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The Coca Economy in the Upper Huallaga

Summary

The cooperative USG/GOP effort to stem the flow of coca from the Upper Huallaga (UH) is based on a two-pronged approach: on the one hand, eradication and interdiction, on the other, provision of alternate income to cultivators. AID's concern is primarily with the latter, though the two are interdependent. An effective strategy requires a clear understanding of the role that coca currently plays in the regional economy. It is convenient to divide consideration of this role into two general areas: activities directly related to the cultivation and processing of coca leaf, and those indirectly dependent on the income generated from coca production. A great deal of study (of varying methodological quality) has been done in the first area while almost none has been done in the second. This memo summarizes and evaluates the existing information in each area and suggests directions for further study.

The major factual conclusions are:

-- Current AID estimates of 115,000 to 200,000 hectares of coca cultivation in the UH are probably too high. A range of 50,000 to 100,000 hectares is more likely. Primary support for this conclusion comes from studies of the availability of labor.

-- Dry leaf yield per hectare is probably higher than previously estimated. A figure of 1.3 metric tons per year is suggested as a conservative estimate (previous calculations have used 1.0).

-- Rather arbitrarily, a figure of 80,000 hectares is used to estimate the 1988 UH production of dry leaf at 104,000 metric tons. This represents at least 50% of the national total. The most important coca producing region after the UH is the Province of La Convencion, in the Department of Cuzco, with about 40,000 hectares under cultivation, though yields are somewhat lower than in the Upper Huallaga.

-- It is estimated that about 40% of UH production leaves the valley in paste form (375,000 kgs) and about 60% in the form of cocaine base (150,000 kgs).

-- The total value of this production is estimated at $540 million, of which $375 million accrues to cultivators, small scale paste producers, and wage laborers.

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-- In contrast, legitimate agriculture brings in less than $50 million, accounting for no more than 13% of the valley's agricultural GDP. Nevertheless, many cultivators produce both legitimate crops and coca (often in different locations), partly due to the intangible benefits associated with the former (easier access to health/education facilities and greater security for their families).

-- The valley's labor force is estimated at 78,000, including about 15,000 migrant workers from surrounding provinces. Of these, 52,000 work in agriculture. Legitimate crops account for about 25% of agricultural days worked, leaving a full-time equivalent of 40,000 workers available for coca production (although, as noted above, many split their time between coca and other crops). A minimum of 125 worker days annually is needed for the cultivation of one hectare of coca, assuming 4 harvests per year.

-- Wage laborers in coca earn about $12/day ($3,600/year), which is 2.5 to 8 times more than laborers in other crops. They account for about 65% (26,000) of the agricultural labor force. Cultivator/owners (14,000 total) gross about $3,900 per year from a hectare planted in coca, which is 3 to 11 times more than the value of other crops.

-- The remaining 26,000 economically active residents of the valley are involved in subsequent stages of coca processing and provision of secondary services (retail, transportation, financial, security, and personal). There are 150 retail businesses in Tingo Maria with annual sales totalling about $80 million, and a handful of stores/taverns in each of the smaller towns. A substantial portion of the income from coca production probably does not enter the local retail/service economy. Anecdotal evidence suggests that much of it is spent on consumer goods purchased in Lima or smuggled in from other countries.

-- Coca also represents a major cash source for the surrounding provinces. An estimated 20% of the economically active population, on a full-time equivalent basis, migrates to the selva to provide wage labor. Since migrants spends only part of each year in the selva, this figure actually represents a much higher percentage of the neighboring province work force that depends on coca for its main source of cash income.

Further study is recommended in the following areas:

-- labor requirements for all stages of coca processing
-- income levels of coca producers/laborers
-- structure of the coca labor market (degree of self-employment, role of coercion, amount of migrant labor, etc.)
-- involvement of terrorist groups in the coca trade
-- financing of coca cultivation and processing
-- number and income of secondary service providers

Improved information in these areas is needed to better calculate the requirements for providing viable alternative sources of income and the degree of resistance/acceptance that is likely to be encountered in the local population.

More information is also needed on the requirements and sources of supply for other inputs to the coca production process. Regulation of kerosene distribution, in particular, may be a fruitful approach to reducing coca production, given the large volume required for the conversion of leaf into paste (200-400 litres per kg of paste) and the fact that this activity must be performed near the point of harvest. A serious obstacle to this approach is the large number of distributors and wide variety of legitimate uses for kerosene.

Finally, concern with the Upper Huallaga should be complemented by increased attention to coca production in other areas of the country, particularly the Central Huallaga/Lower Mayo, Pichis/Palcazu/Pachitea, Maranon, Tambo, and Urubamba river valleys, which are likely to become increasingly important as production is displaced out of the Upper Huallaga. Better data is needed on the extent of current cultivation in these regions. Some sources estimate that the Department of Cuzco actually produces more leaf than the Upper Huallaga, though a more reasonable estimate would put the figure at about half as much. Note that this is still a significant amount.

Estimates of Coca Production

There are basically four stages in the production of cocaine: cultivation and harvesting of coca leaf (HC), transformation into raw paste (PBC-B), conversion into cocaine base (PBC-L), and final production of crystalline cocaine (HCl). In order to calculate the direct contribution of coca processing to the economy of the Upper Huallaga (UH), it is necessary to estimate the volume, unit value, and distribution of returns at each stage of production.

