HUALLAGA VALLEY AGRIBUSINESS AND MARKETING STUDY

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HUALLAGA VALLEY AGRIBUSINESS
AND
MARKETING STUDY

I. SUMMARY

The objective of this agribusiness study is "to identify opportunities and requirements for increased agricultural marketing efficiency and for expanded agribusiness activity".

The implementation of the study was effected by a team of agribusiness, marketing, transportation and other specialists who reviewed the available reports and documents in the Huallaga Valley and made on site field visits as well. The major crop, livestock, processing, and marketing activities were investigated in varying depths within the time available.

Four priority sectors were identified and recommended as promising for the private initiative:

- Lime and other agricultural inputs
- A tea nucleus estate with small satellite farms
- Oil palm satellite farms
- Cacao production and processing

For the public sector, the priority areas that would overcome major constraints and have the greatest impact on agribusiness activity and economic development were considered to be:

- Transportation
- Credit
- Research, Extension and Training

In addition, seventeen other significant crop, animal husbandry, and related activities were investigated and evaluated for their agribusiness potential. In some cases such as yuca, no action is recommended. However, with other crops such as corn, cotton and soybeans, some definite programs are suggested.

One of the major constraints to production and subsequent agribusiness activities in the Huallaga Valley is the generally low levels of soil fertility. This presents both problems and opportunities. The fertility problem results in low levels of production for most crops. This in turn, results in low levels of income and a low standard of living for the people. The opportunity is presented by the fortuitous fact that the Huallaga Valley is abundantly supplied with agricultural limestone, one of the key elements to increased productivity on the acid tropical soils.

A high priority is given to the promotion of lime, fertilizer, improved seeds and other agricultural inputs. Lime is considered the key to getting NPK responses with many crops. Additionally, it can provide the dramatic results often needed to gain acceptance of the other key inputs such as improved seeds. Furthermore, the spin-off benefits from improved corn production, for example, will have downstream benefits to feed formulation, poultry, swine, trucking, processing, and marketing industries.

Based on work at the Yurimaguas experiment station and earlier work in Brazil by IRI and others, the confidence rating is high for the success of lime utilization. In Brazil in 1983, about 5,682,000 Mt of lime was sold to farmers by 192 companies which operated 351 limestone crushing plants. The tremendous increase in the production of soybeans, corn and other crops in Brazil in recent years was due largely to the increased use of lime, fertilizers and other agricultural inputs.

It is proposed that the production and distribution of lime be done by the private sector. This could require credits in the range of US$15 to 20 million for imported lime crushing and ancillary equipment. To create the farmer demand, an applied research and demonstration program is recommended. This is estimated to cost about US$5 million over a five year period. Farmer production credits will also be required to develop an impact field program. It is recommended that funds be set aside to guarantee loans to farmers for the purchase of lime, fertilizers, improved seeds, and other inputs.

Tea is recommended for the hills on the eastern side of the Huallaga Valley from Tingo Maria to Aucayacu. It is well adapted to the soils and climate of this area and has been grown in the region for forty years. It is proposed that a tea nucleus estate complete with a factory be developed and operated on a private basis. This would be surrounded by private small satellite farms which would sell to the factory and be paid on the basis of a percentage of world market prices. Some new high yielding clones offer additional promise for profitability of this venture. Total investment would be about US$20 million, part of this to be on a soft loan or grant basis for developing the small satellite farms. Assistance to the two established tea-producing cooperativas is also recommended. This would strengthen their management capabilities and improve the quality of their production. Investment would be in the region of $300,000.

Oil palm is growing well in the Tocache area and it is proposed that this activity be expanded with a series of small private satellite farms. These small producers would sell to the local mills. Intermediate credit is needed for planting and caring for the oil palm trees for about three years until the

cash flow can be expected. A sum of US$1,200,000 over three years is projected for this Project.

The Naranjillo Cooperative at Tingo Maria is completing a new cacao processing plant. The capacity of the new facilities exceeds the total production in the area. Consequently it is proposed that assistance be given to small farmers to expand plantings of cacao. Credits of about US$4 million will be required. In addition, there is a need to upgrade the quality of the cacao by improved fermenting and drying. About US$800,000 is proposed for pilot facilities in these areas.

Transportation is considered the principal constraint to agribusiness and the general development of the Huallaga Valley. This is essentially a public sector problem involving the upgrading of existing roads and the construction of new roads. Maintenance of roads is a particularly urgent matter which will pay substantial dividends in terms of cost savings and the economic development of the valley. Upwards of US$500 million could be spent on improving the road system in the area. However, the top priority of considerable urgency is to establish a system of road maintenance centers. Seven rock crushing and road maintenance centers are proposed at an estimated equipment cost of about US$25 million. An additional US$18 million is recommended to upgrade the Central Marginal Highway with a good, all weather gravel surface. Furthermore, about US$25 million should be spent to upgrade the bridges which in some cases are limited to about two-ton loads, making it necessary for trucks to ford the streams.

Credit was a constraint in most of the activities investigated. Inflation makes the cost of money excessive for many agricultural production, processing and marketing activities. Policy problems regarding subsidies of credit are complex and involve broad economic, political and social

relationships. These problems are reviewed in some detail and recommendations made for possible financing alternatives, with priority being given to credit for lime and other production inputs, tea, oil palm, and cacao.

Research, extension and training were considered priority areas worthy of additional public sector support. The initial thrust of the research and extension effort should be related to the priority problems of lime, fertilizers and agricultural inputs that will have an impact on production in the Huallaga Valley. It is also recommended that certain promising commodities such as spices and essential oils receive more applied production research attention so that some of these new commodities can be commercialized in the future.

This report is organized into six major parts. They are:

I. SUMMARY--giving a brief overview;

II. STRATEGY STATEMENT;

III. INTRODUCTION--Gives a short background on the problem and the procedures of the study;

IV. PRIVATE SECTOR PRIORITY PROJECTS--identifies some activities considered suitable for private sector participation for accomplishment, such as lime production and distribution, tea, oil palm, and cacao;

V. PUBLIC SECTOR PRIORITY--describes those activities that fall within the public sector's responsibility, including the problems of transportation, credit, research, extension, and education;

VI. POSSIBLE PROJECTS--reports on seventeen other projects. Some of these are considered promising; others are given a low priority for implementation at this time.

II. STRATEGY STATEMENT

The strategic plan for the development of the Huallaga Valley attempts to optimize the use of the natural resources of the region to improve the standards of living of the people in the area. The basic thrust of the proposal is to use the private sector of the economy to achieve these goals to the maximum extent possible.

An economic system that incorporates the profit motive, with private enterprise operating in a free market society, has generally resulted in a higher standard of living for more people than has any other economic system. The environment required private enterprise to operate successfully is not easy to achieve, particularly in an inflationary economy and during periods of social unrest.

However, there are some fundamental problems which must be tackled if progress is to be made. For example, production is a vitally essential first step. In any economic system, it is impossible to divide up more than is being produced. The efficient production of low cost and high quality raw materials is basic to agro-processing industries and to agro-marketing activities. A survey of the Upper Huallaga Valley indicated that the 93 industrial plants studied, including about 20 agro-industrial plants were operating at an average of about 45% of capacity. The lack of low cost and high quality raw material is one of the reasons for this under-utilization of plant capacity. A similar situation exists in the Central Huallaga region where a cotton gin with a 10,000 + PY capacity processed only 800 tons last year. Also a meat packing plant with a 80 head/day capacity slaughtered an average of only about 23 head/day. Yet meat is being imported from Argentina.

Early in the planning stage of this product, it was presumed that processing agricultural products in the producing areas and improved marketing were the keys to economic development in areas distant from demand sources. This presumption is rational and worthy of attention, but the fact that considerable investments in product-processing facilities in the Huallaga Valley have preceded this study prompts modified evaluations. One of the most relevant observations is that product-processing facilities in the study area are seriously underutilized. Over-capacity is a major concern for firms that have not reached a break-even level of output.

Inadequate supplies of the raw farm produce is that major limiting factor. It would be irrational to promote additional agroindustry investments until the present facilities are more fully used. Insufficient supplies raw products are a consequence, in part at least, of a shifting away from food and fiber products in response to the strong demand for cocoa in the area. Causal factors also include low yields, low levels of technology, inadequate use of lime and fertilizers and low farm prices.

There is justification for backing up just a bit and putting priorities into focus. Production expansion with improved technology must be emphasized before agroindustry investments can realize their economic potential.

A strategic framework prioritizing matrix is presented in Table II.1 to demonstrate conveniently the process of project proposal evaluations. This matrix helps to provide the justification for the strategy statements that follow.

Table II.1. Huallaga Valley Agribusiness and Marketing Study Strategic Framework Prioritizing Matrix*

Alternative Projects	Effect on Income	Spin-out Spin-out Factor	Invest. Reqmnt. **	Potent. Market Demand	Product. Constrn. **	Transport Constrn. **	Human Resource Constrn.	Time of Impact ***	Return on Invest.	Overall Price
1. Lime Prod. & Dist.	1	1	M	1	L	M	L	S-M-L	1	1
2. Tea Prod. & Proc.	1	2	H	1	L	M	H	S-M-L	1	1
3. Palm Oil Sat. Farms	2	2	M	1	M	L	H	S-M-L	1	1
4. Cacao Production	2	1	M	1	L	L	L	S-M-L	2	1
5. Transportation Impl.	1	1	H	na	na	na	M	M-L	1	1
6. Research & Extension	1	1	M	na	na	na	H	M-L	1	1
7. Credit Expansion	2	2	H	2	na	na	na	M-L	2	2
8. Market News & Grades	4	2	1	na	na	na	na	M-L	3	2
9. Poultry Processing	2	2	M	1	L	M	L	S-M-L	2	2
10. Soybean Prod. & Proc.	3	1	M	1	M	M	M	M-L	3	2
11. Formula Feed Proces.	3	2	M	2	L	M	L	S-M-L	2	2
12. Coffee Processing	3	2	L	2	M	M	M	S-M-L	2	2
13. Corn Drying	3	3	L	2	M	M	L	S-M-L	3	3
14. Rice Milling	3	3	M	3	L	M	L	S-M-L	3	3
15. Cotton Production	3	3	L	3	M	M	M	S-M-L	3	3
16. Livestock & Pastures	3	3	M	2	M	H	M	M-L	3	3
17. Ret./Wholesale Frt. Mk	3	3	L	na	na	M	M	M-L	3	3
18. Milk Prod. & Proces.	4	4	M	2	M	H	M	M-L	4	3
19. Energy and Technology	2	2	M	3	M	M	M	S-M-L	3	3
20. Spices	4	4	L	3	H	L	H	L	4	4
21. Fruit Processing	4	4	M	3	H	M	M	M-L	4	4
22. Aquaculture	5	5	H	2	H	M	H	M-L	5	5
23. Yuca Processing	5	5	M	5	L	M	L	M-L	5	5
24. Forestry Products	5	5	H	3	H	H	M	L	5	5

* Rating on a scale of 1 to 5 with 5 representing the low end of the scale.
** High, Medium, and Low
*** Short-term, Medium-term, and Long-term

For the marketing system to operate efficiently there must be an adequate transportation and communication system. Roads

and the distance from the Lima market and the export ports are major constraints. This necessitates the production or conversion of commodities into relatively high value crops such as the conversion of corn into poultry or pork meat. It also puts improvements of the transportation system high on the development priority list.

Research, extension and education are public sector supported activities that are vital to the development strategy. Applied production oriented research provides the farmers with data and information on how to increase production economically. It also shows agribusiness which of the inputs will be profitable to the farmer and which will be a profitable input for the agribusiness to merchandise.

One of the production inputs that is abundantly available in the Huallaga Valley is agricultural limestone. Research at Yurimaguas and elsewhere has shown the technical and economic benefits of lime when combined with fertilizers, improved seeds and other modern inputs. The increased commercialization of these inputs by private agribusiness enterprises appears to be a major opportunity for an immediate impact program which will increase farmer incomes and generate increased economic activity in the Huallaga Valley. Equally important is the downstream benefit of increasing the area's production of raw material, which will impact on the agribusiness processing and marketing activities.

Listed below are some of the short-term programs for immediate implementation over the next two years. Also listed are some medium term recommendations that will require additional study and/or major financial committment over the period from years three through seven.

