

The decision of farmers from the tropical region of Cochabamba in Bolivia to cultivate coca instead of state-recommended alternative products

La decisión de los agricultores del área tropical de Cochabamba (Bolivia) de cultivar coca en lugar de los productos alternativos recomendados por el Estado

Juan Carlos Barrientos¹ and Walter Schug²

Abstract: Despite national coca cultivation having been prohibited from 1973 onwards and the rapid reduction of coca plantations up to 2000, coca is still being cultivated in the tropical region of Cochabamba. Technical and economic aspects are responsible for many farmers deciding to continue to cultivate coca and not to cultivate alternative crops. Coca cultivation is technically more adaptable and less demanding than the five alternative crops analysed in this research (pineapples, banana, passion fruit, palm hearts and pepper). These require more input or capital from the producers than cultivating coca as well as more technical experience and skills on their part. In economic terms, the demand for coca leaves exceeds their supply, contrary to that of alternative crops; coca prices therefore tend to increase. This is why coca producers often obtain higher profits from cultivating coca than by cultivating alternative crops. Coca leaves can also be marketed relatively easily compared to alternative products as coca purchasers are less demanding regarding coca leaf quality, their transport is easy and cheap and there is the possibility of quick, guaranteed sales. However, many advantages listed regarding coca cultivation in relation to cultivating alternative crops conflict with coca being prohibited and the fight against its cultivation.

Additional key words: alternative crops, agricultural commodities market, agrarian marketing, alternative development, comparing crop profitability

Resumen: A pesar de la prohibición estatal del cultivo de coca desde 1973 y de la reducción rápida de las plantaciones de coca hasta 2002, este arbusto todavía se cultiva en las zonas tropicales de Cochabamba (Bolivia). Tanto aspectos técnicos como económicos, son responsables de que muchos agricultores se decidan por el cultivo de la coca y no por el de cultivos alternativos. Técnicamente, el cultivo de la coca es más adaptable y menos exigente, en comparación con los cinco cultivos alternativos analizados en esta investigación: piña, banano, maracuyá, palmito y pimienta; que requieren mayores insumos o mayor capital, así como más experiencia y habilidades técnicas de parte de los productores. Desde el punto de vista económico, la demanda de hojas de la coca, contrariamente a la de los cultivos alternativos, excede a la oferta, por lo que los precios de la coca tienden a subir. El cultivo de coca es, en este sentido, más ventajoso, porque les deja a los agricultores mayores ingresos que a aquellos que reciben de los cultivos alternativos. La comercialización de las hojas de la coca, así como su transporte, es relativamente fácil, principalmente por la escasa exigencia de calidad por parte de los compradores. La posibilidad de venta rápida –y, en cierta medida, garantizada– de las hojas de coca favorece claramente su cultivo, comparada con la de los productos alternativos. Sin embargo, muchas de las ventajas mencionadas del cultivo de coca, respecto a las de los cultivos alternativos, se ven desfavorecidas por la prohibición y el combate a los cultivos de coca por parte del estado.

Palabras claves adicionales: cultivos alternativos, mercado agrario, mercadeo agrario, desarrollo alternativo, comparación de beneficios entre cultivos

Fecha de recepción: 10 de noviembre de 2005
Aceptado para publicación: 11 de mayo de 2006

¹ Profesor asistente, Facultad de Agronomía, Universidad Nacional de Colombia, Bogotá. e-mail: jcbarrientosf@unal.edu.co

² Profesor, Instituto para Política Agraria, Investigación de Mercado y Sociología Económica, Universidad de Bonn (Alemania). e-mail: schug@agp.uni-bonn.de

Introduction

AN AREA OF APPROXIMATELY 2,500-3,000 HA was being cultivated for coca in the tropical colonised region of Cochabamba until the early 1970s (CIDRE, 1989). It covered the population's "traditional" consumption, particularly that of the rural population. Despite a Law passed in 1973 (Barrientos, 2005) restricting coca cultivation in non-traditional areas (the major area of coca cultivation in this region), the total cultivated area gradually expanded from the mid 1970s onwards, reaching its peak of around 40,000 ha in 1989. The government had already intervened against such expansion some years before. The Prodes (in Spanish, Proyecto de desarrollo Chacabamba-Yungas) development project was implemented without success between 1975 and 1980. Between 1981 and 1985 the government again tried to reduce coca fields by introducing a voluntary and compulsory reduction programme (the new "controlled substances law") but this also led to no positive results. From 1986 to the early 1990s the government first carried out "the three-year fight against drugs' plan" followed by the "the integral development and substitution plan"; both had little success in reducing coca production (Barrientos, 2005).

Law 1008 (coca regime and controlled substances law) was intended to reduce and control coca cultivation through a new alternative development programme based on controlling the production, transport and marketing of coca leaves, substituting coca cultivation for legal crops and controlling cocaine production and trafficking (Cardozo et al., 1999; Rojas, 2002). This programme's first years promoted an understanding of the crops which might replace coca being planted and the methods pertaining to such substitution. There was a massive introduction of selected crops such as pineapples, banana, passion fruit, palm (for palm hearts) and pepper at the beginning of the 1990s.

While the area devoted to legal crops increased (reaching about 24,000 ha during 2002), coca plantations in this region had become reduced to about 7,500 ha by 2002 (Dai-Concade, 2003; Barrientos, 2005). Following the boom in alternative crops, farmers again began to cultivate coca from 2000 in contravention of Law 1008 so that the area covered by coca fields was around 28,000 ha in 2005. Numerous factors are responsible for continued coca production. This research analysed pertinent technical and economic aspects to ascertain why farmers choose to remain imbrued in the coca culture. A technical and economic comparison is made between

producing and marketing coca and alternative crops to establish the most influential factors determining why farmers continue to cultivate coca.

