1984). Farmers could have substitute agriculture in the Sierra with coca cultivation to act as a refuge crop in case of emergencies. The farmer's use of coca as refuge crop has been suggested by Mansfield (1999) and Bedoya (2003). Thus, this also suggests that the traditional group is composed by farmers who used to rely on subsistence crop production in the Sierra to supplement their coffee income, in contrast to the farmers in the commercial group.

b) Pro – Social Behavior

Coca chewing, as an indigenous status identity variable, does not statistically influence the number of coca bushes cultivated in any of the two groups of farmers, although the negative sign indicates that coca chewers are less prone to grow more number of bushes. This could be

partially corroborated with the statistically significant negative effect of the Aymara variable on the number of coca bushes, meaning that in general, indigenous farmers would grow less number of coca bushes. Other identity variable included in the research is proud of being coffee farmer. This variable has a significant negative effect on the number of coca bushes for both groups. Those results are expected, according to the identity theory (Akerlof and Kranton, 2000): people's notion of who they are, is associated with belief of how they suppose to behave, and violating this might provoke discomfort. Thus, indigenous farmers are supposed to grow coca for self – consumption, but not to sell it to narcotraffic business, which might constraint its behavior.

On the other hand, the variable born in the research area has a statistically significant positive effect in the number of coca bushes for both groups, which is the opposite expected effect. In this case, this could be related with less on-farm or off-farm opportunities outside the research area, given that those farmers might have restricted contacts in other regions. Therefore, they might have to rely on growing coca to supplement their income. On the other hand, reciprocal farmers (those who participate in reciprocal labor and have a sense of obligation to offer coca to their agricultural guesses as a reciprocity signal) do not grow less number of coca bushes. This could be related with a replication effect of reciprocity (detrimental responses to detrimental actions of others), although those variables did not show significant effects on the number of coca bushes.

c) Crime and Punishment Model

As expected risk aversion shows a statistically significantly negative influence on the number of coca bushes for both groups, although, also as expected, the effect is larger in the case of the commercial group. The morality index only plays a significant role in the case of traditional coca farmers: higher morale is associated with lower number of coca bushes. On the other hand, perceived importance to obey the law does not have a significant effect on the number of coca bushes, and it only shows the expected negative sign for the case of traditional growers. Both morality index and perceived importance to obey the law showed a positive influence, but highly insignificant for the commercial farmers, suggesting that their behavior is indifferent to changes in these variables. Religious belief, measured as being catholic, negatively influence the number of coca bushes for the traditional group. Religion, or the social gatherings associated with it, seems to play a role on coca growing decisions.

Ibanez and Carlsson (2009) in a similar way found a positive influence of being protestant with farmers' coca areas.

Interestingly, the frequency of attendance to religious meetings significantly positively influences that number of coca bushes for both groups. This could be related to the perverse social capital formation – the ability to obtain resources through networks or other social structures that benefit vicious behaviors - that could be reinforced during those social gatherings, more than with an issue of faith. In relation to fear of eradication, this variable has negative influence in the number of coca bushes, but this effect is non significant. This makes sense considering that this is practically a new coca region for narcotraffic business, and have been never subject to eradication efforts.

d) Other Factors beyond the Profit Maximization Rationale

The positive effect of risk aversion given than coca growing reduces agricultural uncertainties as suggested by Revilla (1993) was not evidenced in our case. On the other hand, having a debt with the co-operative significantly increases the number of coca bushes grown by the traditional group. Compulsory celebrations during the last two years show a significant positive effect on the number of coca bushes cultivated by both groups.

An important variable that need further discussion is education. As expected, this variable has a significant negative influence on the number of coca bushes but only for the traditional group. On the contrary, education shows a positive and significant effect for the commercial group. One of the possible reasons for this result could be that the latter group manages their farm in a more commercial oriented manner, and are in average more educated than the traditional group (see Table 5). Thus, increases on education for this latter group could have the spillover effect of increasing the ability to manage their farm in a more efficient way, probably meaning more coca bushes, given their profitability. Here, we also have to take into account that there have not being any forced eradication program implementation in the research area and that farmers in the commercial group are in average less risk averse than the ones in the traditional group (see Table 5). Ibanez and Carlsson (2009) also found a positive relation between coca growing and education in Colombia, and suggested that the coca growing parents have more money to educate their children who become coca growers too. This option is probably ruled out in our case, given that coca growing for narcotraffic business is a relatively new activity in our research area.