A. IMMEDIATE SHORT TERM PROGRAMS (Years 1 and 2)

POSSIBLE PROJECTS	ESTIMATED COSTS US$ Millions
LIME	
Initiate field demonstration plots at experiment stations and in farmer fields to show the economic benefits of lime, fertilizers, improved seeds, etc. Complete soil analytical laboratories, train personnel. Organize private companies to work with extension service and credit groups to get technological packages to the farmers.	
Cost	2.5
Farmer credits for above program	1.5
Install lime road rock crusher near Tarapoto and provide additional equipment for Tingo Maria installation.	
Cost	1.8
TEA	
Increase planting material of recently introduced high-yielding African clones. Provide technical assistance to existing tea cooperatives to increase yields and improve quality. Complete feasibility study and arrange financing for tea nucleus estate and satellite farm project.	
Cost	0.5
Provide credits to the Cooperativas Jardines de Té to fully utilize their production capacity and improve tea quality and finance training courses.	
Cost	0.3

OIL PALM

Arrange for importation of hybrid oil palm seeds, organize nursery and grow seedlings to about 16 to 18 months in nursery. Organize satellite farms, arrange financing, screen and select small farmers, clear land, lay out fields initiate plantings.

Cost 0.8

CACAO

Import hybrid cacao seeds, germinate and grow in nursery. Provide technical assistance and financing through Naranjillo cooperative to increase cacao planting in the Tingo María area.

Cost 1.6

Pilot project to improve quality of cacao through improved fermentation and drying practices consisting of collection system and assembly points to process cacao more efficiently.

Cost 0.8

TRANSPORTATION

Establishment of seven rock crushing quarries and road maintenance centers complete with emergency road repair equipment.

Cost 25.0

Resurface with gravel the Central Marginal Highway.

Cost 18.0

Upgrade the bridges on the Central Marginal Highway.

Cost 25.0

CREDIT

Specific items requiring credit funding are listed under the particular projects. Considering the complexities of the credit problem and especially the importance of credit in the implementation of the lime and agricultural inputs project, it is recommended that a long-term advisor and short-term consultants be utilized to expedite the implementation of the project.

Cost 0.4

RESEARCH, EXTENSION AND TRAINING

Funds are needed to employ additional research personnel, extension communication specialists and to provide training as well as long-term and short-term expatriate advisors in both Upper and Central Huallaga areas. Also funds needed to provide some additional equipment and materials as well as up-grading of physical facilities at experiment stations and UNAS.

Cost 3.0

PASTURE AND LIVESTOCK

For improving pastures and expanding the double purpose cattle herds.

Cost 0.4

CORN DRYING

For a pilot program of in-farm grain drying and cereal storage.

Cost 0.2

COFFEE PROCESSING

For pilot program to improve coffee quality through improved facilities for fermenting and drying of coffee.

Cost 0.4

SPICES AND ESSENTIAL OILS

Initiate an applied production research program to determine technical and economic feasibility of producing and marketing specialty crops from the Tingo Maria area as future substitute crops for coca. Considering the promising preliminary results, this is considered a good bet for a research and development pay out.

Cost 0.6

B. MEDIUM TERM PROGRAMS (Years 3 through 7)

POSSIBLE PROJECTS	ESTIMATED COSTS
LIME	
Continue field demonstration plots with particular emphasis on cost/benefit analysis and carry over effects of lime and fertilizers. Also most profitable crop rotations including a pasture cycle in applicable areas.	
Cost	7.5
Farmer credits for the above program. Expected to increase each year up to annual needs in seventh year.	
Cost	15.0
Additional lime crushers to service areas not covered by the road rock crushing equipment.	
Cost	4.2
TEA	
Install new tea factory with nucleus estate and satellite farms.	
Cost	20.0
OIL PALM	
Continue development of small satellite oil palm farms.	
Cost	2.0

CACAO

Continue the development of new cacao plantings in Tingo María area.

Cost 4.0

Expand centralized fermenting and drying facilities if the pilot program in years 1 and 2 is successful.

Cost 2.0

TRANSPORTATION

Construct an all weather gravel road from Tarapoto to proposed new port site at confluence of Marañon and Huallaga rivers near Jeberas.

Cost 11.0

Construct all-weather secondary road on west bank of Huallaga from Tingo María to Tocache.

Cost 22.6

Construct dirt feeder road from the above new roads.

Cost 40.9

Construct dirt trails from the feeder roads.

Cost 9.0

CREDIT

Continue to explore innovative methods of utilizing credit to achieve development objectives through the private enterprise system. Particular emphasis on small farmers with repayment in kind, working with guaranteed loans or other mechanisms to compensate for inflation and other problems in the Huallaga. Technical assistance to be provided by long-term and short-term consultants.

Cost 1.0

RESEARCH EXTENSION AND TRAINING

Continue efforts to upgrade the human resources and physical facilities at the experiment stations and the Universities. Long-term and short-term advisors to be used in addition to a strong fellowship program for in-country training and graduate level study abroad.

Cost 10.0

PASTURE AND LIVESTOCK

If the initial two-year program is successful in improving production and the economic viability of the livestock industry, additional credits should be made available. Particular consideration should be given to upgrading the fertility levels of pastures through a rotation of the areas into crops such as corn or soybeans.

Cost 5.0

CORN DRYING

Assuming success with the two-year pilot program, credits should be made available for on-farm cereal drying and storage facilities. This could stimulate agribusinesses in the production of such equipment.

Cost 3.0

COFFEE PROCESSING

As with corn drying, credits should be made available to expand the program if the initial pilot program is successful.

Cost 1.0

SPICES AND ESSENTIAL OILS

The development of new crops and cultural techniques adapted to the Huallaga Valley will require continuity of effort and good research management as well as careful cost projections. However, the relatively high value of these crops makes them ideal for the Huallaga Valley.

Cost 2.0

Recommendations and strategy statements are meaningful only within a well defined economic and social setting. The economic characteristics of the Huallaga Valley are explained in detail in Appendix 1 of this report. However, the social setting remains a disturbing element that has an impact on all development programs in the area. Specifically the rapid shift from traditional production to cocoa in the Upper Huallaga and the instability created by the deteriorating security situation forces of strategic courses of action. The recommendations in this report have largely been motivated by the basic economic development relationships with minimal modifications as a result of the cocoa complex.

A strategy statement which fully recognizes the reality of the deteriorating security situation cannot be neglected. If one were to assume a significant improvement in the social situation in the Upper Huallaga area in the near future, virtually no modification in the recommendations would be necessary. If, however, one assumes that no real or immediate improvement can be anticipated in the near future, then the following strategy is justified.

Expenditures already made in the area and the PEAH involvement must be salvaged as best possible, and as long as hope remains the complete abandonment of the on-going projects cannot be justifies. It is proposed that PEAH devote its

energies to the existing projects to maximize the payout of past and present expenditures. New projects will have to be set on the shelf temporarily. The lime, oil palm, cacao and tea projects should be considered as long-term efforts whose benefits will accrue primarily to the population not engaged in cocoa production. Even though the transfer to cocoa production is creating a serious problem those who are producing other crops should not be neglected.

In response to serious security problems, a major shift of program orientation, credit, technical assistance and project implementation might well be made toward the Central Huallaga area. The Central Huallaga, in many ways, is more promising and more likely to respond to development programs than the Upper Huallaga. There is strong support for a shift to the Central Huallaga area because of the favorable development environment. It is strongly recommended that USAID shift its technical assistance to projects in the Central Huallaga or even the Bajo Mayo area. The research, extension and training thrust can be greatly enhanced in that area, and as time goes by, the benefits will be diffused into other areas. The lime proposal is equally important to the Central as it is to the Upper areas. The tea proposal would not be transferable to the Central Huallaga nor would the palm oil or cacao expanded production proposals, but additional emphasis can be placed on the livestock, poultry, formula feed, milk production, corn, rice, sorghum, cotton, aquaculture and fruit processing proposals. No less-emphasis on road construction, research, extension, credit, market improvement or lime distribution need occur. The required feasibility studies prior to major investment inputs could be directed toward the Central Huallaga area as long as the security problem persists in the Upper area.

High labor costs and a shortage of labor are consequences of the strong demand for labor coming for the cocoa industry.

Because the net returns from production and harvesting cocoa are substantially higher than for traditional crops, the labor costs are generally above the levels feasible for other lines of production. This is of major importance in planning expanded production and may be a constraint that is beyond the capacity of the farmers to overcome. Promotional recommendations for production or processing must take this into account. Activities that make heavy use of labor may have to wait for a change in the economic environment before they can expect extensive investment. The differences between the rates that can be paid by traditional producers and the rate paid by the cocoa trade have been widening rapidly and a reconciliation between the two levels is not likely.

III. INTRODUCTION

The way to make the most productive use of natural and human resources to optimize human welfare has eluded many nations for throughout history. In most countries resources are not uniformly distributed nor are they combined in ways that permit universal application of a single set of guidelines for effective results. In addition, the specific goals, objectives, and values differ with cultural backgrounds and often change over periods of time.

As a result there is a continuous and relentless search for the combination of resources, institutional organization, and method of distributing benefits which will best enhance human standards of living. Peru has explored different approaches in recent years with somewhat mixed results. The objective of this study is to identify opportunities and requirements for increased agribusiness activity in the Huallaga Valley which would stimulate the production and economic development of the region.

This study attempted to avoid duplication of efforts and utilized the reports and experiences of other studies as well as field trips and the development of new data as required. Nine short-term expatriate consultants and several local consultants participated in the collection of data and writing the report. The study extended over a four-month period late in 1984 and early 1985.

In order to identify the opportunities for increasing incomes and economic activity, it was essential first to understand the agronomic potential of the Huallaga Valley. After extensive interviews and reference to background materials, promising crops and commodities were selected for further consideration. The crops adaptability to the climate, soils and

topography of the Huallaga Valley was taken into consideration and the comparative advantages weighed. For example cacao, tea and coffee are best adapted to the higher rainfall areas of Tingo Maria and Aucayacu. The existing palm oil plantations in the Tocache area are thriving and appear to warrant expansion. Cereals and annual crops such as cotton are best grown on the flatter lands in the Tarapoto region. The continued productivity of many of these commodities depends heavily on inputs of lime, fertilizers, and pesticides, and the proper use of these inputs is considered one of the priorities for the development of the area.

IV. PRIVATE SECTOR--PRIORITY PROJECTS

In this section there are listed some priority agribusiness projects that appear to fall primarily within the domain of the private sector. The criteria utilized in selecting these projects included the effect on increasing incomes as well as stimulating production and other spinoff activities in the Huallaga Valley.

A. LIME AND AGRICULTURAL INPUTS

The use of lime and other modern agricultural inputs is considered essential to move agricultural production from the fluctuating slash and burn levels of production to a stabilized high plane of productivity. Achieving this on an economic basis will stimulate a broad range of agribusiness activities.

1. Background

Most of the soils of the Huallaga Valley are acid and like most tropical soils have a fragile level of fertility. After one or two crops, deficiencies or imbalances start to occur followed by a decline in production. When yields drop, the traditional approach has been to abandon the area, chop down more virgin forest, burn off the vegetation during the dry season and plant a crop when the rains begin. In remote tropical areas without roads and after infrastructures, this agronomic and economic approach is the only one available for the survival of the small farmers. Large parts of the Huallaga Valley have gone through this extractive cycle, resulting in a depletion of the soil's mineral reserves and a degradation of the productive capacity of the soil.

Fortunately, agricultural technology has demonstrated that it is economically feasible to recuperate the productive

capacity of these soils and usually to improve it by the proper use of lime and fertilizers. The chemistry of this process is complex as illustrated in Figure IV.A-1. Thirteen elements have been identified as essential for plant growth. Shortages or excess quantities of any of these elements can result in depressed yields. In addition, excess quantities of non-essential elements such as aluminum can result in depressed yields. The acidity of most tropical soils presents a problem for many crops, and liming is a practical and economic solution to this problem.

The experiment station near Yurimaguas has demonstrated the importance of lime, along with other fertilizers, for continuous crop production in this region.

With the traditional slash-and-burn agriculture, yields usually drop to zero after about three consecutive crops. With complete fertilization and rotating rice, corn and soybeans, a yield of 7.8 tons of grain per hectare per year was achieved. These economic gains are highly encouraging and it has been calculated that the annual family income could be increased four fold, from the present average of $750 to about $3,000.