LEGAL PRODUCTION

It should be noted that a small amount of legal cultivation takes place each year, providing leaf for domestic "chewers" and legitimate pharmaceutical purposes. This production is regulated by the National Coca Institute (ENACO). According to official figures, the total area under cultivation in 1987 was 17,913 hectares, with 6,457 in the Upper Huallaga, 7,877 in the Department of Cuzco, and small areas in 10 other departments (1). Total Leaf production was 9,746 metric tons (TMs), with 1,981 coming from the Upper Huallaga. The price for dry leaf paid by ENACO is considerably lower than that paid by drug traffickers ($0.60/kg vs $3.60/kg). Because it is relatively insignificant, legal production will not be further discussed in this memo.

AREA UNDER CULTIVATION

By far the most study has gone into estimating the number of hectares under cultivation, which provides the basis for determining quantities at each subsequent stage of production. Unfortunately, because of the difficulties inherent in arriving at a reasonable figure, the existing estimates cover a wide range. Furthermore, most are based on information obtained in 1986-87 which makes it likely, given the rapid increase observed during the preceding decade, that the actual area has increased in the intervening 2-3 years.

AID estimated about 60,000 to 70,000 hectares (2) at the end of 1986, based on analysis of aerial photography done by NAU. At the current time, internal discussions generally assume that this has increased substantially, to between 115,000 and 200,000 hectares (3).

A March, 1988 study (1) by two students at the Escuela de Administration de Negocios (ESAN) arrived at the following figures, based on estimates gathered from published newspaper articles, for Peru as a whole in 1987: 150,000 using declarations by government officials from OFECOD, ENACO, and MAG; and 320,000 using "declarations by non-official persons and institutions familiar with the problem of coca production". Averaging these two numbers, they derived a figure of 230,000 hectares, of which they estimated (without saying how) that 80% was in the Upper Huallaga, giving a figure of 184,000 for the valley. They further estimated, based on growth trends since 1980, that an additional 20,000 hectares was added in 1988 (16,000 in the UH), giving a total for the valley in 1988 of 200,000 hectares.

Another study, conducted under the auspices of the Midamerica International Agricultural Consortium (MIAC) in October 1987 (4),

estimates the total 1986

area of coca cultivation for the country as a whole at 81,675 hectares, based on analysis of data from the Encuesta Nacional de Hogares Rurales. No methodology is given for this calculation.

The most methodological detail is provided in an October 1988 study (5) by the United Nations Development Programme (UNDP). The study uses four different methods to estimate maximum possible hectareage under cultivation in the Upper Huallaga in 1987: availability of suitable land area, availability of labor, analysis of aerial photography, and inflow of kerosene, a major ingredient in the production of PBC-B, to the region.

Land Use Potential

The first method, based on an analysis of land use potential, divides the valley using existing data (sources not specified) into different zones and then estimates the proportion of land in each of five categories: prime agricultural land suitable for annuals, poorer land suitable for perennials, pasture land, land suitable for forestry, and land not suited to agro/forestry exploitation. Based on this analysis, the following calculations are provided:

Total land area in the UH:	1,859,000	
Agricultural surface area:	192,702	
Land in use for legitimate crops:	69,381	
Official estimate of coca land:	30,183	
Pasture land:	10,238	
Fallow land:	82,796	
Needed to "stabilize production of legitimate crops (78% x 69,381)":		54,340
Available for coca production:		28,456
Additional forest land "potentially usable for agricultural within a short time:"	100,168	
Natural Pasture in Use:	25,000	
"Mountains and woods:"	61,736	
"Other land:"	13,432	
Maximum amount that might be in coca cultivation (61,736 + 13,432 x 10%):		7,516
TOTAL LAND POTENTIALLY AVAILABLE FOR COCA PRODUCTION (28,456 + 30,183 + 7,516):		66,155

It should be noted that there are several inconsistencies and ambiguities in the generation of these figures from the raw data, and that some of the assumptions in the above table seem highly arbitrary. For example, merely by assuming that no fallow land is being maintained for the "stabilization of legitimate crops" (on the theory that it can more profitably be employed in coca production) and that 30%, rather than 10%, of the land "potentially usable for agriculture within a short time" is currently planted in coca, the above estimate of total hectareage available for coca can be doubled.

Labor Availability

The second method, based on an analysis of the availability of labor, shows considerably more promise. Using projections from the 1981 census, the following demographic data is provided:

Total (1987) population of the UH:	169,758
Rural:	103,510
Urban:	66,248
Economically active (PEA):	63,954
Rural:	39,894
Urban:	24,060
PEA in agriculture:	36,817

Note that these figures for the PEA match those provided in the Upper Huallaga labor study (see below) and are roughly consistent with those currently in use by AID: 56,729 males aged 15-64 x 75% = 42,546 potentially available for coca cultivation/production (6). To the permanent PEA in agriculture living in the valley the study adds a maximum estimate for migrant labor of 20% of the total PEA in agriculture of the five neighboring provinces of Huanuco, Huamalies, Marañon, Pataz, and Coronel Portillo: 20% x 77,384 = 15,477. This gives a total of 52,294 potential agricultural workers in the UH.