The set of variables that have not significant effect both in the likelihood of growing coca or the number of coca bushes cultivated by the farmers are being male (probably due to the small number of female responses), planning to increase coffee areas, security or communal activities. Trust in neighbors has a significant positive effect on the number of coca bushes but only for the traditional group, suggesting that for this group, perverse social capital formation – the ability to obtain resources through networks or other social structures that benefit vicious behaviors- could have taken place. This also resembles the positive and significant effect of trust in the areas of coca obtained by Ibanez and Carlsson (2009).

4.3 Does de latent class separation make sense?

It is expected that the farmers classified under the traditional group will have significant different socio – economic characteristics than the farmers classified under the commercial group, and that those differences should correspond to an associated behavior for each group. For example, traditional growers are expected to have less number of coca bushes than the commercial ones, given that they are supposed to grow coca mostly for self-consumption. At the same time, traditional farmers are supposed to have less education than the commercial ones, as suggested by the DEVIDA (2004). Table 5 shows the statistically significantly different characteristics of those groups based on sample t-tests.

Table 5: Descriptive Statistics by Latent Class Group

Variable	Traditional	Commercial
Number of coca bushes	972.000*** (3005.596)	5014.866*** (8586.589)
Education	7.704*** (3.195)	8.746*** (3.047)
Total area	4.763* (0.297)	4.696* (0.303)
Number of children	3.306** (2.098)	2.704** (1.770)
Risk aversion	1.194* (0.716)	1.035* (0.646)
Law obedience	1.861** (0.398)	1.732** (0.545)
Time to road	100.417*** (67.582)	69.359*** (53.608)

Sample t test reveal significant differences between the two groups at:
* 0.1% level, ** 0.05% level, and ***0.01% level

In general, the results above support the expected characteristics of the traditional versus commercial coca farmers. The traditional group has statistically significant less number of coca bushes, less education, more number of children, and are more risk averse than the commercial group. The former group has also significantly larger total area (in log), but are located further from the road, and seem to consider more important to obey the law than the commercial group. It is worth mention the traditional group seems to include mostly farmers who grow coca only for self-consumption, but it also includes farmers who sell it, given the relative large average number of coca bushes.

4.4 Policy Implications

In Peru and Bolivia, the area under coca bush cultivation has increased for the third consecutive year. Larger increments in coca cultivation have been observed in previously only traditional coca growing regions, such as our research area (UNODC, 2009). Moreover, our particular study region is of strategic interest for narcotraffic business, because it is located at the border with Bolivia, and therefore provides an access to an external exit route (UNODC Office in Peru, 1999). The Peruvian Government is particularly focusing its anti-drug policy programs in preventing the expansion of coca bush cultivation in this and other regions in the country (INCB, 2010). Anti - drug policy recommendations are formulated below, suggesting the overall effect that the policy could have in our research area and similar ones. Weighted marginal effects for selected significant variables of the latent class model were constructed and are presented in Table 6.

Table 6: Weighted Marginal Effects from the Latent Class Model

	Weighted Marginal Effects	Standard Error	p-value
Proud of being coffee farmer	-0.715***	(0.242)	0.0031
Organic	-0.574*	(0.334)	0.0860
Time to road	-0.012***	(0.004)	0.0004
Education	0.138**	(0.062)	0.0

Proud of being coffee farmer has a large and significant negative effect in the number of coca bushes grown by the farmers. Importantly, this negative effect is observed in both groups of coca growers (see Table 4). The coffee co-operatives could help to enhance pride among their members by coffee quality contests, motivational talks during General Assemblies to increase

awareness of coffee farmer identity, celebrations associated with coffee farmer's heritage, or any other associated activity that could raise feelings of self - respect among the coffee farmers.