With the recommended liming and fertilizer programs, land formerly in fallow under a one-year production and two-years fallow rotation would be released for cultivation on a continual cropping basis. About two hectares are in disuse for every one hectare in use. An optimistic projection of expanded production seems to be justified for this reason alone.

The findings of the experiment station near Yurimaguas confirm earlier work by IRI Research and others in Brazil. In that work, it was clearly demonstrated that lime was the key to obtaining economic NPK fertilizer responses on the Camp Cerrado (savannah) and the old crop lands.

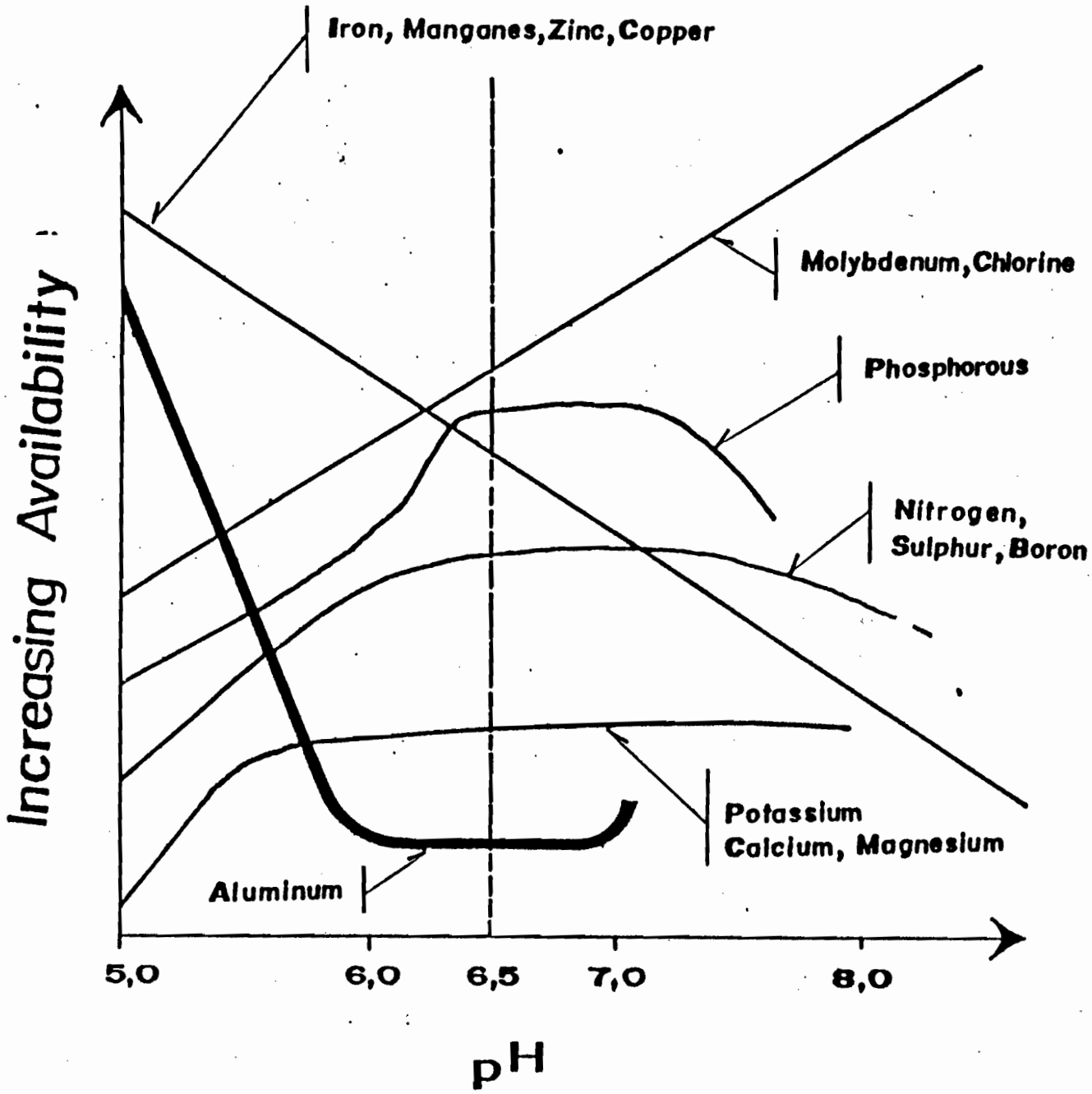


Figure IV.A-1. The effect of changes in pH on the availability of essential plant nutrients and aluminum. One of the effects of liming is to reduce the toxic effect of aluminum in those soils where this is a problem. (Malavolta, 1979)

In Brazil the consumption of lime in the Sao Paulo geo-economic region increased from 30,000 tons per year in 1957, when IRI first published field results, to a current yearly rate of about 2,000,000 tons. In Brazil the lime producers association (Asociocao Dos Productores De Calcario Agrícola) reported that in 1983 its 191 member companies sold 5,682,000 Mt of agricultural lime. Brazil has 351 limestone crushing mills with a total installed capacity of 3,990 Mt/hr.

2. Limestone deposits

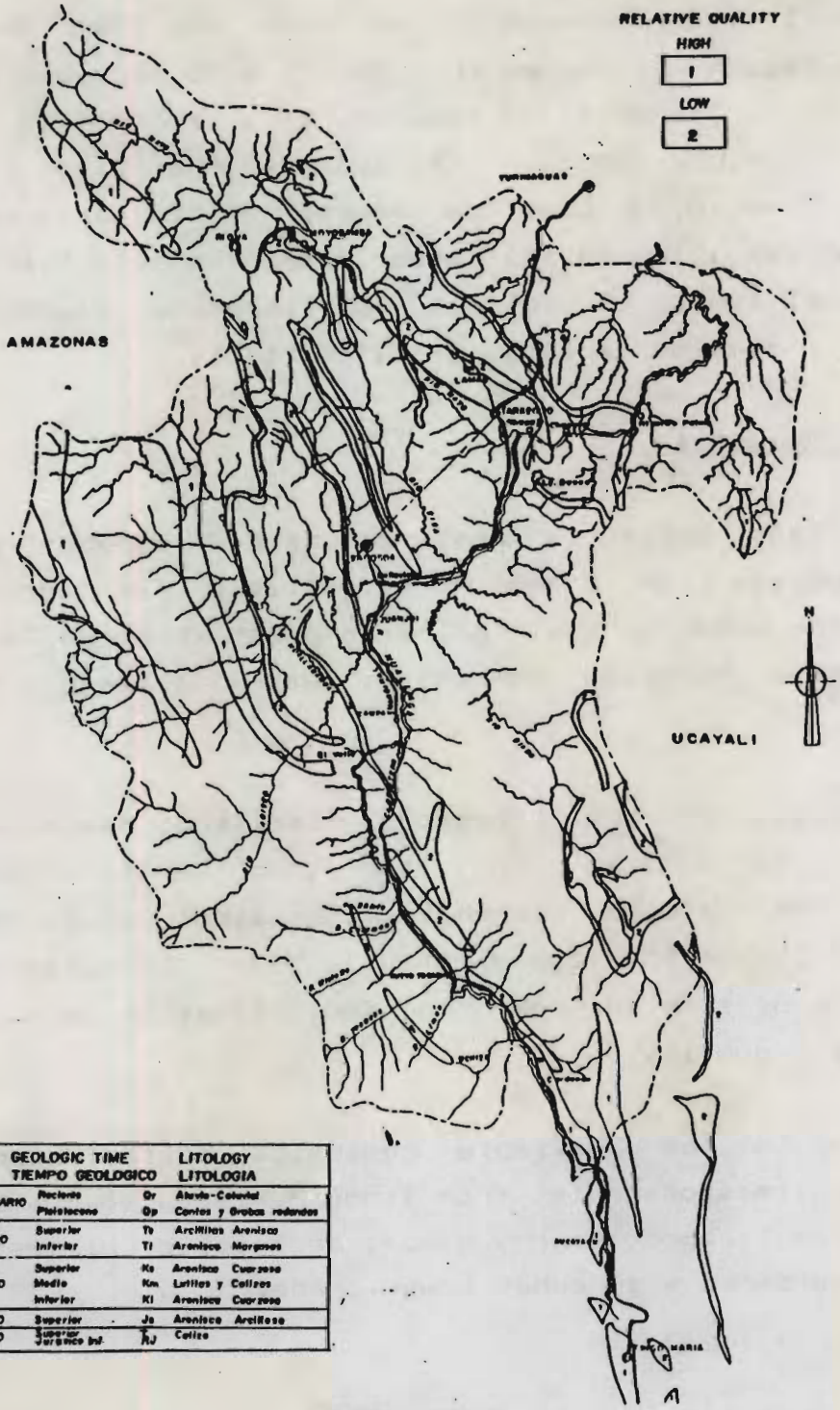
The Huallaga Valley is most fortunate in apparently having abundant supplies of limestone available for agricultural purposes. The maps on the following pages (Figures IV.A-2 and IV.A-3) show the reported formations where limestone deposits occur.

An analysis of the limestone from Tingo Maria where the rock crusher is located indicated good quality dolomitic limestone. The calcium carbonate equivalent is 92.25%. The calcium is 17.5% and the magnesium is 11.59% Similar analyses should be made of samples from other deposits at an early date to determine their quality.

According to the available geological data, deposits of good quality limestone exist from Tingo Maria up to Juanjui. In the region from Tarapoto to Moyobamba, deposits of limestone but these are considered a somewhat lower grade.

HUALLAGA VALLEY

LIMESTONE DISTRIBUTION

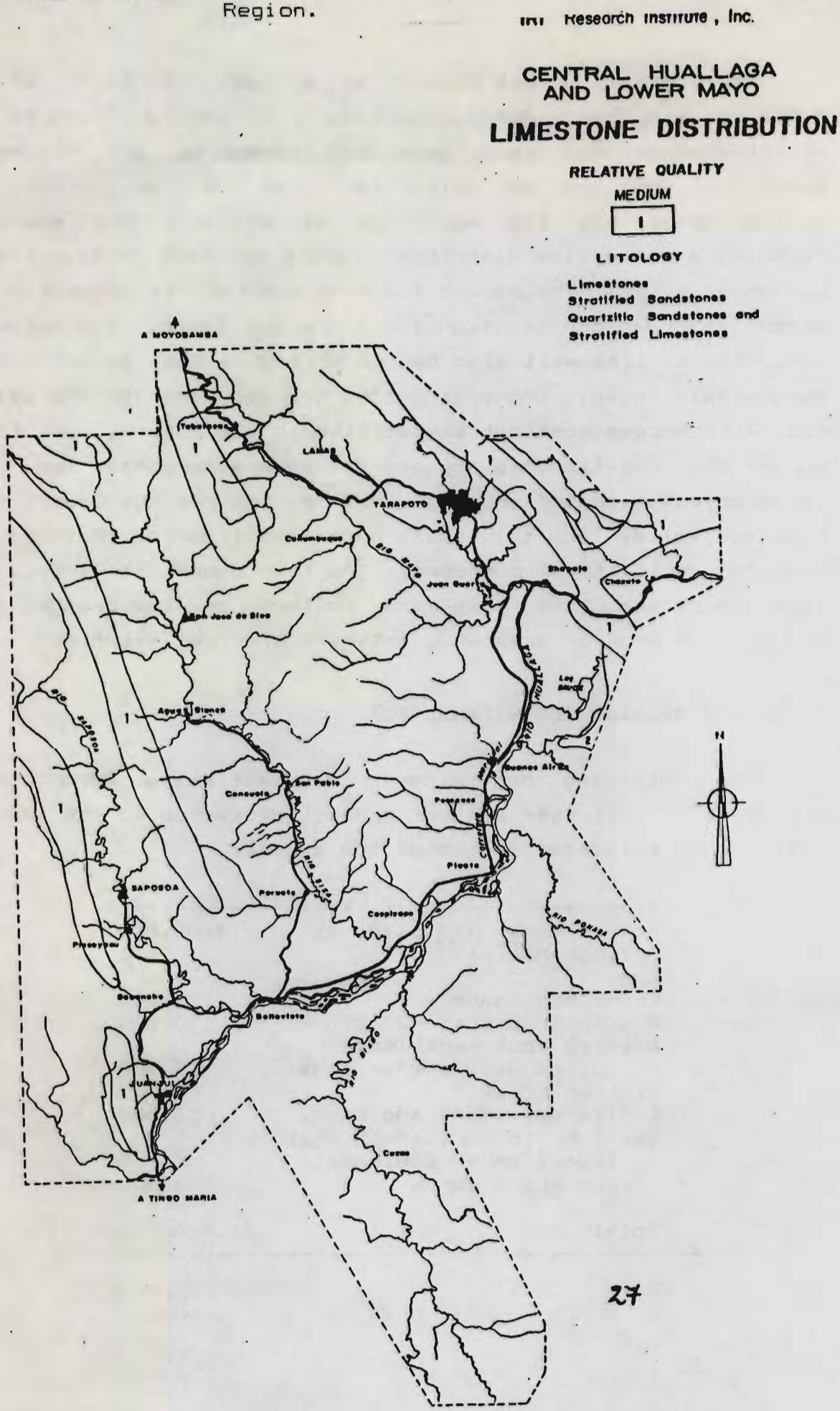


GEOLOGIC TIME TIEMPO GEOLOGICO			LITOLOGY LITOLOGIA
CUATERNARIO	Reciente	Qr	Aluvio-Coluvial
	Pleistoceno	Qp	Cantos y Gravas redondos
TERCIARIO	Superior	Ts	Arcillitas Areniscas
	Inferior	Tl	Areniscas Margosas
CRETACEO	Superior	Ks	Areniscas Cuarzosas
	Medio	Km	Lutitas y Calizas
	Inferior	Kl	Areniscas Cuarzosas
JURASICO	Superior	Js	Areniscas Arcillosas
TRIASICO	Superior Jurasico Inf.	TJ	Caliza