The next step is to estimate the labor requirements for the legitimate crops in the valley, subtract this from the total amount available, and finally, using an estimate of the labor required per hectare of coca, calculate the maximum amount of coca that could be cultivated by the remaining workers. Two sets of figures are offered for agricultural labor requirements: one based on hypothetical estimates by the Tingo Maria branch of the Banco Agricola (BAP) assuming "techniques designed to produce a high yield per hectare" and the other, based on interviews with cultivators, of actual labor used per hectare. The second set of figures is much lower, possibly due to the shortage of labor generated by the coca boom. Using the BAP estimates, the total number of workers required to produce the legitimate crops grown in 1987 was 22,07: using the "actual" estimates, the figure is only 12,789. Assuming the lower number, this leaves 39,505 workers available for coca cultivation. Further assuming the "actual" (lowest) estimate of workers required per hectare of coca (125 worker days/hectare/year divided by 300 work days/worker/year = .42 workers/hectare/year) gives a maximum cultivable area of 94,059 hectares. It should be noted that the study itself presents a much lower figure for the likely area under cultivation of 42,000 hectares, using a higher estimate of .7 workers (208 worker days/hectare/year) needed for coca (7) and an average of the "actual" and BAP estimates of labor requirements for legitimate crops (giving 17,448 workers total), and by assuming that a more reasonable figure for migrant labor is 10% (rather than 20%) of the agricultural PEA of the surrounding provinces.

These calculations are based on two key factors for which additional evidence is available: extent of migration from neighboring provinces and labor requirements for cultivation.

Regarding the first, a survey of 101 families in a small village in the Sierra (fictitious name used, but location was "about 6 days walk west of Uchiza") found that in 1981, 18% of heads of families migrated to the Selva to work and 43% made shorter trips to trade (8). It was not stated how long workers stayed away, but in one "typical" example the length of time was 3 months. Extrapolating this pattern to all villages in the neighboring provinces would yield a migrant labor force of 5% of the PEA, computed on a full-time equivalent (FTE) basis (18% x 3 months/year). The wage cited for day laborers in coca was $2-$3/day, considerably lower than the $12/day reported by a subsequent study in 1987 (9), although the figure cited for the minimum legal wage ($1.60/day) was comparable to today's figure. It thus appears likely that labor demand, and migration along with it, has risen significantly since the 1981 study. Nevertheless, the 20% figure used in the above calculations represents a four-fold increase over the 1981 level. It seems reasonable to concur with UNDP in using this estimate as an upper limit. Note that the figure is an FTE; it could, for example, represent migration by 80% of the PEA for 3 months out of the year, or by 40% for 6 months.

Incidentally, an important conclusion suggested by these estimates is that in designing effective income substitution programs, attention must be paid to the impact of coca eradication on the economies of the neighboring regions, as well as its effects on the economy of the UH itself. Coca cultivation may well be the primary cash source for a much wider area.

Several studies provide supporting data on labor requirements for coca production. The ESAN study estimates (based on interviews with cultivators, traffickers, government officials, etc.) that 5 persons per hectare are required for harvesting and 3 persons per hectare for drying and bundling coca leaf. The study does not say for how long these 8 people work to complete one hectare, but concludes (using the previous figure of 230,000 hectares under cultivation in Peru in 1987) that "about 1,800,000 persons obtain their income from these activities" (of which presumably 80% must be in the Upper Huallaga)--this is clearly ridiculous. However, a USAID/Bolivia study (10) of coca production in the Chapare region estimates 200,000 workers involved in the cultivation and processing of only 28,300 hectares, which is roughly comparable to the ESAN figure. (The Bolivia study uses a very high yield/hectare figure of 2.5 TMs; this may partially explain an unusually high labor requirement.)

More useful figures are provided by a 1981 study done under contract to AID/Peru (11), which reported the following labor requirements per harvest for a hectare of coca:

Fertilizing and Pest Control:	6 worker days
Weeding:	20 worker days
Harvest:	15-20 worker days
TOTAL:	41-46 worker days
Times 4 harvests per year:	164-184 worker days

Note that these figures do not include initial clearing of the land. This study uses very low yield estimates: 170-230 kgs of

dry leaf per harvest. Presumably labor requirements for higher yields would be greater.

Support for these figures is provided by an August, 1987 study of the labor market in the Upper Huallaga (9) which estimates (based on interviews with cultivators) an average piece wage for harvesters of I/3 per pound and an average productivity of 80 pounds per day. The same study estimates 1,000 pounds/harvest/hectare (note this is fresh leaf) and 6 harvests per year, for a total of 6,000/80 = 75 worker days/hectare/year needed for harvesting. AID estimates specifying 4 harvests per year and about 1,500 pounds (626 kgs) per harvest yield roughly the same total amount harvested per year. Note that using NAU's estimate (12) of 6,000 plants per hectare, this amount of labor represents less than 2 minutes harvesting time per plant. Thus, even if we assume less time spent in weeding and fertilizing than the 26 days per harvest cited above, it seems reasonable to use .42 workers (125 worker days) as the minimum labor requirement per hectare, if the yield estimates we are using are correct. (One possibility is that some land, particularly in remote areas, is being cultivated less intensively, perhaps generating only 1 or 2 harvests per year. This would allow a larger area of cultivation with the available labor force, but with a lower yield per hectare, so that the effect on total production would be unclear.)