In addition, organic certification also seems to have an overall negative effect on the number of coca bushes, although for the traditional group, our results suggest that organic certification has a positive effect, which as already mentioned could be related with the coca function as refuge crop as farmers become permanent settlers in rainforest areas. This positive effect is overcome by the larger negative effect on the commercial group. On the other hand and contrary to what is expected, road construction and education seems to positively influence the number of coca bushes in the research area. These latter results could be of temporal nature, given that road construction reduces transactions costs first for coca and then for other agricultural crops (see Lupu, 2004), and education enhances the quality of life of the farmers. Therefore, both on the long term should have positive effects on the community well-being, which could translate into a potential reduction on coca areas.

5. Conclusions

In this paper, we investigate the joint decision to grow coca and the number of coca bushes cultivated by indigenous farmers in a rainforest community located in Peru, at the border with Bolivia. This community did not show significant quantities of coca bushes under cultivation until recently, and currently is one of the coca growing regions with the largest increases on coca areas in the country, given its proximity to an external exit route. Thus, it is very likely that in this region traditional (mostly self-consumption) coca growers and commercial – oriented coca growers co-exist. Each of group is supposed to have different motivations to grow coca and therefore should follow different distribution functions.

A preliminary statistical evaluation of the data indicated that the Cragg model performed better than the Tobit and Heckman or sample selection models. A probit for the decision to grow coca, followed by a Cragg model for the decision of the number of coca bushes under cultivation were used for the analysis; first, considering the farmers as homogenous group, and then relaxing this assumption and assuming heterogeneity. For the heterogeneity evaluation, a latent class Cragg model specification was used, given that this type of model allows the analyst/researcher to separate the farmers into two or more classes with different

parameter estimates. The latent class Cragg model performed statistically better than the standard Cragg model.

Our results suggest that there is unobserved heterogeneity among the coca growers. Thus, based on this unobserved heterogeneity, farmers could be classified in two groups called for convenience “traditional” and “commercial”. Traditional farmers represent around 35% of the sample and have smaller coca areas. They seem to grow coca mostly due to poverty. Larger total agricultural plot areas, more availability of family labor, better quality of soil, and shorter distance to the road have a negative statistically effect on their number of coca bushes for this group. On the other hand, for the commercial coca growers represent the remaining 65% of the sample and have significant larger coca areas than the other group. Larger agricultural plot areas, better quality of soil, shorter distance to the road, and smaller areas of coffee have a positive and significant effect on their number of coca bushes. This latter group seems to have a commercial oriented management of their farm by destining the better land to coca production, and balancing their coffee areas according to their extension of coca.

On the other hand, our results also suggest that increases in the pride of being coffee growers and organic coffee certification would statistically significantly reduce the number of coca bushes in the overall region. On the contrary, other common anti-drug policies such as education and road constructions have a significant and positive effect on the number of coca bushes, at least on the short term, although given that they increase the quality of life of the community, it could be expected that in the long term those types of policies would lead to a sustainable reduction on the number of coca bushes. This paper has just scratched the surface about the motivations of coca growers, and more research is needed, which should include the use of panel data, to be able to recommend sound anti-drug policies that are urgently needed in benefit of the overall society.

Appendix

This is a game. Before playing it, you need to choose one of the options displayed below. Then I toss a coin. If for example you have chosen option H, and I toss the coin and it is heads, you do not win any money at all; but if it is tails, you win S/.200. On the other hand, if you have chosen option A, you receive S/.50 regardless if the tossed coin is heads or tails. Which option from all of the above would you choose before I toss the coin?