GEOLOGIC PROFILE

Figure IV.A-2. Limestone deposits in the Huallaga Valley.

Figure IV.A-3. Limestone deposits in the Central Huallaga Region.



Fortunately, a rock crusher is already in place at Tingo Maria in the Upper Huallaga Valley. It serves a dual purpose: crushing rock for road beds and screening out the smaller particles for use on soils to boost the lime content. This double usage has the advantage of dividing the sources of revenue, and the lime distribution does not have to bear the full burden at first. The demand for road-bed rock is expected to be strong as road construction funds are available. The demand for agricultural lime will also become strong as the benefits become more widely known. Unquestionably, the two uses for the dolomite rock will become somewhat competitive in the future, but for the moment the relationship appears to be a synergistic one. There is an urgent need for crushed rock to improve the roads in the Huallaga Valley and the small particles from the crusher can be used for agricultural purposes. As the demand for agricultural lime increases, the jaws and rollers of the crusher can be adjusted to provide greater quantities of finer material.

3. Estimated lime production cost

The following preliminary cost estimates were used to arrive at a cost per ton of product delivered to the farm site within a 50 kilometer radius of the crusher.

Rock crusher (in place at Tingo Maria)	$600,000
Front end loader	120,000
2 dump trucks at $75,000	150,000
Bagging equipment (some buyers will prefer bags)	85,000
Pick-up truck	12,000
Office equipment and misc.	33,000
Small Bulldozer, additional trucks other equipment and spare parts	400,000
Total	$1,400,000

Assume an average production of 400 tons per day for 250 days gives an annual production of 100,000 tons.

Assume a five year depreciation of equipment on the average (some items may last much longer) annual cost of depreciation $280,000.

Assume the following operational costs per week:

Diesel fuel plant, dump trucks, and payloader	$450
Gasoline transport	250
Lube oil, grease	75
Parts including tires	550
Labor/wk - 3 men on crusher, 2 truck drivers, 1 payloader operator, 1 bagger, 2 helpers Av. of $5/day	270
Total weekly cost of operations	$1,595
Total annual cost of operations	$79,750

Assume the following overhead weekly costs:

Salary for manager	$400
Salary for secretary	40
Telephone	150
Light (including stand-by equip)	80
Travel	200
Total/week	$870

Assume the following costs of mining equipment:

Compressor	$35,000
2 drills	7,000
Hose, pipe, misc.	5,000
Total cost	$47,000

Assume a five year amortization results in a depreciation cost of $ 9,400/yr

Assume the following operational costs of mining:

4 men at $6/day	$ 120
Dynamite, primer, etc.	300
Weekly mining cost	$ 420

Summary of annual costs:		
Depreciation of crushing equipment	$280,000	
Depreciation of mining equipment	9,400	
Operational cost per year	79,750	
Overhead cost per year	45,240	
Operational costs of mining	21,000	
Total annual costs	$435,390	
Direct cost per ton on the basis of producing 100,000 tons/year		$ 4.35

Assume a 100% burden for interest, general overhead, taxes, and non-predictable costs	$ 4.35
Assume a profit margin of 40%	3.48
Total estimated cost/ton delivered to farm gate within a 50 km radius of the crusher.	$12.18

4. Market for agricultural lime

In an attempt to quantify the potential market for agricultural lime, a review was made of some of the several soil surveys made of the area. By including some of the surrounding areas adjacent to the lime deposits, it is believed that about 1,500,000 ha might be a reasonable future market. If lime is applied at the rate of three tons every third year or an average of about one ton per year, the potential market might be 1,500,000 Mt/year.

The qualities and characteristics of soil are basic to all agricultural activities. Even though technology changes the capacity of soils to produce the basic classification and description is the starting point. The National Office for the Evaluation of Natural Resources (ONERN) reports the following classification and description of soils in the Central Huallaga area.

Table IV.A-1. ONERN classification and description of soils.

Classification	Cultivation Recommendations
Class A - 138,700ha (16%)	Appropriate for clear cultivation. Soil fertility is a limiting factor. Elevated levels of soil acidity. Some drainage problems.
Class C - 38,500ha (4.4%)	Appropriate for perennial crops. Low fertility and high acidity. Subject to erosion.
Class P - 19,000ha (2.3%)	Appropriate for pastures. Risks of erosion, low natural fertility, and high soil acidity.
Class F - 241,700 (28%)	Appropriate for forestry. Limitation of use because of risk of erosion and unstable soil. Soils are low in fertility and are acid.
Class X - 423,300 (49.1%)	Soils that must be protected because of topography, rock, swamps, rivers, and other.

The soil classes for the Alto Huallaga were reported with a different classification--II, III, IV, V, VII, and VIII. The description of the soil in each class emphasized low natural fertility and high acidity. (Refer to the Appendix of this study for hectares in specific crops).

An ONERN-FAO study in 1968-69 reported the following regarding soils in the Huallaga and surrounding regions:

- In the Yurimaguas area, residual soils are derived from rocks that are not calcareous. Reaction is from extremely strong to extremely acid. There are about 562,000 ha in this area;
- In the Chirayacu and Nieva area, the dominant residual soils vary from extremely strong to strongly acid. The source material is not calcareous. Approximately 436,000 ha would be in this category; and

- In the Alto Mayo area, in the middle and high terraces, the residual soils are derived from rocks that are not calcareous and range from strongly acid to extremely acid. About 392,000 ha are estimated to be of this type.
- In the Central Huallaga and Bajo Mayo areas, some of the soils are derived from different source materials. One special group of soils shows calcium carbonate content up to 14.5% and in other profiles it reaches up to 38%. Both of these soils are derived from limestone, reflecting the limestone deposits existing in the region. The area totals about 865,000 ha including the above mentioned special soils.

On the basis of these soil surveys, a preliminary estimate might be made that the potential market for lime in Huallaga Valley and surrounding areas could be in the order of magnitude of 1,500,000 ha, as indicated earlier. If it is assumed that the lime is applied at the rate of about three tons every third year, the potential market could be as much as 1,500,000 Mt/yr for the lime.

However, it should be emphasized that a major market development effort will be required to achieve such a goal. This effort will have to start on the experiment stations. Despite the positive results from the work of INIPA and North Carolina at Yurimaguas, not all the research and extension staff are convinced of the positive benefits of lime. Demonstration plots need to be installed at the experiment stations in Tulumayo, Tarapoto and appropriate substations on the proper soils and with crops such as corn, cotton, and soybeans which can be expected to give maximum responses and maximum economic returns to the lime.

In addition to the proper amounts of lime, the optimum levels of NPK fertilizers and micro-nutrients must be applied. Improved seeds must also be used, weeds properly controlled, and the necessary insecticides applied on a timely basis. For soybeans, a fresh and viable rhyzobium innoculant should be applied, along with some molybdenum for insurance purposes.

When positive results are achieved, field days should be held showing the growth differences between the treated and the control plots. Careful cost data should be kept and after harvest a complete cost analysis made. These data should be presented to leading farmers and they should be encouraged to install trial plots in their own fields.

As in Brazil, it is anticipated that private enterprise in Peru will take up the production and marketing of lime. However, the first step is to convince the farmers of the economic benefits of lime and fertilizers. This will require the assistance of the research and extension personnel as well as of the fertilizer and lime salesmen.

5. Economic benefits

The experiment station at Yurimaguas reports a payout of US$1.29 to US$4.95 for every dollar expended on in lime and fertilizer. This is consistent with the results obtained in Brazil by IRI and others. Yurimaguas also reported that the average small family farm could increase its income by as much as four fold by using lime, fertilizers and other modern inputs.

Results published by IRI in Brazil on the "campo cerrado" or savannah type soils which have very low fertility status, showed the following financial returns:

Table IV.A-2. Crop production and return from lime and fertilizer in Brazil.

	Soybeans	Corn
Yield	2290 kg/ha	6980 kg/ha
Value of production	US$ 412	US$ 526
Gross return after cost of lime & fertilizer	US$ 225	US$ 420

Examples of some of the dramatic responses that were obtained in Brazil on the "campo cerrado" are listed below (Table IV.A-3). In some cases the native level of fertility was so low that the plants died after germination and the yields were zero.

Table IV.A-3. Some Comparisons of Crop Yields in "Campo Cerrado" or savannah-type soils in Brazil, with and without lime and fertilizers.

Crop	State or District	Yield in kg/ha	
		No Fertilizer	Lime and Fert.
Bean	Brasilia	100	735
Cabbage	Brasilia	0	27,000
Corn	Brasilia	0	6,440
Corn	Sao Paulo	385	4,765
Eggplant	Sao Paulo	1,850	4,710
Peanuts	Sao Paulo	560	3,200
Sorghum	Brasilia	0	4,880
Soybean	Brasilia	20	3,200
Soybeans	Parana	46	2,222
Soybeans	Sao Paulo	260	2,000
Tomatoes	Brasilia	0	4,630
Wheat	Parana	71	955

On the following page in Figure IV.A-4 is shown the economic analysis of some of IRI's earlier work in Brazil. The fundamental relationships are still considered valid and the material is presented for illustrative purposes.

In this study three crops were grown for two successive years on the same plots. Two extremes of soil types were chosen

representing the higher production potential for the "campo cerrado" or savannah soils (Orlandia) and the lower production potential (Pirassununga).

Production costs were determined by using typical land rental values, the costs of land preparation, liming, fertilizing seed, planting, pest protection and harvesting. The plots giving the maximum production were used to determine yields, and the cost of inputs used to obtain those yields were included in the production costs.