Methodology

This study was based on documental and descriptive research. Quantitative (secondary data) and qualitative data were considered when analysing the problem. Cultivating bananas, palm hearts, passion fruit, pineapples and pepper (being five important alternative crops in this development programme) was compared to coca to establish the most important factors determining farmers' decisions to cultivate coca. Four important aspects were considered: production, market, marketing and the benefits obtained from each crop. A question and hypotheses concerning each aspect were formulated to make analysis easier.

Results and discussion

Is cultivating coca technically easier than cultivating alternative products?

Coca plant requirements such as climate, soil, necessary cultivation work and the need for inputs must be compared with the demands of alternative crops to answer this question. The farmers' experience regarding cultivating suitable products and their associated risks is closely examined.

The coca plant makes less demand for good soil conditions and its adaptability to the region is greater than that of alternative crops

The coca plant (*Erythroxylon huanaco*) is a ligneous, evergreen shrub which is adaptable and undemanding regarding the soil and climatic conditions of those regions where it is cultivated. It grows without difficulty on acid, shallow and slope soils typical of the humid tropics, tolerates intense shade, full sun, weathers longer dry periods and short-term parched water table. The coca plant is able to settle at altitudes up to 2,000 masl (the Cochabamba tropical region lies at 200-1,200 masl) and tolerates an extensive temperature range as well as high air humidity (Cordep-Dai, 1999; SPI Consultora, 1987; Matteucci, sf; Pohlan, 2001 in Torrico, 2002). The tropical-subtropical region of Cochabamba is outstandingly suitable for cultivating coca in spite of high rainfall and great soil variability. This was confirmed by copious crop acreages mainly being established when regions were colonised from the mid 1970s to the end of the

1980s. Although coca plants do not grow and produce equally well everywhere, they provide their producers with the expected profitable yields; coca plantations can be profitably farmed for up to 60 years, depending on soil fertility and care (Sanchez, 2002).

Regarding soil and climatic conditions, the so-called alternative crops are generally more demanding and less adaptable than coca; an appropriate location must be selected for each individual crop for profitable production. Pineapples (*Ananas comosus* L. Merr.) need up to 2,000 mm annual rainfall (there are 2,550-4,500 mm in the study area), a loamy or loamy-sand soil with good drainage and an altitude of up to 1,000 masl; however, it cannot withstand extremely low temperatures. The roots of the pineapple plant begin to putrefy on badly drained soils having more than 2,000 mm rainfall. Altitudes over 300 masl as well as a temperature of less than 15 °C (the Cochabamba tropical region is 15 °C-34 °C) can affect growth and the beginning of blossom-time. If temperature drops to less than 7 °C for only a few days it can cause fruit damage (Rizzo, sf; Infoagro; Corporación Proexant).

The same holds true for bananas (*Musa paradisiaca*). Banana plants need deep, well-drained loamy or loamy-clay soils at an altitude of less than 300 masl for optimum growth, as well as an annual 1,500-1,900 mm rainfall and a temperature of around 25 °C. Such conditions in the tropical region around Cochabamba are, however, available only on a limited basis. Low-lying fields in the vicinity of large rivers are frequently inundated. Habitat for banana plants exceeding 500 masl is associated with retarded growth; temperatures below 10 °C (which can damage the fruit) occur here during the winter more frequently than elsewhere (IBTA/Chapare, 1996; Ocampo, 1996; Rizzo, sf; SPI Consultora, 1987).

Soil is also an important factor for passion fruit (*Passiflora edulis*); it has to be fertile, well-drained and loamy-sand to loamy-clay. Excessive rainfall exceeding 1,800 mm per year, which is not rare in the tropics of Cochabamba, may particularly harm the lower parts of the plants (Corpei, 2001; Cordep Dai, 1999; Planthogar, 2004; Sica, 2001). The choice of location regarding soil characteristics is also very important for palm heart (*Bactris gasipa* HBK) production. Although this plant is considered to be robust because it is able to grow nearly everywhere in the tropics of Cochabamba (like the coca tree), it requires fertile, well-drained soils to be economically profitable. Infertile and badly-drained soils sub-

stantially retard palm heart growth and harvest (Brenes et al., 1999; Inturias, 1996; Fieam; Portal Agrario).

The selection of soil is even more important for pepper (*Piper nigrum* L.) crops than palm cultivation because, apart from reduced crop yield, infertile and badly-drained soils may be life-threatening for the plants. High rainfall of more than 2,000 mm per year weakens the plants and makes them more susceptible to disease (Ecuagro; Infoagro; Rizzo, sf).

The alternative crops require lower manpower than coca

Not so many activities need to be carried out when cultivating coca compared to alternative crops, particularly if a plantation has already been established (table 1). However, weed and pest control, as well as harvesting, do require a large work-force, especially during the harvest; this obviously leads to providing many jobs in rural areas. Such labour, mainly provided by the farmers and their families themselves, is particularly concentrated on the harvest which is carried out four times a year; appropriate weed control is implemented immediately after harvesting. This leaves farmers with comparatively long continuous periods for carrying out other economic activities. The soil is prepared in the same way in this area for nearly all crops; i.e. the forest is cleared, with leafy branches being left for scorching after having been dried. This procedure not only manures the soil with valuable mineral constituents but also decreases soil acidity. Furrows are ploughed and pits dug in these scorched fields into which the seedlings are then transplanted.

Although alternative products take less time for cultivation than coca, the different cropping activities are

Table 1. Manpower and input requirements for producing coca and alternative crops.