According to a recent article in The Peru Report (13), harvesters are paid by the "tarea," which equals one twentieth of a hectare, and workers who are "young and skillful" can pick up to three tareas in a day. This would imply that a hectare could be harvested with as little as 7 worker days of labor. On the other hand, it is clear from the wording of the article that 3 tareas per day is an upper limit on productivity. Although it is not specifically explained this way, it seems plausible that a "tarea" actually represents a day's work for an average worker, which would fit well with the estimates given above.

Based on all the available evidence, it seems reasonable to use the above figure of 94,000 hectares as the maximum area that the 1987 work force of the UH could support. Using AID estimates (6) of 8% population growth in 1988 (from 169,700 to 183,900), we can assume that in 1988, the maximum area of coca cultivation the work force could support was 100,000 hectares.

Aerial Photography

Based on aerial photography performed in 1985 and 1986 by the Direccion General de Aerofotografia (DIGAF) under contract to CORAH, the UNDP study presents the following calculations:

Total area to be photographed (includes a large expanse of the Huallaga below the area covered by PEAH):	1,013,000
Area completed at time of study:	455,850
Area identified as either "coca fields" or "potential coca fields:"	29,501
Percent coca fields in area photographed:	6%
Area not yet photographed:	507,150
Estimated percent coca fields in area not yet photographed:	3%
Estimated coca hectareage in areas not yet photographed (507,150 x 3%):	16,000
MAXIMUM ESTIMATED COCA HECTAREAGE:	46,000

Note that this is lower than NAU's estimate of 60,000 to 70,000 hectares (see above) based on the same photography. It is generally agreed that identification of coca cultivation from aerial photography is difficult and the estimates generated approximate at best.

Kerosene Requirements

The final (and least precise) estimate is generated by calculating the amount of kerosene that could have entered the valley, the amount needed to process one hectare's worth of leaf into paste, and thus the maximum amount of leaf that could have been processed and the hectareage needed to produce it. (It is likely that virtually all leaf is processed into paste before leaving the valley.) The following figures are used. Assuming 75% of the 1987 production of refineries at Iquitos, Yurimaguas, Pucallpa, and Tarapoto is used for coca processing (458,000 barrels) and 92,000 barrels are trucked in from refineries at Eten, Salaverry, Chimbote, and Callao (which represents between 6,000 and 9,000 truckloads of 10-15 barrels each, or 15-25 truckloads per day) would yield a total of 550,000 barrels available for paste production in the valley. Assuming 17 barrels (x 157 litres/barrel = 2700 litres) are needed to process 1 TM of dry leaf (200-400 litres of kerosene needed to transform 100 kgs of leaf into 1 kg of paste) would mean that 32,350 TMs of leaf (550,000 barrels/17 barrels per TM of leaf) could have been processed. Assuming 1 TM of leaf/hectare, only 32,350 hectares would be needed to grow this much leaf. (The higher yield estimate used below would require even less hectareage.)

The only real number in these calculations is the amount of kerosene produced by the various refineries; the rest are pure speculation. On the other hand, even if we assumed that the entire production of the region's four refineries (610,000 barrels) were used in paste production and 490,000 barrels (90 truckloads of 15 barrels each per day) were trucked in, this would still only provide enough kerosene to process 65,000 hectares worth of cultivation. Note that this reasoning assumes that each litre of kerosene is used only once. If recycling is possible, considerably less would be needed on a yearly basis.

These calculations suggest an interesting approach to coca control. If the study's coefficients for the production process are correct and if it is not possible to recycle used kerosene (these are key assumptions which need to be verified), every kilogram of paste (half kilogram of base) that leaves the valley requires the ingress of at least 200 kilograms of kerosene. If legal controls on distribution were enacted (and could be enforced), the illicit provision of so much kerosene would provide a major logistical problem for traffickers. On the other hand, kerosene is the major source of fuel for the valley and there are thousands of small scale distributors and retailers. Regulation would be difficult and might produce undesirable side effects, such as driving up the price for legitimate industrial purposes and encouraging deforestation as wood burning is substituted for kerosene use. Distributional channels within the valley would be impossible to control, given the weak presence of civil authority, so regulation would have to focus on production and transport from other parts of the country. This would virtually ensure that most kerosene entering the valley would be used in coca production (unless an

CULTIVATED AREAS OF COCA IN PERU
(Ha)

Area	Years					Projected	
	1965[1]	1971[1]	1974[1]	1978[2]	1984[3]	1990[4]	1995[4]
Upper Huallaga	3,940	4,880	4,850	8,457	49,278	55,000	70,000
Cuzco	9,200	9,200	10,200	7,877	89,378	95,000	100,000
Ayacucho	840	1,500	1,865	1,137	19,638	22,000	25,000
La Libertad	900	860	840	1,050	9,391	10,000	12,000
Huno	490	700	600	783	5,264	7,000	12,000
Cajamarca	250	190	242	289	3,655	5,000	8,000
Pasco	---	---	---	152	3,391	5,000	8,000
Others	220	350	350	406	3,095	5,000	15,000
TOTAL	15,840	17,681	18,946	17,916	182,781	204,000	250,000
Upper Huallaga as % of Total	25%	27%	26%	47%	27%	27%	28%
Cuzco as % of total	58%	52%	54%	44%	49%	46%	40%
Other areas as % of total	17%	21%	20%	9%	24%	27%	32%

[1] Source: Peruvian Annual Statistics, Ministerio de Agricultura. Peru.
[2] Source: Cocaine 1980. Actas del Seminario Interamericano sobre Aspectos Medicos y Sociologicos de la Coca y de la Cocaina, Lima, Peru, 1980.
[3] Source: Plan Nacional de Eliminación del Narcotráfico. Instituto Nacional de Planificación. 1986.
[4] These estimations are considered conservative and are calculated based on the agroecological and socioeconomical characteristics of the regions.