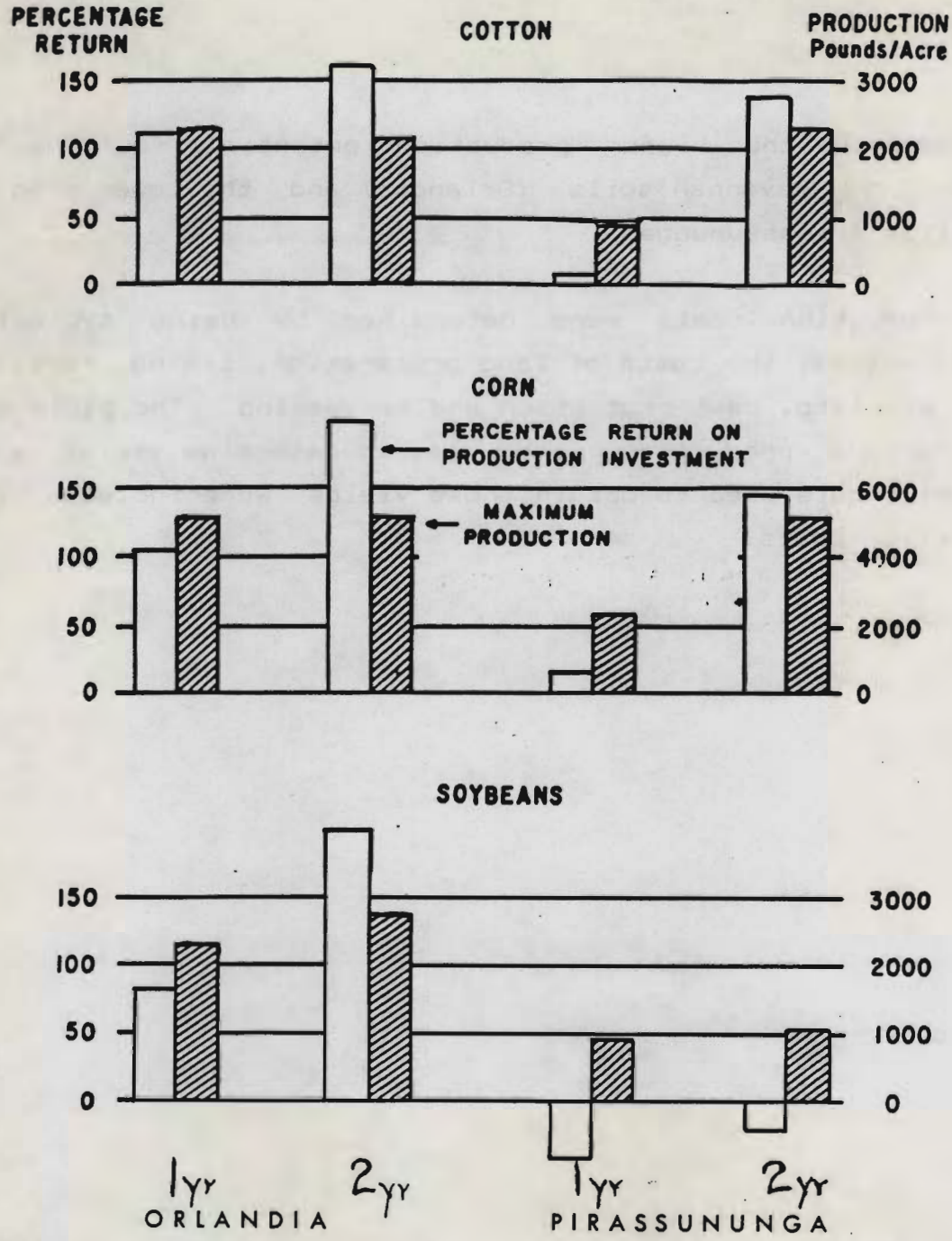


Figure IV.A-4. Economic analysis of the percentage monetary return on the production investment for cotton, corn, and soybeans at two locations (Orlandia and Pirassununga) in the State of Sao Paulo, Brazil. Results are for two successive years. They are based on the maximum yield plot and include all production costs. (From IRI Bulletin No. 29, "Effects of Liming and Fertilizing Cotton, Corn, and Soybeans on Campo Cerrado Soils--State of Sao Paulo, Brazil")

In this evaluation, the total cost of the lime and its application was charged to the first year's harvest even though benefits can be expected over at least a 3 to 5 year period. In the second year, besides the usual cropping costs, the fertilizer expenses were included but not the cost of the lime. The values of the seed cotton, corn and soybeans were calculated from established market prices at the time. This data is summarized in Figure IV.A-4 on a percentage basis showing the percentage return on total production costs.

The maximum production of cotton at Orlandia for the two-years was 2,528 and 2,443 kg/ha seed cotton, respectively. The percentage monetary return on total crop production costs was 110 and 160 percent respectively. At Pirassununga, where production was poor, only 928 pounds of seed cotton were harvested and the percent return on investment was only 5%. However, in the second year, production increased to 2,319 pounds of seed cotton and the profit percentage return was 136%.

The highest corn yields at Orlandia over the 2 year period were 5,638 and 6,004 kg/ha respectively of shelled corn. These are excellent yields, competitive with those obtained under the very best soil conditions of Brazil. The lime and fertilizer treatments used produced a profit on the crop investment of 102% and 200% in the two years reported. On the sandy soil at Pirassununga, yields of shelled corn were 2,774 and 5,708 kg/ha. Percent return on the production cost was 14% in the first year and 146% in the second.

Excellent soybean yields of 2,549 and 2,994 kg/ha were obtained at Orlandia. These yields are typical of those obtained by farmers who have utilized the lime and fertilizer recommendations. The profit returned on the production investment was 82% and 200% respectively. The soybeans at Pirassununga made good vegetative growth, but failed to set seed

because of some physiological disturbance. This problem at Pirassununga resulted in low yields of 871 and 1,026 kg/ha and a loss is shown for this crop.

Due to the lack of research data on liming and fertilizer responses in the Huallaga Valley, some hypothetical examples have been cast up to show the potential economic benefit from lime. These are based on the 1983 yields and prices to farmers for selected crops in the Central Huallaga as follows:

Table IV.A-4. Crop yields based on 1983 information - Central Huallaga.

	Yield	Price	Gross value S/.
Corn	2000 kg/ha	S/.212/kg	S/.424,000
Rice	2000 kg/ha	360/kg	720,000
Coffee	375 kg/ha	1200/kg	450,000

Assuming a 10% increase in yields, (very much less than expected), the returns from lime expenditures would be:

corn 1 to 2.5
rice 1 to 4.3
coffee 1 to 2.7

This example assumes the cost of lime at the farm to be $33 for every three years or $11 every year which gives a S/.16,830 avg cost at the 1983 exchange rates.

In the Upper Huallaga, the yields are shown in Table IV.A-5, crop yields, Prices and Gross Returns.

Table IV.A-5. Crop yields, Prices and Gross Return in the Upper Huallaga area.

	Yield	Price	Gross value S/.
Corn	1,700 kg/ha	S/. 212/kg	S/. 360,400
Cacao	307 kg/ha	2850/kg	903,450
Rice	1,683 kg/ha	360/kg	605,880
Coffee	440 kg/ha	1200/kg	525,000

Thus the ratio of returns to expenditures would be:

corn	1 to 1
cacao	1 to 5
rice	1 to 3.6
coffee	1 to 3.2

In Brazil, lime undoubtedly played a key role in the tremendous increase in the production of soybeans, corn and other crops which have made that country a major factor in the world export markets for these commodities. However, lime must be combined with proper economic levels of nitrogen, phosphorous and potash as well as trace minerals when deficient. In addition, improved seeds, proper plant protection, timely harvesting, and drying and storage facilities are also needed to maximize yields and profits.

The basic infrastructure for agricultural inputs exists in the Huallaga Valley. For example, approximately 10 retail outlets specializing in agro-chemicals and farm supplies were observed in Tingo Maria. However, the market for agricultural chemicals and farm machinery will continue to be limited if the yield levels continue, for example, in the 2,000 kg/ha range for corn. On the other hand, if the corn yields can be pushed profitably to the 5,000 kg/ha range with lime, fertilizer, and other inputs, the farmer will have the cash flow to purchase insecticides, spray pumps and other materials and equipment to further increase his productivity. This will stimulate other

agribusiness activity as well as increasing incomes and providing a better standard of living for the farm family.

6. Recommendations

It is proposed that highest priority be given to implementing an impact program for the development of lime and other agricultural inputs in the Huallaga Valley. This program will increase the incomes of farmers and have a maximum effect on generating spinoff benefits to other sectors of the economy.

New jobs will be created in the selling, handling, transport, production, financing, and other aspects of lime, fertilizers, improved seeds, pesticides, and the equipment to apply these materials. Probably one of the most important economic benefits will be the increased quantities of efficiently produced corn, cotton, soybeans, and other commodities that will be available for downstream agribusiness activities. Sufficient raw material should be available to operate the existing cotton gins at capacity. The poultry and swine producers should have an assured supply of low-cost corn as well as soybean and cotton protein meal to become more competitive in the Peruvian and possibly world markets.

The current constraint to the sale of lime, fertilizers, and other agricultural inputs is the lack of farmer demand. The demand will be created primarily by demonstrations in the field. These will clearly show the economic benefits to the farmer of using lime fertilizers, pesticides, and other agricultural inputs. In addition, the availability of credit for the farmers to purchase the products will be a constraint as soon as the demand develops.

The following specific recommendations are focused on removing some of the constraints and on developing an impact program for lime, fertilizers, and other inputs:

- Two additional soil research scientists (one senior and the other more junior) should be added to the staff of the Tulumayo Experiment Station and two additional scientists to that of the Tarapoto Station. Junior soil scientists should be stationed at the substations to carry out applied field research on lime, fertilizer, and other production problems that are unique to those areas. The focus should be on economically oriented applied production research which will increase yields and increase incomes to the farmers.

- Additional extension/communication personnel should be assigned to and stationed at research centers in Tulumayo and Tarapoto to serve as subject matter specialists on lime and fertilizers. They would organize field days, assist in training extension personnel, meet with farmers, provide news and press releases for radio, television, newspapers, and farm journals.

- Long-term expatriate soil scientists and an expatriate extension/communication specialists should be stationed at both the Tulumayo and the Tarapoto Experiment Stations. These men would work as a team with the local staff to develop the necessary recommendations to local farmers based on field data developed in the area. The necessary field plots will also serve to train and educate the extension personnel and farmers on the proper application methods and amounts of lime, fertilizers, and other inputs to obtain the maximum

economic return on the investment in these critical inputs.

- A long-term agribusiness development specialist should be assigned to the Huallaga Valley to assist in the implementation and coordination of development activities. This specialist will be responsible for organizing an association of private and public companies interested in providing agro-inputs into the valley. and will also provide coordination between the technical research and extension programs and the private companies to achieve the objectives of the lime development program. In addition, a long-term credit advisor is recommended to work on the problem of getting credit for lime, fertilizers and other inputs to the farmers.

- To be effective, the senior scientists and technicians will need field foremen, trained workers, and clerical assistance to execute the field plots with meaningful precision. This is especially important for the impact type program will include a large number of plots placed in the important production zones and on the selected crops and varied soil types.

- Additionally, funds need to be allotted for essential transportation and communication services as well as field equipment such as tractors capable of the deep plowing required to properly incorporate the lime into the soil, sprayers for plant protection, lime spreaders, small plot threshers, moisture meters, scales, specialized laboratory instruments, micro nutrients, and other necessary equipment and supplies.

- Training of personnel on a long-term basis abroad as well as short-term study tours abroad and on-the-job type with seminars and short courses should be an integral part of the program.

- The preliminary estimate of the cost to operate an impact program such as described above would be about US$1,200,000/year. A five year program is recommended which would give a total cost of about US$6,000,000 to implement this important project.

The payout from the US$6,000,000 investment over five years should be compared to the approximately US$50,000,000/year spent for importing corn into Peru. It is not unreasonable to anticipate that Peru could be self-sufficient in corn within 10 to 15 years as a result of the proposed program for lime, fertilizers, improved seed, and other agricultural inputs.

It is not expected that the credit demands by the farmers will be very great in the first year. New practices should be started slowly and farmers are naturally cautious about changing practices until the risks and economic benefits are clearly evident. After the second or third year the demand should increase exponentially as the benefits and proper usage become known and are accepted.

A policy question exists on the type of credit to be extended for liming and whether it should be subsidized. This needs further study and a long-term credit advisor is recommended to concentrate on this problem. Currently, the strong recommendation is to handle the production and distribution of lime through the private sector following the successful Brazilian pattern. Hopefully, competition will keep prices at reasonable levels.

Considering the lead time anticipated for the build-up of demand for agricultural lime, it is proposed that the rock crusher at Tingo Maria be used initially for the production of crushed rock for improving public roads. It can be used for such purposes as improving the internal road system at the Tulumayo Experiment Station, most of which is not usable during the rainy season. Thus the agricultural lime output will initially be a by-product. As the demand increases, the percentage of agricultural lime could be increased to meet the market requirements.