Important labour in cultivation	Coca	Alternative crops*				
		Pineapple	Banana	Passion fruit	Palm hearts	Pepper
Total daily labour per year	280	231	117	194	133	215
Total input costs (us\$/ha/year in 2002)	230	1410	955	935	1155	5435

References: Revised edition by author based on Direco, 2002; España/Ballon, 2002; Barrientos, 2003.
 * Pineapple variety: 'Cayena Lisa'; planting density: 35,000 plants/ha; technology: commercial.
 Banana variety: 'Cavendish'; planting density: 1,800 plants/ha; technology: commercial.
 Passion fruit variety: 'Golden Star'; planting density: 1,333 plants/ha; technology: commercial.
 Palm heart variety: 'Macrocarpa'; planting density: 7,000 plants/ha; technology: commercial.
 Pepper variety: 'Guajarina'; planting density: 2,000 plants/ha; technology: commercial (deadwood stakes)

distributed throughout the year; consequently, not much contiguous time remains for other work. Banana producers have to mark the fruit's age each week (Quispe, 1996) and harvest almost weekly. The same holds true for passion fruit cultivation, the difference being that the harvest occurs only between October and July (Cordep-Dai, 1999). It must be mentioned at this point that alternative products have a shorter productive cycle than coca, i.e. they have to be replanted every 2-3 (pineapples and passion fruit) or 10 (bananas, palm and pepper) years (Dai-Concade, 2003) whereas coca plants have to be replanted after 40-60 years. Additional manpower needs thus arise in alternative cultivation.

Coca cultivation demands lower input than that of alternative crops

As coca is a relatively robust plant it requires less maintenance than many other crops. Besides, coca is still cultivated according to traditional methods, i.e. fewer chemicals are used, this being an environmentally-friendly technique (table 1). Lower input results in lower costs, an advantage for the farmers who often have only a small amount of capital available. The costs involved in new planting do not arise until later 40-60 years and those for further tools only after 3-5 years. Cultivating alternative products is more costly than coca cultivation. The costs of coca cultivation are 4 times less than that of bananas and passion fruit and even 20 times less than those for pepper. Alternative crops generally require the use of more chemicals and materials for stakes, plastic bags, etc., by contrast with coca cultivation. Moreover, apart from the higher costs involved, new young plants have to be purchased in shorter cultivation cycles than for coca crops.

The farmers have more experience in cultivating coca than alternative crops

Farmers do not need special expertise for successfully cultivating coca as the coca plants and their consumers are not so demanding. Local knowledge is gained from neighbours and learned and applied through their own work in the fields. Most farmers from the tropical region of Cochabamba emigrated from the valley and surrounding mountainous regions from the end of the 1970s to the end of the 1980s. As they wanted to become coca producers, they immediately began cultivating coca, although lacking knowledge at the beginning. The prospect of easy and quickly-earned profits spurred them on to learn quickly at the time.

By contrast, farmers need longer training for successfully cultivating alternative products. Passion fruit, palm hearts and pepper were new crops and still are so for many farmers. As well as the buyers who insist on large quantities of good quality products, these crops are more demanding than coca plants. Farmers also do not have enough capital to comply with all technical cultivation recommendations.

Is the coca market more favourable for farmers than the alternative products' market?

Demand for coca is greater than its supply

Coca production directly depends on the size of the cultivated area, this being decided by the demand for coca leaves, and indirectly on the demand for coca on the world market, governmental control of coca production and the fight against cocaine manufacturing and marketing. The total area covered by coca plantations in Bolivia, Colombia and Peru hardly changed between 1990 and 2001. It varies around 200,000 ha (figure 1). Not until 2001 did coca plantations decrease in Colombia as a result of nationally-controlled, large-scale reductions. Coca cultivation and production became drastically reduced in Bolivia starting from the second half of the 1990s, particularly in the tropical region around Cochabamba (figure 1). The demand for coca and cocaine became considerably increased during this time as the supply of coca decreased. According to UNODC data (2004), coca leaf consumption rose by about 9.3% between 1992 and 2002 and that of cocaine by about 2.5%, these being small but positive increases, meaning that decreasing coca production faces increasing demand. It can thus be assumed that the demand for coca exceeds supply at present, making additional coca production appear desirable for the farmers.

However, the relationship between supply and demand is very different regarding alternative products. Consumption-mature pineapples and common edible banana production and supply are clearly increasing (albeit fluctuating) as is importing countries' demand for these products, though at a lesser rate (demand being more stable than supply). Fluctuating supply has a more favourable effect on producing countries' domestic consumption than on the demand of importing counterparts; it can thus be determined that the export market for the sale of pineapples and bananas is somewhat safer than the domestic one. The pepper