OPTION	If it is heads, you win:	If it is tails, you win:
A	50 soles	50 soles
B	45 soles	95 soles
C	40 soles	120 soles
D	35 soles	125 soles
E	30 soles	150 soles
F	20 soles	160 soles
G	10 soles	190 soles
H	0 soles	200 soles

Table conversion:
A-B: High risk aversion
C-F: Medium risk aversion
G-H: Low risk aversion

References

Akerlof, G and Kranton, R. 2000. "Economics and Identity". The Quarterly Journal of Economics, Vol. 115, Issue 3, pp. 715-753

Allen, C. 1981. "To Be Quechua: The Symbolism of Coca Chewing in Highland Peru". American Ethnologist, Vol. 8, No. 1, pp. 157-171

Alpizar, F; Carlsson, F; and Johansson-Stenman, O. 2008. "Anonymity, Reciprocity, and Conformity: Evidence from Voluntary Contributions to a National Park in Costa Rica". Journal of Public Economics, Vol. 92, Issues 5-6, pp. 1047-1060

Anesi, V. 2008. "Incentives and Prosocial Behavior in Democratic Societies". Journal of Economic Psychology, Vol. 29, pp. 849 - 855.

Balbin, J. 2002. "Estudio de Variables Concomitantes a la Voluntad del Productor Agropecuario para Abandonar la Producción de Hoja de Coca (*Erythroxilon coca L.*) con Fines Illicitos en el Programa Nacional de Desarrollo Alternativo: 1998 - 2001". Thesis. Department of Economics and Planning. Universidad Nacional Agraria La Molina. Lima, Peru.

Becker, G. 1968. "Crime and Punishment: An Economic Approach". The Journal of Political Economy, Vol. 76, No. 2, pp. 169-217.

Bedoya, E. 1987. "La Economía Familiar en la Selva Alta". Debate Agrario No. 1. Lima, Peru.

Bedoya, E. 2003. "Estrategias Productivas y el Riesgo entre los Cocaleros del Valle de los Ríos Apurimac y Ene". In Aramburu,C and Bedoya, E.: "Amazonía: Procesos Demográficos y Ambientales". Consorcio de Investigación Económica y Social. Lima, Peru.

Beharry-Borg, N and Scarpa, R. 2010. "Valuing Quality Changes in Caribbean Coastal Waters for Heterogeneous Beach Visitors". Ecological Economics. Article in Press.

Breen, R. 1996. "Regression Models. Censored, Sample – Selected or Truncated Data". Series: Quantitative Applications in the Social Sciences. Sage Publications.

Brush, S. 1976. "Man's Use of an Andean Ecosystem". Human Ecology, Vol. 4, pp.147–166

Bolton, R. 1976. "Andean Coca Chewing: A Metabolic Perspective". American Anthropologist, Vol. 78, No. 3, pp. 630-634

Bonnard, M; and David, C. 2004. "Diagnostico Agro-Económico de los Sistemas de Producción Agrícolas del Valle Tambopata". Memoria de Fin de Estudios. Instituto Nacional de Agronomía Paris-Grignon. France.

Burczynski, F; Boni, R; Erickson, J; Vitti, T. 1985. "Effect of *Erythroxylum coca*, Cocaine and Ecgonine Methyl Ester as Dietary Supplements on Energy Metabolism in the Rat". Journal of Ethnopharmacology, Vol. 16, pp. 153-166.

Caballero, V; Dietz, E; Taboada, C; and Anduaga, J. 1998. "Diagnostico Rural Participativo de las Cuencas Alto Inambari y Alto Tambopata Provincia de Sandia, Departamento de Puno". GTZ. Lima, Peru.

Cabieses, H. 2005. "Sobre Coca, Cocaleros y Drogas: Fallos Satanicos y Debates de Fondo". Debate Agrario 39. Lima, Peru.

Cameron, A. and Trivelli, P. 2009. "Microeconomics Using Stata". STATA Press Publication. U.S.

Camino, A. 1984. "La Colonizacion como Problemática Social" in Consejo Nacional de Poblacion. "Poblacion y Colonizacion en la Alta Amazonia Peruana". Lima, Peru.

Caulkins, J; Reuter, P; Iguchi, M; and Chiesa, J. 2005. "How goes the War on Drugs? An Assessment of U.S. Drug Problems and Policy". RAND Drug Policy Research Center. U.S.