It is proposed that a similar dual purpose rock crusher be installed near Tarapoto on a site with good quality agricultural limestone. This would assist the promotion of limestone and sorely needed improvements in the road system. The capital investment cost would be in the range of US$1,400,000 for the crusher and other necessary equipment.

B. TEA PRODUCTION AND PROCESSING

Tea is considered a high priority crop for development in the Tingo Maria to Tulumayo area. It has been grown for over 40 years in this area by the Cooperativas de Producción, "Jardines de Té El Porvenir",as well as "Te Cafe del Peru", and their predecessor organizations. The world market demand is strong, the crop is well adapted to the area and new high yielding clones are available in the area to improve productivity and profitability for the farmers in the area.

It is recommended that assistance be given to the Tea cooperatives to strengthen their practical management techniques and that further help be given to Jardines de Te el Porvenir to modernize its factory and improve the quality of its product.

A nucleus estate operated by private enterprise is also recommended. In addition, private small satellite farms would sell fresh tea to the nucleus estate at a percentage of world market prices.

1. Production

Although there are several positive indicators, tea as a promising cash crop might easily have been overlooked. Due to a number of factors, the production record has not been encouraging. Only 550 ha are currently in production and only 605 ha were reported in 1979 by the agricultural statistics report. At that time, based on the value of production, tea ranked as the 12th crop in the Upper Huallaga areas. Industry sources familiar with the region report a spotty history of poor management and a poor quality product. Non-cooperative members have complained that they have had difficulty trying to sell to the cooperative at a profitable price and many planters have stopped production. A shortage of labor to pick tea also makes production expansion

difficult. No grade differences are recognized, and market information reports for producers are nonexistent.

Notwithstanding the past period of spotty production and other problems, a number of positive considerations exist. The zone around Tingo Maria is climatically and agronomically appropriate for tea production. Tea is among the few crops that thrive in an acid soil. It can be produced on the hillsides, in rough terrain and in soil that is not appropriate for most other crops. Tea is one of the few crops which can produce an evenly distributed and regular income for the producer. In the Tingo Maria area, there is no period of non-production as in Argentine, India & Mozambique. Instead the bush may be cropped all the year round at 8 to 10 day intervals. Another significant fact is that tea is the most likely crop to turn to if coca production were interrupted. In fact, under certain assumptions it may compete with coca economically while other crops fall far short of this potential.

The technology of tea production is known and available. Erosion can be controlled on the steep slopes by contour planting techniques. A mixed fertilizer of 25-5-5 is effective and no major pests or diseases are limiting production in the Americas at the present time. Adequate labor for plucking is a problem and is a constraint at the large plantation level. However, small-holder parcels are not affected, and, if there is a transfer away from cocoa production in this region, the large plantation system will also benefit.

Peru does not produce enough black tea for the internal market, but it avoids imports for foreign exchange reasons. Some tea is being exported to Chile and Europe but in small quantities. Currently, bulk tea is sold on the internal market for $2.50-3.00/kg.

Samples from the area were sent to the USA for commercial evaluation and the results were "most encouraging". Some of the comments on the sample follows:

1/Sample A - 6/20 Hoja Fina - 21% Pref liquor and appearance

2/Sample B - 6/20 Hoja Gruesa - 30% Thinnish liquor, stalky leaf

3/Sample A - 10/20 Bop Hoja Tierna (Extra) - 21% Very nice well made leaf, useful liquor-really O.P. grade

4/Sample B - 10/20 Exportation Hoja Gruesa - 30% Neat leaf also with tip but not as good

5/Sample A - 20/40 Filtrante Extra - 21% Cleanest, leaf all _____ mixed with fibre, liquors all medium colour and quite useful

6/Sample B - 20/40 Filtrante Hoja Gruesa - 30% Cleanest, leaf all _____ mixed with fibre, liquors all medium color and quite useful

7/Sample C - 20/40 Filtro Hoja Gruesa - 30% Cleanest, mixed with fibre, liquors all medium color and quite useful

8/Sample B - 40/60 Filtrante Hoja Gruesa - 30% Quite useful with fibre in leaf

The consultant reported that all tea samples evaluated were superior to factory-run samples because shorter fermentation gave better tea both in leaf appearance and in character. Comments and observations by other tea experts consider the quality of tea that can be produced in the area to be excellent and highly competitive in the world market.

Assistance has been granted to the tea industry by international organizations in the past. For example, the Netherlands Government financed a Project of Rehabilitation of the Tea Industry of Peru (REINTEP) which, although it operated

mainly in the Dept. of Cuzco, also provided some assistance for the modernization of the Tingo Maria Tea factories and technical assistance in the field. This work in the Tingo Maria area terminated in 1982. REINTEP introduced African clones to the Tingo Maria area with amazing results. Their production far surpassed expectations and it is possible that with proper care and management these clones could produce up to 5,000 kg/ha of black tea which would be highly competitive on the world markets. It is also worth recording that after completion of a new high-capacity factory in the Cuzco area in 1984. Tea extension and rehabilitation is being carried out by small-holders at an impressive rate.

2. Processing

In brief, the processing of tea consists of the following stages:

i) Plucking
ii) Withering
iii) Rolling
iv) Fermenting
v) Drying
vi) Sorting & Packing

i) PLUCKING. The type of plucking determines, to a great extent, the quality of the final factory product and may be classified into fine, medium and coarse categories. For a low/medium altitude tea area such as Tingo Maria, medium plucking is normal. This includes the bud and up to three leaves.

Processing of the leaf commences at the moment a shoot is plucked from the bush. This is because natural oxidation commences at the break point. For this reason it is necessary that the fresh leaf be carefully handled from the moment of plucking onward, and any bruising of the leaf should be avoided.

ii) WITHERING. Withering is the removal of some 25-30% of the moisture content of the fresh leaf. This is normally done by blowing ambient of slightly warmed air through the leaf for a period of 12-16 hours. Surface moisture is also removed by this operation. The purpose is to produce a flaccid leaf for the next processing stage.

iii) ROLLING is the crushing, tearing and twisting of the leaf in order to express catechins and enzymes from the cells. The resulting juice is effectively distributed evenly over the surface of all the rolled leaf and immediately a chemical reaction occurs.

iv) FERMENTATION is the name (wrongly) given to the natural oxidation of the catechin polyphenols present in the extracted juice. During this process, which may take 40-90 minutes, the color of the leaf turns from a green to (ideally) a copper color.

v) DRYING of the leaf is commenced when the fermentation is judged to be complete. Hot air at 95°C is blown through the leaf. This immediately arrests the fermentation process and reduces the moisture content of the leaf to some 2.5%.

vi) SORTING is the classification of the dried tea into grades based on its size.

There are now two tea processing firms in the Tingo Maria-Tulumayo area. The Cooperativa "Jardines de Te El Porvenir" is located 45 km from Tingo Maria on the road to Pucallpa. The members of this cooperative have had up to 436 ha of tea in production. They have an average yield of 7,000 kg of fresh leaf per ha which is equivalent to 1,500 kg of dry tea per ha. Annual production is around 600 Mt. The other tea processor is the Cooperativa "Te-Cafe". This firm is located closer to

Tingo Maria but has only 110 ha of tea plantation. Its average yield is 5,000 kg/ha of fresh leaf or 1,120 kg of dry tea per ha. Annual production is only 80 Mt per year. Both firms have expressed a desire to expand tea production and tea processing. Some improvements in management were reported in recent months.

Up to 1982, leaf from about 100 ha of tea owned by non-members of the Cooperatives was sold to the two factories. Because the cooperatives would not pay a realistic market price for this fresh leaf the tea has since been abandoned. Efforts should be made to bring this tea back into bearing. In 1984, the Tingo Maria cooperatives were offering 220 soles/kg for fresh leaf compared to 680 soles/kg in the Cuzco area. A realistic market price giving fair profit to the factory and to the producer at this time was around 1050 soles/kg.

The tea component of the Cooperative Te Cafe is too small to be economically viable. Modern production units are based on a minimum factory capacity of 1200 tonnes. The factory of Te Cafe is antiquated and only the sorting machinery is of any real value. The theoretical capacity of the factory is 225 tonnes annually, working a 20hr maximum day. However, only the drying and sorting machines can cope with this quantity. Withering space is inadequate. The rolling machines are either non-functioning or in a state of near collapse. Fermenting is carried out in a non-effective unhygienic manner. This cooperative must be persuaded to sell its fresh leaf to the larger factory of Jardines de Te.

The factory of Jardines was modernized to a small extent by the REINTEP project with the installation of a modern drying machine, fermenting system and a diesel power unit. The theoretical capacity of the factory is 800 tonnes annually working a 20hr day. The drying and fermenting machines are capable of handling this quantity, but withering space is short

and new rolling machines are required to produce a good quality product. The sorting area also needs additional machinery. (This could come from Te Cafe).

It is recommended that assistance be given to Jardines de Te to allow it to use its full capacity and to improve the quality of its product. An estimation of costs is as follows:

a)	Extension of withering section	
	i) construction	$. 60,000
	ii) equipment	40,000
b)	Re-equipment of rolling section	
	i) equipment	55,000
c)	Additional sorting equipment	20,000
d)	Additional diesel generator	80,000
e)	Re-wiring of electrical installation	30,000
	TOTAL	285,000

Because of the complexities of the cooperative system of management it is felt that training should be given mostly at the working level and to the Consejos de Administracion. However, because of the lack of national specialists in this important industry, agronomists from INIPA or MOA together with carefully selected members of the cooperativas should be assisted to partake of practical training in Argentina and Kenya on courses covering aspects of both field and factory management.

Tea from the two existing tea cooperatives is sorted into four grades:

Table IV.B-1. Grades for processing tea.

Purpose	Grade
. For export	Exportation
. For tea bags	Extra
. For bulk packaging	Primary
. Low-grade	Popular

The majority all of the tea originating in the Alto Huallaga is graded "Popular". That which is graded "Primera" is discounted 6% under teas from elsewhere in Peru because of improper processing. None of the tea from the Alto Huallaga accounted for any of the 470 tonnes of tea exported from Peru in 1983. The reasons for these lower grades (and lower incomes) is primarily in the processing and handling. Quality starts with proper plucking of the fresh leaves. If the plucking cycle is extended, the harvest will include considerable amounts of coarse older leaves with a reduction in quality.

An IRI consultant to PEAH also recommended that additional attention be given to the transportation of the fresh leaves from the fields to the factory. The present method of transferring tea from the plucker's bag to a large plastic bag creates the possibility of damage to the leaf. The broken leaves tend to wilt and ferment with a subsequent loss of quality. The use of baskets would minimize this damage and permit the leaves to be delivered to the factory in a fresher condition and a resulting improved quality.

Strict controls are needed to maintain quality in the factory. The consultant observed the need for better cleaning procedures in the fermenting room to minimize bacterial contamination and avoid the development of off flavors. Also, the withering troughs need to be kept dry and clean. The leaves need to be spread evenly so that drying is consistent and 25% to 30% of the original moisture content of the leaf is driven off

evenly. Another problem caused by extended plucking cycles giving a mixture of finer and coarse leaves is that the finer leaves will wither and be ready sooner than the coarse leaves. Consequently, there will be under-withering or over-withering with a subsequent loss in quality.

All of the above problems can be readily corrected with proper management. From the agricultural, processing and marketing viewpoints, there is ample evidence that good quality tea can be grown, processed and marketed on a profitable basis from the Tingo Maria to Aucayacu area.

There is urgent need for stand-by crops as alternatives for coca. Tea has one of the most favorable income-producing capabilities of the crops studied. This indicates a high and urgent priority for expanded tea production and associated processing facilities in the Tingo Maria to Aucayacu area. The existing production and processing units should not be neglected but assisted to convert to more efficient production and processing operations.

3. World Market Trends

During the last thirty years, total world tea production (excluding USSR, China and Turkey) has risen by 127%. (See table I). During this period there has at no time been a surplus of production over consumption.