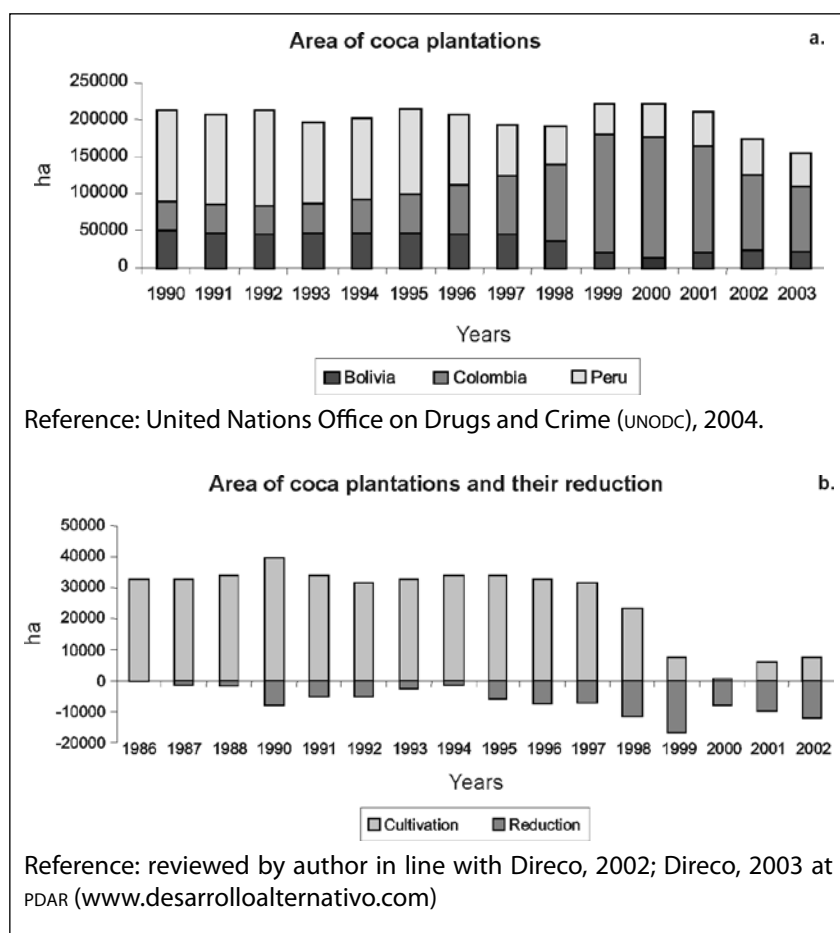


Figure 1. Area of coca plantations in: a) Bolivia, Colombia and Peru, and b) the Cochabamba tropical region in Bolivia.

market is a relatively saturated market, as opposed to other agricultural commodities' markets; speculation is possible due to the product's long storage quality. Supply and demand fluctuate in cycles of around 10 years (table 2).

and fresh pineapples are too high and passion fruit and pepper are produced in too little quantity.

The supply of alternative products from the Cochabamba tropical region has increased due to the expan-

Palm hearts are usually tinned, thereby considerably extending their non-perishability. According to Viscarra (2003), 16,000 t of palm hearts reached the world market in 1999; about a quarter was imported by the United States of America and they doubled palm heart imports between 1995 and 2001. This suggests an upward trend in the consumption of palm hearts world-wide. A similar tendency has been displayed in the consumption of passion fruit which is mainly exported as concentrated juice (Praedac, 2002).

Based on Central Bank of Ecuador (Corpei, 2001) data, around 50,000 t of passion fruit juice were exported worldwide in 2000. Ecuador alone increased its exports from around 5,000 t in 1995 to about 27,000 t in 2000. The biggest markets for all the alternative products mentioned are the European Union and the USA (except for domestic markets) where there is fierce competition among exporting countries regarding price and product quality. Bolivia currently only supplies these markets with palm hearts as transportation costs for edible bananas

Table 2. World production (= consumption) and world import (in tons) of pineapples, bananas and peppers.

Product*	Years										
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Ba _{prod}	53	56	56	55	61	60	65	65	66	69	71
Ba _{imp}	11	12	13	14	14	13	14	14	14	14	15
Pi _{prod}	13	13	13	13	13	12	14	14	15	15	16
Pi _{imp}	3	3	3	3	3	3	3	3	4	4	5
Pe _{prod}	242	223	237	239	235	254	295	310	353	372	399
Pe _{imp}	168	177	174	192	200	237	271	270	321	374	385

Reference: author review based on FAOSTAT data, 2004.

* Ba_{prod} = banana production (millions of tons), Ba_{imp} = banana imports (millions of tons), Pi_{prod} = pineapple production (millions of tons), Pi_{imp} = pineapple imports (millions of tons), Pe_{prod} = pepper production (thousands of tons), Pe_{imp} = pepper imports (thousands of tons).

sion of the area being cultivated (table 3) and increased yield (table 4). Pineapples, bananas and palm hearts are offered for both domestic and foreign markets whereas passion fruit and pepper are just for domestic trade. The farmers are of the opinion that the home market is already saturated with pineapples and bananas and they therefore fear that increased production could lead to price decay, although potential demand still exists in theory in the non-producing areas of Bolivia.

Domestic consumption demand for palm hearts (fresh as well as tinned) is limited. This is due to high prices and the population's traditional consumer habits which do not recognise palm hearts as being foodstuff. On the contrary, the food industry has caused demand for passion fruit, palm hearts and pepper to be larger than supply, just as the demand for pineapples and edible bananas for export (Barrientos, 2003). Apparently limiting factors leading to this imbalance are low prices for producers (palm hearts and pepper) and deficient product quality regarding export goods (pineapples and bananas). Above all, greater efforts are required from the farmers concerning their labour and capital to ensure balance between supply and demand.

The prices for alternative products have dropped by contrast with coca prices

The price for coca usually reacts sensitively to changes in supply whilst demand generally remains elastic. Coca cultivation became reduced from 1986 in the Cochabamba tropical region, intensifying again just before 1990. However, the price of coca has increased nearly continuously, reaching a tempting level for coca producers in recent years (table 5a). As opposed to coca, most alternative products' prices have presented a downward trend (table 6), becoming clearer in 1998-2002. Two price margins exist for pineapples and edible bananas, one being for the home market and the other for the export market. Better quality fruit belongs to the export market where higher prices are usually paid. Of the five alternative products, palm hearts and pepper were subject to a sharper price decrease from 1998-2002. Increased international palm hearts supply caused a lowering of prices due to the substantial increase in producing countries' production, particularly that of Costa Rica, Brazil, Ecuador and Venezuela (Mercanet, 2002). The price of pepper evolved in a similar way (having already known 10 year-cycle price fluctuations). The decline in

Table 3. Areas cultivated for pineapple, banana, passion fruit, palm hearts, and pepper in the tropical region of Cochabamba (Bolivia).