Collins, J. 1984. "The Maintenance of Peasant Coffee Production in a Peruvian Valley" American Ethnologist, Vol. 11, No. 3, pp. 413-438

Collins, J. 1986. "The Household and Relations of Production in Southern Peru" Comparative Studies in Society and History, Vol. 28, No. 4, pp. 651-671

Davalos, L; Bejarano, A; and Correa, L. 2008. "Disabusing Cocaine: Pervasive Myths and Enduring Realities of a Globalised Commodity". International Journal of Drug Policy, Vol. 20, Issue 5, pp. 381-386.

DEVIDA. 2007. "Estudio de Profundidad sobre Narcotráfico, Consumo de Drogas y Desarrollo Alternativo en las Cuencas Cocaleras". Lima, Peru.

Dietz, E; Lessmann, R; Kotowski-Ziss, J; and Berg, C. 2001. "Drugs and Development in Latin America. Strategies, Experiences and Project Examples from the Work of GTZ". GTZ. Germany.

Ehrlich, I. 1973. "Participation in Illegitimate Activities: A Theoretical and Empirical Investigation". Journal of Political Economy, Vol. 81, Issue 3, pp. 521-565.

Eisenhauer, J., 2004. "Economic models of sin and remorse: some simple analytics". Review of Social Economy, Vol. 62, pp. 201–219.

FONANPE (Fondo Nacional de Financiamiento de la Actividad Empresarial del Estado). 2005. "Perú: Oferta de Hoja de Coca. Estadistica Basica (2001-2004)". Lima, Peru.

Fong, C. 2001. "Social preferences, self-interest, and the demand for Redistribution". Journal of Public Economics, Vol. 82, pp. 225–246.

Garcia, J and Antezana, J. 2009. "Diagnostico de la Situación del Desvío de IQ al Narcotráfico". ConsultAndes and DEVIDA. Lima, Peru.

Gerhardus, B. 2003. "Drugs and Poverty. The Contribution of Development – Oriented Drug Control to Poverty Reduction". GTZ. Eschborn, Germany.

Gibson, B. and Godoy, R. 1993. "Alternatives to Coca Production in Bolivia: A Computable General Equilibrium Approach". World Development, Vol. 21, No. 6, pp. 1007-1021.

Greene, W. 2007. "LIMDEP Version 9.0. Econometric Modeling Guide". Econometric Software, Inc. U.S.

Grinspoon, L; and Bakalar, J. 1981. "Coca and Cocaine as Medicines: An Historical Review". Journal of Ethnopharmacology, Vol. 3, pp. 149-159.

Hanna, J. 1974. "Coca Leaf Use in Southern Peru: Some Biosocial Aspects". American Anthropologist, Vol. 76, No. 2, pp. 281 – 296.

Harbaugh, W. 1998. "What do Donations Buy? A Model of Philanthropy based on Prestige and Warm Glow". Journal of Public Economics, Vol. 67, Issue 2, pp. 269-284.

Heckman, J. 1979. "Sample Selection Bias as Specification Error". Econometrica, Vol. 47, Issue 1, pp. 153-161.

Heckman, J. and Singer, B. 1984. "A Method for Minimizing the Impact of Distributional Assumptions in Econometric Models for Duration Data". Econometrica, Vol. 52, Issue 2, pp. 271-320

Henman, A. 1990. "Tradicion y Represion: Dos Experiencias en America del Sur" In Garcia – Sayan, D. "Coca, Cocaina y Narcotrafico. Laberinto en los Andes". Comision Andina de Juristas. Lima, Peru.

Holmstedt, B; Jaatmaa, E; Leander, K; and Plowman, T. 1977. "Determination of Cocaine in Some South American Species of *Erythroxylum* using Mass Fragmentography". Phytochemistry, Vol. 16, pp. 1753-1755.

Hope, R. 2006. "Evaluating Water Policy Scenarios Against the Priorities of the Rural Poor". World Development, Vol. 34, Issue 1, pp. 167-179.