Table IV.B-2. Production of major Tea exporting countries. (x 1000 Tm)

	1954	1964	1974	1982	1983	1984 est.
India *	295.0	372.4	490.0	560.5	587.7	640.0
Sri Lanka	166.0	218.5	204.0	187.8	179.3	210.0
Indonesia	46.7	46.4	51.7	73.6	92.6	92.0
Bangladesh	25.0	28.2	32.2	40.9	43.9	37.5
Malawi	7.8	12.4	23.3	38.5	32.0	34.0
Kenya	7.0	20.2	53.4	96.0	119.7	113.0
Mozambique	5.2	12.0	17.6	21.0	15.0	12.0
Uganda	2.8	7.6	21.7	2.6	3.2	4.5
Tanzania	1.6	4.8	13.0	16.2	15.6	15.0
Argentina	1.2	14.4	34.6	36.8	37.0	40.0
Brazil	0.7	6.2	6.4	10.0	10.0	10.0
Mauricio	0.5	1.4	4.0	5.4	6.1	7.0
Zimbabwe	0.4	1.4	6.1	10.8	10.8	11.0
China, other*	43.1	46.1	101.0	149.8	171.1	174.0
Total	618.0	792.0	1059.0	1250.0	1324.0	1400.0

* China exports only

Tea prices are based on demand and most producers send a proportion of their teas to the London weekly auctions to provide a guide to this demand. London auction prices in pence/kg. have increased by 461% over a twenty year period. (Table IV.B-3.)

Table IV.B-3. Average price at London Auctions. (U.K. pence/kg)

1964	1974	1979	1982	1983	1984
47.2p	59.9p	102.0p	110.5p	149.6p	265.0p

The increase in demand is mainly due to a huge increase in domestic consumption in the producer countries, mainly in India. (Table IV.B-4.) This increase is expected in developing countries and coincides with the increase in purchasing power of the lower and middle classes. Producer country consumption has increased by 418% since 1954.

Table IV.B-4. Consumption in producing countries.

	1954	1964	1974	1982	1983	1984 est.
x 1000 Tm	105	210	315	465	500	544
as% world crop	16.99	26.52	29.75	37.20	37.76	39.00

Another factor affecting the market is an increase of imports by the European block. Whereas the Western world's consumption has remained relatively static (Table IV.B-5.), with the exception of USA where it is steadily increasing, exports to the USSR and Eastern Europe and to non-producers in Asia and Africa have grown by 358% over the last 30 years. (Table IV.B-6.)

Table IV.B-5. Net imports for consumption - "Western World". (x 1000 Tm)

	1954	1964	1974	1982	1983	1984 est.
United King.	228.0	224.6	208.0	183.6	155.2	170.0
U.S.A.	51.7	60.5	80.6	82.7	77.1	90.0
W. Europe	35.0	29.4	36.9	46.7	45.8	47.3
Australia	30.0	38.1	35.2	29.3	29.4	29.4
Canada	20.1	20.2	21.0	17.7	17.5	18.0
Ireland	12.0	9.0	12.0	8.8	10.9	10.0
Total	376.8	381.8	393.7	368.8	335.9	364.7

Table IV.B-6. Net imports for consumption - "Others". (x 1000 Tm)

	1954	1964	1974	1982	1983	1984
African	62.1	89.7	114.2	124.8	149.8	n.a.
Asian	39.0	59.1	146.1	212.1	224.6	n.a.
USSR & E. Europe	0.0	37.4	60.9	95.0	89.0	n.a.
Total	101.1	186.2	321.2	431.9	463.4	

The increased tea consumption of these non-traditional

tea importing countries makes it difficult to foresee a position, in the short or long term, where supply will overtake demand.

4. Availability of Clonal Planting material

Some 20 different African clones were introduced to the Tingo María area in 1979. These clones had been selected for their high quality and production capabilities. Approximately 2000 clonal plants are standing at Te Cafe and a further 200 at Jardines de Te. There is a possibility that this valuable material may be lost through neglect as the cooperatives have no extension or replanting programs for the foreseeable future.

Each tea plant, with proper fertilizing and pruning, is capable of producing a minimum of 200 v.p. cuttings per annum. Mother bush plots are planted at a spacing of 1.20 x 1.20m, i.e. 7,000 bushes/ha and commercial plantations are planted at a rate of 13,0000 plants/ha. (14,000 including losses). Thus one hectare of mother bushed can produce material for 100 ha of commercial planting annually.

The recommendation entails a maximum planting program of 300 ha/yr for which 3 ha of mother bushes would be required. Normal planting practice is to use a minimum of 6 different clones in any one estate to reduce risks of loss due to the susceptibility of any particular clone to drought, disease or insect attack. It is necessary, therefore, to establish nucleus mother bush plots of 3,500 plants for each of the 20 clones, the most successful of which will be used for the commercial planting. This work should be undertaken by the Tulumayo Research Station under the guidance of the long-term Tea specialist. Besides being used for propagation these plots may be used for important research and the harvests sold to existing or future tea factories to provide additional research funds.

5. Recommendations

Assistance to the two tea-producing cooperatives as previously described is recommended. This would involve a loan to the cooperative "Jardines de Te el Porvenir" and training courses for ministry and cooperative personnel. On the job training should also be given by a long-term tea specialist.

A new integrated commercial tea operation is also recommended. It is suggested that a nucleus estate type operation with central processing facilities and small-holders operating satellite farms would be an efficient unit organization. The new plantings would utilize the new high yielding clones which are available and the central unit would provide technical assistance and logistical support to the small units as well as managing its own commercial plantings.

It is recommended that a long-term tea specialist be assigned to work in the area. He will assist in training the tea horticulturist at the Tulumayo station and develop a meaningful research program. In particular, he will assist in the preparation and distribution of the new high-yielding tea clones that are available. A tea extension specialist stationed in the area of production should be added to the staff also. He too will need special training and advisory assistance as the project takes hold.

Additional short-term consultants may be required to supplement the work of the long-term tea advisor. In particular, experts on farm management and market development may be required.

6. Strategy statement

A combined financial and technical assistance program is proposed with objectives of: (1) Diversifying the crops that are at present grown in the Huallaga Valley; (2) Providing the campesino with a regular year-round income; and (3) Attracting business investment to the area. To achieve this, a combined financial and technical assistance program is proposed.

The financial assistance would cover:

a. The construction of a tea factory with a capacity of 2,200,000 kg black tea annually; and

b. The preparation and planting of 200 ha of clonal tea suitable for mechanical harvesting;

The technical assistance would cover:

a. The preparation and planting of 800 ha clonal tea in small-holder's parcels;

b. The maintenance costs of the above area for a period of three years from planting;

c. The preparation and distribution of eucalyptus plants, to ensure 1,000 ha of plantation in small-holders plots for future sale to the factory as firewood;

d. The infrastructure for the above to ensure leaf collection points, access roads, etc; and

e. Technical assistance personnel to supervise all the above program and the training of necessary counterparts.

The preliminary estimates and numbers presented here must be understood in light of the following information, assumptions and omissions. First, it is assumed that funds will be made available for the capital expenditures and for the technical assistance and labor needed to obtain a total of 1,000 ha (200 ha for the nucleus factory and 800 ha for small-holders). Hence the sources of the necessary capital and funding are not clear at

this time, no interest charges have been included in the preliminary projections. It is possible that the cost of building the tea factory and perhaps the installation of the 200 ha of tea to be operated by the nucleus estate with mechanical pickers would be commercially financed or possibly with some concessionary interest rates.

For the small-holders, it is assumed that the funding for this aspect of the development would be largely on a concessionary basis. It is proposed that the small-holders on the 800 ha area will provide the necessary labor during the development phase of the first few years and that they would be remunerated for these services. Therefore, an income column for this item is shown as well as a column for income from tea sales. The small-holders would be subsidized for the initial four years until the tea reaches commercial production levels.

The preliminary figures are presented on a cash basis. Equipment including trucks and tractors normally would be amortized over a two-to-five year period. Over twenty years the tea factory and the tea plantations, if properly maintained and if the misses are replanted, need not have depreciation charges as they would have a relatively indefinite life.

The activity would still be viable even if these costs were included and even if interest charges were included for capital expenditures. The production cost estimates are believed to be realistic and the selling price of $2.00/kg could be increased to $12 to $15/kg for a good portion of the crop plus the cost of tea bagging equipment with a relatively modest capital investment.

The figures and estimates presented on the following pages are of a preliminary nature and will require further refinements

before credit institutions or donor organizations can be approached with definite proposals.

Preliminary investigation into possible sources of finance have shown that a U.S. tea company is interested in participating in the factory and nucleus estate, but only when strong guarantees are provided. The U.N. Division of Narcotic Drugs has also shown an interest in co-sponsoring the establishment of the satellite farms via its Fund for Drug Abuse Control.

Table IV.B-7. Tea production budget.

1. Financial Assistance	
a) Capital expenditure plantation	$ 739,450
b) Capital expenditure factory	$ 2'875,000
c) Infrastructure	$ 690,000
d) Upkeep & running inc. Yr 4	$ 2'197,500
Sub-total	$ 6'501,950
2. Technical Assistance and labor	
a) Capital expenditure plantation	$ 3'316,750
b) Infrastructure	$ 300,000
c) Upkeep 3 years after planting	$ 6'371,000
d) Tech. assistance personnel	$ 3'412,740
Sub-total	$ 13'400,490
Total Costs	$ 19'902,440

These figures are based on a minimal yield per ha of 2,000 kg black tea/ha for small-holders and 3,000 kg for the plantation, although results of experimental clonal plantations in the zone show that actual yields may reach 5,000 kg/ha. The sale price of the black tea is taken at a modest $2.00/kg. The small-holder receives 11% of $2.00 per kg of fresh leaf supplied to the factory. (The factor of 11% of average black tea sale price must be established by ministerial decree to protect the interest of small-holders. A decree exists which defines the quality of leaf acceptable to a factory).

Table IV.B-8. Net Income of tea production.

	Factory	Small-holders Total	From Tea Sales	From Labor
Year 2	$ -(477,250)	800,000	--	$ 800,000
Year 3	$ -(337,850)	$ 1'115,100	$ 155,100	$ 960,000
Year 4	$ 417,600	$ 1'381,900	$ 361,900	$ 1'020,000
Year 5	$ 814,025	$ 1'634,600	$ 614,600	$ 1'020,000
Year 6	$ 1'110,175	$ 1'169,300	$ 929,300	$ 240,000
Year 7	$ 1'275,800	$ 1'187,300	$ 1'107,300	$ 80,000
Year 8	$ 1'323,000	$ 1'200,250	$ 1'200,250	--
Year 9	$ 1'369,600	$ 1'284,100	$ 1'284,100	--

Table IV.B-9. Planting program, rates of fertilizer application and rates for upkeep of tea production.

Planting Program:		
a) 200 ha for mechanical plucking		
	Year 2	- 100 ha
	Year 3	- 100 ha
b) 800 ha for small-holders		
	Year 2	- 200 ha
	Year 3	- 200 ha
	Year 4	- 200 ha
	Year 5	- 200 ha
Rates of fertilizer application:		
a) 200 ha for mechanical plucking		
	Year 2	- 1000 kg/ha
	Year 3	- 1000 kg/ha
	Year 4	- 500 kg/ha
	Year 5	- 750 kg/ha
	Year 6 on	- 1000 kg/ha
b) 800 ha for small-holders		
	Year 2	- 1000 kg/ha
	Year 3	- 1000 kg/ha
	Year 4	- 500 kg/ha
	Year 5	- 500 kg/ha
	Year 6 on	- 750 kg/ha
Rates for Upkeep:		
All tea area		
	Year 1	- 200 man-days/ha
	Year 2	- 100 man-days/ha
	Year 3 on	- 50 man-days/ha

The per diem rate for a laborer is calculated at US$4.00.

Table IV.B-10. Capital expenditures of tea production.

Capital Expenditure	per ha	Total
Costs of 200 ha mech. plucked		
1. Land preparation	400	80,000
2. Clonal material	1,740	348,000
3. Plucking machines (5)		150,000
4. Tools & Implements		5,000
5. 2 tractors 6 trailers		60,000
6. Price increases (15%)		96,450
Sub-Total		739,450
Costs of 800 ha "Te villageois"		
1. Land preparation	400	320,000
2. Clonal material	1,740	1'392,000
3. 8 tractors 24 trailers		240,000
4. Re-forestation material	250	250,000
5. Infrastructure		300,000
6. Price increases (15%)		375,300
Sub-Total		2'877,300
Sub-Total Field Works		3'616,750
Costs of Factory		
1. Buildings		800,000
2. Machinery		1'700,000
3. Price increases (15%)		375,000
Sub-Total		2'875,000
Costs of Infrastructure		
1. Administration Buildings		50,000
2. Senior staff housing		150,000
3. Junior staff/labor quarters		150,000
4. Workshop		50,000
5. Roads		200,000
6. Price increases (15%)		90,000
Sub-Total		690,000
GRAND TOTAL CAPITAL EXPENDITURE		7'181,750

Table IV.B-11. Current expenditures for tea plantations.