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acceptable substitute were developed causing hardship to legitimate users. Nevertheless, considering the resources

expended to date by CORAH and their limited impact on total production (15,000 hectares eradicated and 125,000 kgs seized since 1985), this approach merits further study.

Official Projections

Finally, the following figures (next page) have been provided by a member of the AID UHAD project committee, using projections based on estimates by various official agencies, most recently the Plan Nacional de Eliminacion del Narcotrafico and the Instituto Nacional de Planificacion. Note that the 1990 projection for the UH is 55,000 hectares and that this represents only 27% of the total area under cultivation in Peru as a whole (204,000). A much larger area (95,000) is projected for the Cuzco area. Production figures based on these projections do show that the UH currently has the highest yield per hectare (1.5 TM vs only 1.0 in the rest of the country), but even so, it represents only 35% (82,500 TMs) of total 1990 production (231,500 TMs), while Cuzco represents 41% (95,000).

All other sources reviewed in this memo assume that the Upper Huallaga provides 50-80% of total national production. The above estimates are projections that probably take the area of legal cultivation as a starting point. Note that the percentages of hectareage registered with ENACO for the Upper Huallaga (36%) and Cuzco (44%) are similar to the percentages presented here. Analysis of satellite photography taken in June, 1985 (13) shows a maximum of 45,000 hectares in the Cuzco area. The President of ENACO claims that there is no illegal cultivation in Cuzco, but says there are about 30,000 hectares in Junin, between Satipo and Camisea, and another 10,000 in Sandia Province in Puno (13). AID staff members believe that greater attention should be paid to other valleys in the alta selva, particularly the Pichis-Palcazu-Pachitea, where cultivation has already started. These areas have the capacity to rapidly absorb production displaced from the UH as eradication and interdiction efforts are increasingly successful.

Based on the evidence reviewed above, the best estimate for area under cultivation in the Upper Huallaga in 1988 is between 50,000 and 100,000 hectares, representing at least 50% of the national total.

YIELD PER HECTARE AND COEFFICIENTS OF TRANSFORMATION

Estimates for yields per hectare range from .5 to 2.5 TMs per year, involving up to 6 harvests. There is general agreement that the UH is a particularly productive area and that yields are probably higher here than elsewhere. The most reliable studies (AID, UNDP) use a conservative estimate of 1 TM per hectare in 4 harvests. The ESAN study uses 1.3 for the UH and .9 for the rest of the country. Thus, the best estimate of dry leaf production for the UH is between 75,000 and 150,000 TMs per year, representing 75% of national production.

There is considerably less disagreement regarding the coefficients of transformation from coca leaf into cocaine than there is regarding the amount of leaf produced. The following numbers have been provided by the studies under review here:

STAGE	NAU (12) AID/PERU (14)	AID/BOLIVIA (10)	ESAN (1) UNDP (5)
Dry leaf into paste	.005	.009	.01
Paste into base	.4	.278	.45
Base into HCl	1.0	.83	.73
Dry leaf into HCl	.002	.002	.0033

Everyone agrees that virtually all leaf is converted into paste near the point of harvest. There is less agreement on how much of the conversion from paste into base takes place within Peru. According to the ESAN study, this figure has been growing rapidly, rising from only 2% in 1980 to 85% in 1987. Internal AID estimates (14) use the more conservative figure of 50% for 1986-87. Both sources agree that a negligible amount (less than 1%) of base is converted into HCl in Peru. (Incidentally, AID/Bolivia estimates that all paste is converted into base and 50% of base into HCl before leaving Bolivia.)

VALUE OF PRODUCTION

Coca Leaf: According to the ESAN study, the price paid for dry leaf has been fairly constant (in dollar equivalents) since 1980, ranging between $3 and $4 per kg, with higher prices paid for UH leaf. An average of $3.60/kg is used to calculate the gross value of the crop in 1987. The authors claim that the large scale traffickers who deal mainly in paste/base buy a small amount of leaf (10,000 TMs in 1987) directly in order to regulate demand and ensure that the price stays constant. AID believes that there is considerably more price fluctuation (both by year and by region), with prices ranging from $1.30 to $7 per kg. They use an average, however, that is quite close to the ESAN figure: $3/kg. The MIAC study (4) gives a price of $2.50/kg in 1980, falling to $1.30/kg in 1983 and then rising back to nearly its 1980 level in 1986. A recent (June, 1989) estimate by the President of ENACO put the current price at I/720,000 per quintal ($4.80 per kg using an exchange rate of I/3,000 = $1), compared to I/100.000 per quintal ($.65 per kg) paid by ENACO (13). None of these sources differentiate between farmgate prices and those paid by pit operators, the assumption being that paste conversion takes place near the point of harvest.