Cultivated area (ha)	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Pineapple	2608	3355	2200	3424	3804	3952	1668	1856	2012	2325
Banana	10762	12408	13600	14190	10968	13559	12450	14442	15309	16075
Passion fruit	63	85	45	52	130	77	80	112	148	162
Palm hearts	227	309	600	642	3321	4876	2980	3052	3160	5157
Pepper	24	31	40	34	79	61	163	278	356	408

Reference: Dai-Concade, 2003.

Table 4. Development of yield (t/year) of pineapple, banana, passion fruit, palm hearts, and pepper in the tropical region of Cochabamba (Bolivia).

Crop ¹	Annual yield (t/year)				
	1993	1995	1996	1998	2002
Pineapple	-	-	12,97 (a)	-	35-41 (b)
Banana	5,4 (c)	6,6 (c)	13,1 (c) - 26,4 (a)	16 -37 (c)	18-31 (b)
Passion fruit	1,1 (c)	1,73 (c)	6,1 (c)	5,19 (c)	7,0-9,6 (b)
Palm hearts	-	0,02 (c)	0,04(c)	0,15(c)	0,45-0,70 (b)
Pepper	-	-	-	0,015 (c)	0,825-1,18 (b)

References: author review based on: (a) Cordep-Dai, 1997; (b) Dai-Concade, 2003; (c) Cordep-Dai, 1999; (d) Brenes et al., 1999.

¹ An average 1.8 kg/fruit unit weight was used for pineapples, an average 92kg/"chupa" weight was used for bananas, an average 200g/"palmito" weight was used for palm hearts and the first value for pepper stands for plantations having living stakes and the second for plantations having deadwood stakes.

Table 5. Prices for coca leaves and alternative products.

a) Average annual prices for coca (Bs/100pounds).

86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02
152	143	152	153	72	164	160	251	238	309	276	372	378	828	1596	1693	1885

Reference: INE, Jul.2002, p 325; Direco, 1988, p 28-30; INE, 2004.

b) Average annual prices for alternative products (Bs/kg).

Product	Sale location	Annual prices			
		1992	1996	1998	2002
¹ Pineapples	Domestic market	0.77 - 1.53 (a)	0.91 - 1.78 (b)	0.55 - 1.10 (c)	0.64 (d)
	Export market	—	—	1.07-1.38 (f)	0.96 (d)
² Bananas	Domestic market	0.08 (a)	0.13 - 0.25 (b)	0.33 (f) - 0.56 (c)	0.17 - 0.45 (d) 0.20 - 0.52 (g)
	Export market	0.33 (a)	0.33 (b)	0.75 (c) - 0.81 (f)	0.47 (d) - 0.62 (g)
Passion fruit	Domestic market	0.92 (a)	1.27 (b)	1.23 (e)	1.22 (d)
				1.2-1.5 (f)	
³ Palm hearts	Domestic market and export market	—	10.16 (b)	7.44 (c)	3.95 (d)
				7.5 - 9.0 (f)	
Pepper	Domestic market	—	10.16 (b)	25.40 - 30.48 (c)	15.58 (d)
				22.04 - 24.80 (f)	

Reference: author review based on: (a) IBTA-Chapare, 1992; (b) Antezana, 1996; (c) Cordep-Dai, 1999; (d) España/Ballon, 2002; (e) Cordep-Dai, Jun.1998; (f) Cordep-Dai, Jul.1998; (g) Dai-Concade, 2003.

¹ Prices are valid for both 'Cayena Lisa' and 'Pucallpa' varieties and vary in product quality. ² For converting data, it was assumed that one export box weighs 22 kg and one "chupa", 90 kg. ³ For converting data, it was assumed that one palm heart unit weighs 200 g. These prices correspond to those paid by the industry.

Table 6. Annual transportation costs for coca and alternative products (Bs/ha).

Transportation costs	Coca	Alternative crops				
		Pineapple Y = 35 t/ha	Banana Y = 25 t/ha	Passion fruit Y = 8 t/ha	Palm hearts Y = 0,5 t/ha	Pepper Y = 1 t/ha
Bs/ha/year	330-1.100	5.833	2.777	800	250	100

Reference: Barrientos, 2003.

¹ Transporting pineapples, bananas and pepper from production area to the town of Cochabamba (Bolivia). Transporting passion fruit and palm hearts from production location to the next food industry in the tropical region of Cochabamba.

price is not currently as sharp as that for passion fruit; the production manager for EMCOPAIVI (a passion fruit processing company from the Cochabamba tropical region) has stated that passion fruit price will continue to drop in the future (Barrientos, 2003).

Is marketing coca easier than marketing alternative products?

The alternative product market has more demand for product quality than the coca leaf market

Coca has first to be processed after being harvested before coming onto the market. The crops are harvested manually, consisting of sun-drying followed by squashing the leaves by trampling on them and packaging them into bags holding 50 English pounds of coca (1 pound = 454

g) (1988). This happens just after the harvest if the weather is dry; harvested crops are stored until the next sunny hours or days if it rains during harvesting day. The longer such storage lasts, the worse the quality of the coca leaves becomes, particularly in humid and unventilated conditions even if the leaves have already been dried. They lose their economic value in the worst case due to oxidation or mould. Coca leaf quality refers to size, formation, maturity, chemical transformation during storage time and cleanliness, purity and area of origin. Coca leaves from the Yungas of La Paz are preferred for chewing contrary to those of Chapare which are bought for cocaine production. Size, formation, maturity, cleanliness, degree of purity and area of origin are not as crucial for quality as chemical transformation during longer storage time caused by oxidation or fungal attack leading to coca leaves turning brown. Such brown leaves can still be sold despite

this quality-reducing change in colour, albeit at a lower price. The product rarely has to be rejected due to quality loss; product wastage is consequently very low.