Huck, S. and Tyran, J. 2007. "Reciprocity, Social Ties, and Competition in Markets for Experience Goods". Journal of Socio-Economics, Vol. 36, Issue 2, pp. 191-203

Ibanez, M and Carlsson, F. 2009. "A survey-based choice experiment on coca cultivation" Journal of Development Economics, In Press, Corrected Proof

Instituto Indigenista Interamericano. 1989. "La Coca… Tradición, Rito, Identidad". Mexico.

INCB (International Narcotics Control Board). 2010. "Report of the International Narcotics Control Board for 2009". United Nations. Austria.

Jacoby, H. "Productivity of Men and Women and the Sexual Division of Labor in Peasant Agriculture of the Peruvian Sierra". Journal of Development Economics, Vol. 37, pp. 265-287.

Jenkins, A; Llosa, T; Montoya, I; and Cone, E. 1996. "Identification and Quantitation of Alkaloids in Coca Tea". Forensic Science International, Vol. 77, pp. 179-189.

Larme, A. 1998. “Environment, Vulnerability and Gender in Andean Ethnomedicine”. Social Science Medicine, Vol. 47, Issue 8, pp. 1005-1015.

Lupu, N. 2004. “Towards a New Articulation of Alternative Development: Lessons from Coca Supply Reduction in Bolivia”. Development Policy Review. Vol 22 (4), pp. 405-421.

Malaga, C. 2003. “Rastreando la Vida en el Alto Tambopata”. Revista Rumbos. Lima, Peru. Biodiversity Reporting Award Honorable Mention. Availability: http://www.biodiversityreporting.org/article.sub?docId=825&c=Peru&cRef=Peru&year=2003&date=February%202003 Accessed: June 23, 2009.

Mansfield, D. 1999. “Alternative Development: The Modern Thrust of Supply Side Policy”. Bulletin on Narcotics, Volume LI, Numbers 1 and 2. United Nations Office on Drugs and Crime. Austria.

Mansfield, D. 2006. “Development in a Drugs Environment: A Strategic Approach to Alternative Development”. Discussion Paper. Development Oriented Drug Control Program. GTZ. Germany.

Matshe, I and Young, T. 2004. “Off-farm labour allocation decisions in small-scale rural households in Zimbabwe”. Agricultural Economics, Vol. 30, pp. 175-186.

Marshall, G. 2009. “Polycentricity, Reciprocity, and Farmer Adoption of Conservation Practices under Community-Based Governance”. Ecological Economics, Vol. 68, Issue 5, pp. 1507-1520.

Mayer, E. 2004. “Casa, Chacra y Dinero. Economías Domésticas y Ecología en Los Andes”. Series: Estudio de la Sociedad Rural 28. Instituto de Estudios Peruanos. Lima, Peru.

Meier, S. 2006. “A Survey of Economic Theories and Field Evidence on Pro – Social Behavior”. Working Paper 06-06. Federal Reserve Bank of Boston. U.S.

Milon, J and Scrogin, D. 2006. “Latent Preferences and Valuation of Wetland Ecosystem Restauration”. Ecological Economics, Vol. 56, pp. 162-175.

Negrete, J. 1978. “Coca Leaf Chewing: a Public Health Assesssment”. British Journal of Addiction, Vol. 73, pp. 283-290.

Office of Technology Assessment. 1993. “Alternative Coca Reduction Strategies in the Andean Region”. U.S. Congress. OTA-F-556. Washington, U.S.

Ostrom, E. 1990. “Governing the Commons: The Evolution of Institutions for Collective Action”. Cambridge University Press. U.S.

Owen, A and Videras, J. 2007. “Culture and public goods: The case of religion and the voluntary provision of environmental quality”. Journal of Environmental Economics and Management, Vol. 54, pp. 162–180.

Painter, M. 1984. “Changing Relations of Production and Rural Underdevelopment”. Journal of Anthropological Research. Vol. 40, Nro. 2, pp. 271-292.

Portes, A and Landolt, P. 2000. "Social Capital: Promise and Pitfalls of its Role in Development". Journal of Latin American Studies 31, pp. 529 – 547.