Coca Paste: The ESAN study gives the following figures:

Period	Price Paid to Producer by Small Scale Collector	Price Paid to Collector by International Trafficker
80-82	$1,000/kg	$1,500/kg
83-85	$450/kg	$750/kg
86-87	$500/kg	$650/kg

AID (14) uses figures of $700/kg for 1986, $500/kg for the first half of 1987, and $400/kg for the second half of 1987.

Cocaine Base: The ESAN study gives the following figures:

Period	Price Paid to Producer by Small Scale Collector	Price Paid to Collector by International Trafficker
80-82	$2,000/kg	$2,500/kg
83-85	$1,000/kg	$1,200/kg
86-87	$1,200/kg	$1,500/kg

Note that these figures imply that there is no value added in the transformation of paste to base, since 2.2 kgs of paste are required to produce 1 kg of base. If these figures were accurate, small producers would actually have lost money in the transformation process in 1980-82 (converting $2,200 worth of paste into $2,000 worth of base), broken even in 1983-85 (not counting the cost of other inputs), and earned only $100 extra per kg of base produced in 1986-87. AID (14) estimates a price range of $3,000 to $5,000 per kg of base ($3,500 as a conservative average) in 1986, dropping to a range of $2,200 to $3,000 ($2,500 average) in 1987.

The AID and ESAN estimates for leaf and paste prices are fairly close. For base, AID estimates are significantly higher. Given the fact that the ESAN prices show little (or even negative) value added at this stage, the AID estimates seem more reasonable.

TOTAL VALUE OF COCA PRODUCTION IN UH

To estimate the total value added in coca production for the year 1988, the following figures are used. Note that they should be treated as rough averages only. In practice, it seems likely that there is considerable variation in both prices and yields at each stage of processing.

Hectares: 80,000 (range: 50,000-100,000 -- see above)

Yield: 1.3 TM/hec (ESAN estimate for UH--AID/Peru figure (1.0 TM/hec) seems too conservative given other evidence)

Leaf to paste: .009 (AID/Bolivia--middle of 3 estimates)

Paste to base: .278 (" " " ")

% converted to base: 60% (slightly higher than AID/Peru estimates given higher ESAN estimate and likelihood that figure is increasing)

Price/kg of leaf	$3 (AID/Peru)
Price/kg of paste	$400 (AID/Peru)
Price/kg of base	$2,500 (AID/Peru)

TOTAL VALUE OF LEAF:	$312 million
TOTAL VALUE OF PASTE:	$375 million
Part not converted to base (40%):	$150 million
TOTAL VALUE OF BASE:	$390 million

TOTAL	$540 million

If we assume that the UH represents 60-75% of production for the country as a whole, the value of coca to the Peruvian economy in 1988 would have been $700 to $900 million.

Effects of Coca on the Wider Economy of the UH

Very little study has been done on the indirect effects of coca on the Upper Huallaga Valley. The information that does exist focuses on quantifiable benefits. Indirect costs, such as environmental destruction, drug addiction, and the deterioration of civil authority, are difficult to quantify and have generally been overlooked, not only by researchers, but often by the very residents that ultimately must bear them. It is beyond the scope of this analysis to deal quantitatively with these costs, but further study is clearly needed.

In 1985, according to the Project Evaluation of PEAH prepared for AID by ECONSULT (2), the value of non-coca agricultural production for the Upper Huallaga was $19.5 million. The UNDP study gives a figure of $40.2 million for 1986. The difference is partly explained by significant increases in production between 1985 and 1986 and partly by the lower (official) exchange rate used by UNDP. Even accepting UNDP's very conservative estimate of $260 million for the value of the coca crop, legitimate products account for only 13.5% of the agricultural GDP of the UH. (ECONSULT puts the figure at 7.2% for 1985.) There are a handful of agro-industrial enterprises in the valley (including a chip-board manufacturer and a cacao processing plant) but they are currently operating at substantially below capacity and do not contribute significantly to regional GDP.

Interestingly, it is not true, as often supposed, that coca cultivation has crowded out legitimate agriculture, at least through 1987. Production by weight of 9 major crops increased 14% between 1985 and 1986, and 65% (mostly accounted for by a doubling of palm oil production) between 1986 and 1987 (UNDP, p 31), though there were significant decreases in several crops (rice, coffee, platano, and tea) in the early 1980s. The recent pattern seems to be one in which, as eradication and police effectiveness increase in the fertile valley floor, coca production is displaced to the slopes while former coca land is planted in other crops. Also, many coca growers keep their families on plots growing legitimate crops, some within the confines of large cooperatives such as Naranjillo, CAP Te-Cafe, or CAP Jardines de Te el Porvenir, where education and health facilities and a modicum of security from terrorism are provided. Thus, legitimate crops seem to be a stable (growing?) but still relatively insignificant part of the valley economy. In terms of employment, legitimate agriculture is somewhat more important, accounting for 35% of agricultural days worked (in 1986) according to the UH labor study (9), or 25% (in 1987) based on estimates of the maximum possible coca work force in the UNDP study.