Regarding the alternative products, much more attention is paid to quality compared to coca; however, pineapples and bananas are sold on domestic markets as long as they are eatable. Home market customers are less demanding whilst only fruit of a certain quality is accepted for export. Size, degree of maturity, cleanliness, health condition, colour and weight are examined. The same also holds true for palm hearts and passion fruit which are mainly purchased by the catering industry. Small, broken, dried or oxidised palm hearts are mostly rejected, just like immature and burst passion fruit which are usually thrown away. Pepper is not homogenous and is often impure if prepared manually by the producers themselves; this and fungal infestations caused by unfavourable storage reduce the value of pepper on the market. The product completely loses its economic value if mouldering is extreme, which is not uncommon in the humid tropical region of Cochabamba. Deficient quality fruit being rejected by the market causes a loss for the producers; such losses caused by packing centre or food industry refusal amount to around 8% in pineapples, 20% in bananas and 8% in both passion fruit and palm hearts (Barrientos, 2003).

Transporting coca leaves is easier than transporting alternative products

The coca leaves, packed in 50-pound bags, are transported on the farmers' shoulders or by bicycle from the fields to the closest country road or up to the nearest market (DIRECO, 1988). Public means of transport such as taxis, small or large trucks as well as buses are used for longer distances in areas having roads; transport cost per bag varies depending on coca price and transportation distance. Prices range from 3 to 10 Bs per bag within the production area (Barrientos, 2003). One hectare yields around 2.5 t dried coca leaves annually, being approximately 110 bags per year and 27 bags per harvest every three months. Transporting coca leaves into the big cities, such as Cochabamba or Santa Cruz, costs about twice as much as transporting them within the production districts where leaf weight and relatively small volume simplifies transport. Coca plantations are also established where no roads are present due to this advantage.

A country road as close to the cultivated fields as possible is necessary for transporting leaves to market for

all alternative products (except for pepper). Only in this way can the relatively large harvest quantities – around 35 t · ha of pineapples, 25 t · ha of bananas, 8 t · ha of passion fruit and 0.5 t · ha of palm hearts (Dai-Concade, 2003) – be transported to market or the food industry (table 6). Transport costs vary depending on product weight and volume and the distance to the market. Transporting the yield from one hectare of pepper or palm hearts costs less than that of one hectare of passion fruit, bananas, pineapples and even coca. A small or large truck is needed for these products (except for pepper) to make transport profitable.

The sale of coca leaves is faster and more secure than that of alternative products

Selling coca leaves is not difficult as the demand for them is still larger than supply; there are sufficient purchasers at the farm-gate as well as in primary and secondary markets. Coca was mostly sold on farms in the tropical region of Cochabamba during the coca boom (mid-1970s to the end of the 1980s). As the largest part of such production went to manufacturing cocaine, the purchasers collected the coca leaves directly from the producer and paid in cash, even in advance. The coca was nearly always sold individually; common sales or something similar did not exist because it was not necessary. This contributes towards the conception of a successful agrarian trade from the coca growers' viewpoint.

The alternative products are sold on farms, at the market and in the food industry. The palm heart industry itself picks up palm hearts from the farmers' fields. Passion fruits usually have to be taken to the processing industry by the producers themselves. Part of the pineapple, banana and pepper production is purchased by the transporters at the farm-gate, another part is taken to the market by the producers themselves and a third part is sold to crop associations' packing centres. Pineapples and bananas taken to the packaging centres for export are sold by the crop associations, thus not on an individual basis; the same happens for passion fruit and palm hearts which go to the food industry (Barrientos, 2003). Alternative product demand was low and irregular during the mid-1990s to the end of the decade, with exception of traditional pineapples and edible bananas intended for the home-market. Food industry demand, particularly for palm hearts and passion fruit, increased from the beginning of 2000 as it did for pineapples and bananas for export. However, orders were irregular, making producers insecure and distrustful. Payment

on credit also contributed towards this, particularly regarding pineapples and bananas for export and passion fruit and palm hearts for industry. The time interval for final payment varied from 1-52 weeks for pineapples, 0-16 weeks for bananas and 1-12 weeks for passion fruit, palm hearts and pepper (Barrientos, 2003).

Is cultivating coca more profitable than alternative crops?

Cultivating coca was very profitable during the coca boom. Coca prices fell for a short time following national control being taken of both coca and cocaine production and trading and the reduction of coca plantations; however, they rose again when supply decreased. Coca cultivation is still currently the most profitable activity in the tropical region of Cochabamba. Annual capital expenditure can be exceeded by approximately 17-fold with the yield from one hectare. The need for capital (only being available to farmers on a limited basis) becomes considerably reduced once a plantation has become established.

Tables 7 and 8 show the annual volume of sales per hectare is much lower for alternative cultivations than for coca. The initial investment involved in the alternative crops is relatively high for the farmers in this area who only have an average total income of about us\$2,000 per family per year.

Most established plantations were only possible until today due to national subsidies because this has been the only way the farmers have been able to make a profit. However, this is not the case with all alternative cultivations. Farmers must increase crop yield and improve product quality to make a considerable profit in banana-, passion fruit-, pepper- and particularly palm heart-cultivation or they will not make a profit, as is the case at present with palm heart cultivation.

Conclusions

Coca cultivation is technically easier than that of the alternative products. The coca plant's robustness makes it easy to care for (i.e. it needs little work to cultivate it and

Table 7. Production costs for coca and alternative products in US\$/ha* in 2002.

Level of investment		Crop					
		Coca	Pineapple	Banana	Passion fruit	Palm hearts	Pepper
Initial investment	Labour	680	707	479	825	885	765
	Input	230	1.410	955	935	1.155	5.435
	Total	910	2.117	1.434	1.760	2.040	6.200
Annual investment	Labour	723	561	255	476	488	510
	Input	55	685	505	225	155	569
	Total	778	1.246	760	701	643	1.079

Reference: author review based on DIRECO, 2002; España/Ballon, 2002; Barrientos, 2003.