Rivera, M; Aufderheide, A; Cartmell, L; Torres, C; and Langsjoen, O. 2005. "Antiquity of Coca – Leaf Chewing in the South Central Andes: A 3000 Year Archaeological Record of Coca – Leaf Chewing from Northern Chile". Journal of Psychoactive Drugs, Vol. 37, Issue 4, pp. 455 – 458.

Revilla, J. 1993. "Producción Cocalera y Migración Campesina en el Perú". Notas para el Debate 11. GRADE. Lima, Peru.

Rodriguez, A. 2003. "La Economía de la Coca (Erythroxylum coca) en el Valle del Río Apurimac". Escuela de Post Grado. Magister Scientiae Thesis. Specialization in Agricultural Economics. Universidad Nacional Agraria La Molina. Lima, Peru.

Rospigliosi, F. 2004. "Analisis de la Encuesta DEVIDA-INEI" in Rospigliosi, F. 2004. "El Consumo Traditional de la Hoja de Coca en el Peru". Instituto de Estudios Peruanos. Lima, Peru.

Sauvain, M; Rerat, C; Moretti, C; Saravia, E; Arrazola, S; Gutierrez, E; Lema, A; and Munoz, V. 1997. "A Study of the Chemical Composition of *Erythroxylum coca var. coca* Leaves collected in Two Ecological Regions of Bolivia". Journal of Ethnopharmacology, Vol. 56, pp. 179-191.

Sevenant, M and Antrop, M. 2009. "The Use of Latent Classes to Identify Individual Differences in the Importance of Landscape Dimensions for Aesthetic Preference". Land Use Policy. In Press.

Singh, I and Subramanian, J. 1986. "Agricultural Household Modeling in a Multicrop Environment: Case Studies in Korea and Nigeria". In: Singh, I; Squire, L; Strauss, J. "Agricultural Household Models. Extensions, Applications, and Policy". The World Bank. U.S.

Singh, I; Squire, L; Strauss, J. 1986. "Agricultural Household Models. Extensions, Applications, and Policy". The World Bank. U.S.

South, R. 1977. "Coca in Bolivia". Geographical Review, Vol. 67, Nro. 1, pp. 22-33.

Thurow, A; Conner, J; Thurow, T; and Garriga, M. 2001. "A preliminary analysis of Texas ranchers' willingness to participate in a brush control cost-sharing program to improve off-site water yields". Ecological Economics, Vol. 37, pp. 139-152.

Thoumi, F. 2003. "Illegal Drugs, Economy, and Society in the Andes". Woodrow Wilson Center Press. Washington, U.S.

Torgler, B. 2006. "The Importance of Faith: Tax Morale and Religiosity". Journal of Economic Behavior and Organization, Vol. 61, Issue 1, pp. 81-109.

Torrico, J; Pohlan, H., Janssens, M. 2005. "Alternatives for the Transformation of Drug Production Areas in the Chapare Region, Bolivia". Journal of Food, Agriculture and Development, Vol. 3, Issue 3-4, pp. 167-172.

Tyler, T. 2006. “Why People Obey the Law?” Princeton University Press. U.S.

UNODC. 2009. “Perú. Monitoreo de Cultivos de Coca 2008”. Lima, Peru.

UNODC Office in Peru. 1999 “Desarrollo Alternativo del lnambari y Tambopata”. Documento de Proyecto AD/PER/99/D96. Availability: http://www.onudd.org.pe/web/Html/Templates/proyectos.htm (accessed on June 15, 2009)

U.S. Department of State. 2009. “International Narcotics Control Strategy Report. Volume I: Drug and Chemical Control”. Bureau for International Narcotics and Law Enforcement Affairs. U.S.

Weil, A. 1981. “The Therapeutic Value of Coca in Contemporary Medicine”. Journal of Ethnopharmacology, Vol. 3, pp. 367-376.

Williams, J and Sickles, R. 2002. “An Analysis of the Crime as Work Model: Evidence from the 1958 Philadelphia Birth Cohort Study”. Journal of Human Resources, Vol. 37, Issue 3, pp. 479-509.