How is the income from coca production distributed? Even assuming that much of the estimated $175 million in value added at the cocaine base production stage never enters the valley economy, this leaves $312 million paid directly to farmers and $63 million to paste producers. Assuming about 40,000 cultivators and day laborers, this works out to an average of $7,800 per person.

This calculation can be refined further using the estimate from the labor study (based on a survey of 88 cultivators) that 64% of agricultural days worked are accounted for by wage laborers (9). This would imply about 26,000 wage laborers and 14,000 cultivator/owners. Note that this accords well with AID's (6) estimate of 13,500 family units, if we assume that most cultivator/owners are heads of families while most wage laborers are single males (including a large percentage of migrants). The labor study also gives a figure of I/240 per day ($12 at an exchange rate of I/20 per dollar for early 1987) as the average wage paid coca harvesters, which would yield an estimated average annual income of $3,600 per day laborer ($92 million total). This leaves $220 million accruing to owner/cultivators (including sharecroppers), which is also consistent with the estimate (based on cultivator interviews) that labor costs account for 25-35% of the total value of the crop. Using the previous estimate of $3,900 ($3 per kg x 1,300 kgs of dry leaf) for the yearly value of one hectare's yield, we can calculate that if wage labor were 25% of crop value ($975), it would represent 81 person days per year at $12/day, while if it were 35% of crop value ($1,365), it would represent 114 days. Incorporating the estimate that wage labor accounts for 64% of days worked gives a range of 126 to 177 total person days per hectare, which accords well with the previously-cited figures for labor input. Thus, independent estimates of labor requirements, wage labor participation, factor income, and crop value are all roughly consistent.

It should be noted that the Peru Report (13) gives figures that are somewhat inconsistent with those presented above. They cite I/15,000 ($6.50 at the early May exchange rate of I/2,300 = $1) as the piece wage for harvesters per "tarea" (equal to one twentieth of a hectare). If workers can pick up to 3 tareas in a day, as the report claims, then wage figures (up to $19 per day) would be roughly consistent with those given above, but only 7 plus worker days would be needed per hectare. On the other hand, if a "tarea" is actually one day's work for the average worker, which is consistent with previously-cited harvest labor requirements (15-20 worker days per hectare), then wages are only $6.50 per day, or about half of the figure used above. Several factors contribute to this type of inconsistency, including variations across region and time and the difficulty of determining meaningful exchange rates in a hyperinflationary economy.

According to the labor study (9), wages for day laborers in coca cultivation are 2.5 to 8 times greater (I/240 per day vs. I/30 to I/100 per day in 1987) than wages for those in legitimate crops. From the cultivator/owner's point of view, the value per hectare of coca leaf is 3 to 11 times greater than the value per hectare of legal crops ($3,900 for coca vs. $350 to $1,400 for 9 major crops, according to 1986 figures given in the UNDP study). On the other hand, there is evidence that non-traditional crops and improved technology could dramatically increase the value of legitimate agriculture, even to the point of making some crops competitive with coca. For example, coffee yields are currently around 9 quintals per hectare but proper cultivation (pruning and fertilization) could increase this figure to 90. Cacao yields could be nearly tripled, from 400 kgs to 1000 kgs per hectare. Achiote and pineapples have been suggested as high-value non-traditional crops.

If coca is currently bringing 85% to 95% of the cash into the valley, then presumably a large proportion of the income of

providers of secondary services is also dependent on coca. The non-agricultural PEA for 1987 is estimated at

about 26,000 (UNDP). It is not clear how many of these are involved in other aspects of cocaine production. For example, are pit operators and laborers counted as part of the agricultural work force? How much of paste production is carried out by cultivators and how much by independent small producers? The only estimates of labor requirements for coca processing beyond the cultivation stage come from the ESAN study. Its authors contend that 4 people ("chemists" and security personnel) are involved in the processing of 1 TM of leaf, but again they don't specify over what time period. Nevertheless, as with their estimates of labor required for cultivation, they multiply this figure by total leaf production to generate an estimate for "persons involved" in this stage of processing. Using my estimate of 104,000 TMs of annual production (which is much lower than theirs), this would mean 400,000 people involved in paste production. Clearly these figures are not much use.

The ESAN study goes on to estimate about 1,000 persons involved in small scale collection rings (50 groups of about 20 persons each) and about 4,000 (20 groups of 200) involved in major wholesale organizations. No justification is given for these figures. Presumably they are based on interviews with jailed drug traffickers and police officials, both of which are cited as data sources used in the study.

There is not much data currently available on the breakdown of labor and income in the non-coca service sector of the UH economy. According to the president of the Tingo Maria Chamber of Commerce (15), in May, 1987 there were 150 retail establishments in the city grossing about I/110 million ($6.1 million) per month ($73 million per year) of which about 2/3 was food stuffs and 1/3 was household goods and consumer electronics. In addition, there were three car/motorcycle dealers whose combined sales averaged 35-40 vehicles per month. Assuming an average cost of $15,000 per vehicle, this would represent an additional $7 million per year, giving a total of $80 million in retail sales for the city. (Tingo Maria comprises 56% of the urban population of the UH.) An informal survey of Uchiza reported about a dozen retail businesses, although it was observed that in addition, consumer appliances were sold in the square "at three times the Lima price" and that "business was brisk." This is probably typical of other towns in the valley.