* 1 us\$ = 7.5 Bs in 2002.

Table 8. Average annual sales in Bs/ha of coca and of alternative crops in 2002.

Annual sales	Crop						
	Coca	Pineapple	Banana	Passion fruit	Palm hearts	Pepper	
Annual yield (t/ha)	2.5	35	25	8	0.5	1	
Prices (Bs)	Per bag (50 pound)	942	—	—	—	—	—
	Per fruit unit (1,8 kg)	—	1.2 / 1.8	—	—	—	—
	Per palm hearts (200 g)	—	—	—	—	0.7	—
	Per "chipa" (90 kg)	—	—	25 - 42	—	—	—
	Per bag (50 kg)	—	—	—	—	—	500
	Per kg	—	—	—	1.3	—	—
Earnings (Bs/ha)	103,744	23,333 - 35,000	6,944 - 11,667	10,400	1,750	10,000	

Reference: Revision by authors based on Dai-Concade, 2003; Barrientos, 2003; INE, 2002.

little production input, thereby minimising the need for capital). The experience gained by the farmers in a short time is completely sufficient for cultivating the unassuming coca plant. Reduced supply combined with slightly rising demand results in high prices, making the coca market the most attractive one for farmers at present. In theory, the entire production could be sold quickly and at a good price. The alternative products are affected on the market by the demand for quality, decreasing prices and strong competition, contrary to coca.

Coca leaves are easy to market, returning a high profit which is substantially attained with less effort compared to most alternative products as demand exceeds supply and most buyers in the production areas purchase directly on farm. Coca leaves are also easier to transport and there are no quality and quantity restrictions.

Coca cultivation is without a doubt the most profitable cultivation in the tropical region of Cochabamba at present. There is much to be said for it; only a small amount of investment capital is needed at the same time as little agricultural experience, not much land and little investment of time; however, the amount annually invested in the crop is returned several times. Many farmers thus risk their time, money and even their liberty by facing the threat of arrest because of being involved in illicit coca cultivation; however, making quick and easy money counts for more for these farmers, at least compared to possible alternatives. The stated development programme must ensure the best conditions for producing and marketing legal products accompanied by capital investment, experience and infrastructure for successfully substituting coca plants by alternative crops.

Many of the aforementioned advantages associated with coca cultivation are due to its being "illegal" and "nationally controlled" compared to any other crop. There is thus no product directly competing with coca, the coca market is not saturated and attainable profits are high. If coca were not the raw material for cocaine it might not be the ideal crop for farmers in the Cochabamba tropical region.

References

Antezana, O. 1996. Ficha técnica-económica: banano – flujo de costos e ingresos para una hectárea (us\$), Cordep-Dai. Cochabamba (Bolivia).

Barrientos, J.C. 2003. Encuesta a agricultores y expertos sobre los cultivos alternativos a la coca. First results of the empirical analysis. Bonn (Germany). 20 p.

Barrientos, J.C. 2005. Vermarktung der den Kokaanbau ersetzenden Alternativen Produkte der Tropen von Cochabamba (Bolivien). Doctoral thesis. University Friedrich-Wilhelms, Bonn (Germany).

Brenes, R. et al. 1999. Estudio de la producción del subtrópico de Cochabamba y la comercialización en el mercado boliviano. Palmito cultivado, maracuyá y pimienta negra. Dai-Concade. Cochabamba (Bolivia). pp. 9, 16.

Cardozo et al. 1999. Cifras y datos del desarrollo alternativo en Bolivia. Centro de documentación e información Bolivia. Talleres Gráficos Kipus, Cochabamba (Bolivia). pp. 52-94.

Cidre (Centro de Investigación y Desarrollo Regional). 1989. Monografía del trópico, Departamento de Cochabamba, Cochabamba (Bolivia). 510 p.

Cordep-Dai (Proyecto de Desarrollo Regional de Cochabamba - Development Alternatives Inc.). 1999. Guía informativa: banano, piña, palmito, maracuyá y pimienta. Cochabamba (Bolivia). pp. 1-2.

Cordep-Dai. 1998. Guía informativa: banano, piña, palmito, maracuyá y pimienta. Cochabamba (Bolivia).

Cordep-Dai. 1997. Guía informativa: banano, piña, palmito y maracuyá. Cochabamba (Bolivia).

Corpei (Corporación de Promoción de Exportaciones e Inversiones). 2001. Product profile: sour passion fruit concentrate. In: Servicio de Información y Censo Agropecuario, <http://www.sica.gov.ec/agronegocios/productos%20para%20invertir/CORPEI/maracuyá.pdf>; consult: february 2004.

Corporación Proexant (Promoción de exportaciones agrícolas no tradicionales). Piña: cultivo, cosecha y postcosecha. In: Corporación Proexant, <http://www.proexant.org.ec/Manual%20de%20pi%C3%B1a.htm>; consult: february 2004.

Direco (Dirección General de Reconversión Agrícola). 2002. Coca in numbers. Cochabamba (Bolivia). pp. 3, 5, 8.

Direco. (Dirección General de Reconversión Agrícola). 1988. Producción de coca. Cochabamba (Bolivia). 162 p.

Dai-Concade (Development Alternatives Inc. - Proyecto Consolidación de los Esfuerzos del Desarrollo Alternativo). 2003. Oportunidades inexploradas de negocios. Guía para inversionistas. 5th edition. Dai-Concade. Cochabamba (Bolivia). pp. 19, 22, 24-26.

Ecuagro. La pimienta. In: Ecuarural, http://www.ecuarural.gov.ec/ecuagro/paginas/cult_org/paginas/pimienta.htm; consult: march 2004.