These figures suggest that a significant portion of the $375 million per year from paste sales does not enter the valley's retail/service economy. Anecdotal support for this conclusion comes from the ESAN study, which states that much of the income from coca production is used to buy luxury consumer goods, either trucked in from Lima or smuggled in from other countries, thus providing little multiplier effect on the regional (or in the case of smuggled goods, on the national) economy. This contrasts with the AID/Bolivia study, which estimates a GDP multiplier of 2 for value added at the cultivation and paste production stages, and 1.5 for value added in the conversion to cocaine base. Applying these estimates to the direct income figures for the Upper Huallaga would yield a total impact on regional GDP from coca production of $1 billion (2 x $375 million + 1.5 x $165 million). Using the direct estimates of retail trade cited above, a more realistic range may be $600-$700 million, with much of this distributed among a relatively small number of wholesalers and HCl producers.

More important than the numbers, however, is the general conclusion that the impact on retailers and service providers of a significant reduction in the flow of coca dollars would be considerably less than the magnitude of the reduction itself, since it appears that many of these dollars are not being spent in the local economy anyway. This does not mean that there would not be strong resistance by the local population. Even a small percentage of $540 million per year is a major boom to the towns of the UH. The ESAN study also notes that drug traffickers provide the local population with "goods, liquor, and entertainment, and give money to the most needy" (p. 85) in order to buy their goodwill. Equally significant is the impact of coca on the economies of surrounding provinces. A significant proportion of agricultural workers migrate to the Upper Huallaga coca fields for part of the year, earning cash wages which supplement the subsistence cultivation of food crops in their home districts.

Directions for Further Study

Of the research reviewed, the most promising seems to be that focusing on labor and income. We need much more information than we currently have on labor requirements for all stages of coca processing, particularly those beyond cultivation and harvest. Are significant areas cultivated less intensively than we have assumed (4 harvests per year)? What would be the yield of land harvested only once or twice per year? How much time is really spend on weeding and fertilizing? How many worker hours are involved in converting 1 TM of dry leaf into paste? How many in converting 1 kg of paste into half a kg of base? What about transportation and "security"? Also, what is the average income of workers at each stage of production? How many are self-employed? What is the size of the migrant labor force and average length of stay? What is the level of participation of women in coca production? To what extent is coercion involved in the provision of labor? What, exactly is the role of Sendero? What percent of coca income do they capture? (According to The Peru Report, Sendero tells farmers in many areas what they can and can't plant, and those that don't agree are forced out. The Report further states, "...Tarapoto sources said that Sendero is now demanding 50 percent of each harvest.") What about financing? Which parts of the production process are financed in dollars and which parts in intis? How is money dispersed? How much liquidity is there among middlemen? What is their profit margin? Are there any "weak links" in this chain?

Moving beyond coca production, how many retail vendors are there in the valley? (We have rough estimates only for Tingo Maria.) What is their average income? Markup? What about providers of other services (transportation, financial, personal, security)? How many are there? What do they earn? How does this compare with other rural areas of Peru, not dependent on the coca trade? What percent of coca dollars are absorbed by legitimate businesses? What percent are spent on smuggled goods? What percent go to foreign/Lima-based banks?

This information is important for two reasons. First, a better understanding of labor requirements for coca production, labor use in other sectors, and labor force size and migration patterns, will allow more accurate estimates of coca cultivation and processing. Second, we cannot hope to provide viable alternative

income sources unless we have a clear understanding of how earnings in all sectors are affected by coca, and what degree of coercion is

involved in current labor allocation. Unfortunately, this information is difficult to obtain. Much of it can only be gathered through field research (with all the attendant methodological and security problems). Furthermore, labor and income patterns are highly fluid, changing rapidly with fluctuations in labor supply and coca demand, as well as responding to eradication and interdiction efforts by the authorities.

One source of some information that is probably available at nominal cost by request from the appropriate government agencies is statistical data (demographic, sectoral GDP, etc.) broken down by province--published information generally does not disaggregate below the level of the department.

It is also important to get more information on the inputs used in coca processing, particularly those involved in converting leaf into paste, which reduces the weight of the product by a factor of 100, and thus must be done near the point of harvest. What exactly are the requirements? How much potential is there to substitute inputs? What are the main sources for each input? How easy would it be to control these sources? What other sources might traffickers then resort to? Kerosene has already been mentioned as by far the most bulky of the inputs, other than the leaf itself. However, as noted above, kerosene has many legitimate uses, so its control may not be feasible. Are there other substances (sulfuric acid, potassium permanganate, ether, ammonia, potassium carbonate) that might be more easily controlled? Given the limited success of direct eradication and interdiction efforts to date (which are a prerequisite for adoption by the local population of alternative income-producing activities), other approaches to limiting production are worth exploring.

Finally, more study is needed of other regions, particularly those where coca production might be displaced if eradication efforts in the Upper Huallaga are successful. Areas that are suited to coca production and have already begun to be cultivated include the Central Huallaga, Lower Mayo (16), Maranon, Tambo, Urubamba, and Pichis/Palcazu/Pachitea river valleys. It will accomplish little, either for the United States or Peru, if efforts to reduce coca production and develop an alternate economy in the Upper Huallaga succeed only in shifting production to other areas, maintaining the flow of coca and generating the same social/political/economic/security problems elsewhere.

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