España/Ballon. 2002. Costos de producción e ingreso de 1 ha de piña, de 1 ha de banano, de 1 ha de maracuyá, de 1 ha de palmito y de 1 ha de pimienta. Proyecto Concade, Cochabamba (Bolivia).

Faostat. 2004. In: Food and Agricultura Organization, <http://faostat.fao.org/>; consult: march 2004.

Fieam (Federação das Indústrias do Estado do Amazonas). Pupunha. In: Fieam, <http://www.fieam.org.br/invest/pupunha.htm>; consult: february 2004. Amazonas (Brazil).

Ibta/Ch (Instituto Boliviano de Tecnología Agropecuaria/Chapare). 1996. Manejo integrado de plagas (MIP) en el cultivo de banano. Cochabamba (Bolivia). pp. 6.

Ibta/Ch (Instituto Boliviano de Tecnología Agropecuaria/Chapare). 1992. Costo de operación e ingreso estimados: piña, banano, maracuyá, palmito, jengibre, cítricos, pimienta, achiote, café, coca. Cochabamba (Bolivia).

Ine (Instituto Nacional de Estadística). 2002. Anuario estadístico 2001. Génesis Publicidad e Impresiones, La Paz (Bolivia). 561 p.

- INE (Instituto Nacional de Estadística). 2003. Precio de la hoja de coca según mes (1992-2002). In: INE, <http://www.ine.gov.bo/>; consult: october 2003.
- Inturias, G. 1996. El cultivo del tembe en el Chapare. IBTA/Ch, Cochabamba (Bolivia).
- Infoagro. 2004a. El cultivo de la pimienta. In: Infoagro, <http://www.infoagro.com/aromaticas/pimienta.asp>; consult: february 2004.
- Infoagro. 2004b. Cultivo de piña. In: Infoagro, http://www.infoagro.com/frutas/frutas_tropicales/pina.htm; consult: february 2004.
- Infoagro Bolivia. 2002a. Cadenas agroindustriales: bananos y plátanos. In: Infoagro Bolivia, <http://www.infoagro.gov.bo/>; consult: february 2004.
- Infoagro Bolivia. 2002b. Acuerdo de competitividad de la cadena del banano. In: Infoagro Bolivia, http://www.infoagro.gov.bo/previos_panorama/acuerdos_p.htm; consulta: january 2004.
- Matteucci, S. et al. sf. Aspectos ecológicos del cultivo de la coca. In: Grupo de Ecología del Paisaje y Medio Ambiente, <http://www.gepama.com.ar/matteucci/downloads/Coca.pdf>; consult: october 2003.
- Mercanet. 2002. Palmito: noticias y comercio internacional. 1st Bulletin, 7th year. In: Mercanet, <http://www.mercanet.cnp.go.cr>.
- Ocampo, L. 1996. Banano. Chapare y Carrasco tropical: producción, mercados, tecnología de maduración y conservación. La Paz (Bolivia). pp. 7-9.
- Portal Agrario. Pijuayo. In: Portal Agrario del Ministerio de Agricultura del Perú. http://www.portalagrario.gob.pe/rrnn_pijuayo.shtml; consult: february 2004.
- Planthogar. 2004. Pasionaria, flor de la pasión. In: Planthogar, <http://www.planthogar.net/enciclopedia/ficha.asp?id=165>; consult: february 2004.
- Praedac (Programa de apoyo a la estrategia de desarrollo alternativo en el Chapare). 2002. Estudio de comercialización y mercadeo de productos del desarrollo alternativo bajo el Sistema de preferencias generalizadas (SPG) de la Unión Europea. Cochabamba (Bolivia). 117 p.
- Rizzo, P. sf. Piña de exportación. In: Servicio de Información del Censo Agropecuario del Ministerio de Agricultura del Ecuador, <http://www.sica.gov.ec/agronegocios/Biblioteca/Ing%20Rizzo/nuevos%20exportables/pina.htm>; consult: february 2004.
- Rojas, F. 2002. La economía de la coca. Paper. Instituto de Investigación, Universidad Católica Boliviana, La Paz (Bolivia). pp. 10-17.
- Sánchez, F. 2002. Chapare - Mito y realidad. Fondo Editorial de los Diputados, La Paz (Bolivia). 67 p.
- Sica (Servicio de Información del Censo Agropecuario). 2001. Maracuya passion fruit. In: Servicio de Información del Censo Agropecuario del Ministerio de Agricultura del Ecuador, http://www.sica.gov.ec/agronegocios/productos%20para%20invertir/frutas/maracuya/maracuy_mag.pdf; consult: february 2004.
- SPI Consultora. 1987. Estudio de mercado de frutas del Chapare. Cochabamba (Bolivia). pp. 5-6, 139.
- Torrico, J.C. 2002. Alternativen für die Transformation von Drogengebieten in Bolivien – Ergebnisse aus dem Gebiet Chapare für Nutzungssysteme und Anbaustrukturen. University of Bonn, Bonn (Germany). pp. 18. 112 p.
- UNODC (United Nations Office on Drugs and Crime). (2004). World drug report 2004. In: United Nations Office on Drugs and Crime, http://www.unodc.org/pdf/wdr_2004/wdr_2004_presentation.pdf; consult: october 2004. 63 p.
- UNODC (United Nations Office on Drugs and Crime) and Government of Bolivia. 2004. Bolivia coca cultivation survey. In: United Nations Office on Drugs and Crime, http://www.unodc.org/pdf/bolivia/bolivia_coca_survey_2003.pdf; consult: march 2004.
- Viscarra, A. (2003). La cadena productiva de palmito. In: Sistema Boliviano de Productividad y Competitividad (SBPC) del Ministerio de Desarrollo Económico, <http://www.boliviacompetitiva.org.bo/>; consult: february 2004.