CURRENT EXPENDITURE	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9
200 Ha mech. plucked								
1. Planting	80,000	80,000						
2. Upkeep	80,000	120,000	60,000	40,000	40,000	40,000	80,000	80,000
3. Pegging	160,000	160,000						
4. Fertilizer	30,000	60,000	45,000	37,500	52,500	60,000	60,000	60,000
5. Herbicides/Insecticides	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
6. Transport	25,000	25,000	25,000	25,000	45,000	60,000	60,000	60,000
7. Administration	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
8. Price increases (15%)	62,250	72,750	25,500	21,375	26,625	30,000	36,000	36,000
TOTAL	477,250	557,750	195,500	163,875	204,125	230,000	276,000	276,000
800 Ha "Te Villageois"								
1. Planting	160,000	160,000	160,000	160,000	0	0	0	0
2. Upkeep	320,000	480,000	540,000	540,000	240,000	80,000	0	0
3. Pegging	320,000	320,000	320,000	320,000	0	0	0	0
4. Fertilizer a/c T.A.	60,000	120,000	150,000	150,000	90,000	30,000	0	0
a/c small-holders	0	0	0	30,000	75,000	120,000	165,000	180,000
5. Herbicides/Insecticides a/c T.A.	20,000	40,000	60,000	60,000	40,000	20,000	0	0
a/c small-holders	0	0	0	20,000	40,000	60,000	80,000	80,000
6. Transport a/c T.A.	100,000	100,000	100,000	100,000	0	0	0	0
a/c small-holders	0	0	0	0	21,000	26,000	30,000	32,000
7. Administration	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Subtotal a/c T.A.	1,010,000	1,250,000	1,360,000	1,360,000	400,000	160,000	30,000	30,000
T.A. Total (incl. 15%)	0							
Subtotal a/c small-holder	0	0	0	50,000	136,000	206,000	275,000	292,000
Small-holder Total (incl. 15%)	0							
Factory Running Costs								
Inclusive green leaf purchase	0	28,100	686,900	1,222,100	1,885,700	2,294,200	2,601,000	2,754,400
Black Tea Produced (200 Ha)	0	100	300	450	550	600	600	600
Black Tea Produced (800 Ha)	0	150	350	650	1,050	1,300	1,500	1,600
Total	0	250	650	1,100	1,600	1,940	2,100	2,200
Gross Income From Tea Sales	0	50,000	1,300,000	2,200,000	3,200,000	3,800,000	4,200,000	4,400,000
Net Profit Factory	(477,250)	(337,850)	417,600	814,625	1,110,175	1,275,800	1,323,000	1,369,600
Small Income Green Leaf Sales	0	155,100	361,900	672,100	1,085,700	1,344,200	1,551,000	1,654,400
Small-holder Income Tech. Assis.	800,000	960,020	1,020,800	1,020,000	240,000	80,000	0	0
Net Income Small-holders	800,000	1,115,100	1,381,900	1,634,600	1,169,300	1,187,300	1,200,250	1,284,100

Table IV.B-12. Cost of technical assistance for tea plantations.

COST OF TECHNICAL ASSISTANCE	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	TOTAL
Expatriates								
1. Project Manager	72,000	72,000	72,000	72,000	72,000	72,000	72,000	504,000
2. Agronomists (2)	120,000	120,000	120,000	120,000	120,000	120,000	120,000	840,000
3. Mechanical Engineers	30,000	120,000	60,000	60,000	30,000	0	0	300,000
Subtotal	222,000	312,000	252,000	252,000	222,000	192,000	192,000	1,644,000
Local Staff								
1. Agronomists (4)	24,000	24,000	24,000	24,000	24,000	24,000	24,000	168,000
2. Agro-technicians (12)	28,800	28,800	28,800	28,800	28,800	28,800	28,800	201,600
3. Mechanics/Electricians(4)	12,000	12,000	12,000	12,000	12,000	12,000	12,000	84,000
Subtotal	64,800	64,800	64,800	64,800	64,800	64,800	64,800	453,600
Various								
1. Housing	200,000							
2. Vehicles	120,000			60,000				180,000
3. Travel & Lodging	20,000	20,000	20,000	20,000	20,000	20,000	20,000	140,000
4. Backup Head Office	50,000	50,000	50,000	50,000	50,000	50,000	50,000	350,000
Subtotal	390,000	70,000	70,000	130,000	70,000	70,000	70,000	870,000
Price Increases (15%)	101,520	67,020	58,020	67,020	53,520	49,020	49,020	445,140
Total Technical Assistance	778,320	513,820	444,820	513,820	410,320	375,820	375,820	3,412,740

C. OIL PALM PRODUCTION AND PROCESSING

Peru is a net importer of edible oils and the continued development of African oil palm in the Huallaga Valley should be a priority project.

1. Production

Since only approximately 4,000 ha of oil palm are now in production, this crop does not rank high in terms of land occupied. Its economic importance however, is substantial. With yields of 10,500 kg/ha of fresh fruit bunches a total production of 41,916 Mt was obtained. At an average price in 1983 of 815 soles/kg, the total value of oil palm at the farm level was S/.34,162 million soles making it the second highest income producer in the Upper Huallaga. The sales of plátano, the third ranking income producer, were less than one-third of palm oil sales.

Oil palms are grown on a wide range of soil types. Well drained soils which have deep profiles that permit wide root expansion, are most desirable. Optimum rainfall patterns are those with a steady year-round precipitation. Periods of drought cause moisture stress on the plant and reduced flowering which gives periods of lower subsequent yields. Consequently, a resulting in periods of 2,000 mm with no pronounced dry season is preferred. A preferred temperature range is between 20° and 32°C. At least 5 hours sunshine daily throughout the year is required.

The bulk of the world's oil palm plantings lies between 10° North and 10° South of the Equator. This tropical crop is essentially is a lowland plant which thrives on good soils where moisture is plentiful, sunlight can penetrate, and competition

from other growth is not intensive. In addition to the well-structured alluvial soil that is able to retain moisture, the crop does best on a terrain that is flat to gently-undulating. Steep land is not only more expensive to cultivate, but water and soil conservation become progressively more of a problem with steepness, as does the harvesting and transport of the fresh fruit bunches.

For processing, a plentiful supply of fresh water, an adequate supply of labor, and a good transport system are needed both for the delivery of the fresh fruit bunches and for the delivery of the crude oil extracted to the next processor of finished oil. Environments that do not meet the above criteria can produce oil-palms but with certain disadvantages.

The Tocache and Uchiza area meets the growing conditions fairly well. A significant labor shortage in the area may be a major draw-back for the development plans of the processors. The present plantation-processing plant proximity to the fields is essential because fresh fruit bunches must be processed quickly after harvest. Under a system where small producers participate in production there is a practical limit as to the distance that they can be located from the processing plant in order to meet the time requirements for delivery to the processor. Such private independent producers can contemplate a yield of 20 tonnes of fresh fruit bunches per ha. per year, but this yield will be reached gradually. Maturity is not reached for 4 or 5 years and then yields may be 7.5, 12.5, 17.5 tonnes for the first 3 mature years. Yields, will of course, also be influenced by the fertilization program. Fertilizer costs often account for 20-30% of field costs.

The cost of installing a field of palm trees is approximate $2,000/ha. After maturity, the costs of harvesting and the costs of fertilizer become the major operating costs.

In developing new plantations, the hybrid seed is germinated following special heat treatment procedures. It is grown in nurseries for 3 to 4 months after germination. Off-type plants are rogued out, and the selected plants are put in plastic bags and transferred to a field nursery at 2 ft x 2 ft spacing. Planting in the field generally is done at 15 to 18 months. Field spacing is usually at 30 ft x 30 ft spacing.

2. Harvesting

Correct selection of ripe bunches, careful handling, and speedy transportation to the factory are essential for high quality. The importance of correct field practices cannot be over emphasized. Good quality oil cannot be obtained from poor quality fruit. Loss of quality at any stage is irreversible. As fruits attain full ripeness, the oil content of the mesocarp increases rapidly as a result of the conversion of carbohydrates into fats. When the oil content in a fruit has reached its maximum, the fruit becomes loose on the bunch and some of it falls to the ground. An additional feature as the fruit ripens is that its color changes from deep purple to reddish-orange. During the final week of ripening the quantity of fat expressed as a percentage of the dry weight of the fruit, increases three-fold.

The oil content of fruit is thus a function of its degree of ripeness. However, the fruits on any given bunch do not ripen simultaneously and the time lag between the ripening of the first fruits and the last on a bunch may be as long as 16-20 days. Hence the knowledge of when to harvest is fairly technical. It is a compromise between maximum oil content and fatty free acid which is preferably low yet it increases as the fruit becomes ripe.

Some of the factors that may affect palm oil quality are generic, agronomic, environmental, the age of the palm, and harvesting techniques. Much research work is still required to determine the importance of each of these factors in a given area of production. Of equal importance is considerable amount of time which the extension education specialists must devote to helping producers know when to harvest, how to harvest, and how to handle fruit before delivery. Much of the damage that occurs during harvesting and handling can be avoided. Some of the common practices that reduce quality include:

- Letting fruit fall to the ground;
- Pest damage to ripe fruit;
- Throwing fruit into baskets or containers;
- Rough handling in the collection vehicles;
- Dirt damage from placing fruit on the ground or in dirty containers;
- Rough roads;
- Labor walking on the fruit.

New producers of palm oil have much to learn about correct harvesting and handling methods and extension workers well-trained on the subject can help them avoid the loss of quality before the product reaches the factory.

3. Processing

The palm oil enterprise in Huallaga Valley is centered around the operations of EMDEPALMA, a public oil processor in the Uchiza area. This firm is the only processor in the study area at this time. Their operations include plantation production with 5,250 ha planted and about 3,500 ha now producing. Their output shows a significant growth, with crude oil production in 1976 of 660 Mt, and increasing over the next six years to 3,380, 4,392, 4,429, 5,520, 7,000, 7,708, and 9,559 Mt (in 1984). This

firm has an excess capacity at present with its 20 tonnes per hour, but its projection of 5,250 ha production in the near future will help with this problem. In three years this firm's production will replace 25% of present imports.

Palma del Espino is a second firm that is moving rapidly toward a significant contribution to the volume of crude oil for the market. This firm is a joint public and private operation that produces palm trees in large plantations. About 3,000 ha have now been planted to palm trees, and within three years production will be forth-coming. A processing plant with 40 tonnes per hour capacity is being planned by this firm. It projects a planting of 6,000 ha.

A third processing firm called Palmselva S.A. is planning the produce palm oil in the Tocache area through small holdings with the expectation that the oil produced will be extracted by existing processing firms. PEAH is supporting this proposal.

The market structure for palm oil is in place with 100% of the oil going directly to Lima for packaging and distribution within the country. Peru is deficient in edible oils, so the ready-made market should support a favorable price. Crude oil produced in the producing area is sold to five or six oil processors in Lima who produce a refined finished oil for sale to retailers under their own brand names. The crude palm oil reduction ratio from the raw material from the palm tree is about 1:4.

The state enterprise, La Palma Aceitera S.A. (EMDEPALMA) is producing about 13 tonnes per hour of crude oil which is shipped in bulk to Lima for refining. The kernels are sterilized in an autoclave in order to inactivate enzymes which would cause rancidity, followed by a combination of pressing and centrifugal separation, resulting in a yield of about 70%. The cake from the

fruit is discarded. Because of the high degree of saturation of this oil it is stable to oxidative rancidity. Refining losses are therefore, low in comparison to other vegetable oils.

Oil palm cultivation and processing must always be organized together because of the need to process the fruit as soon as possible after harvesting. The oil-palm produces bunches of fruit that must receive a hot water bath (sterilizing) for about 70 minutes before the fruit is loosened from the bunches. This process also arrests the build-up of the free fatty acid content. In good growing conditions commercial plantings can yield annually up to 32 tonnes of fresh fruit bunches per ha during a twenty-five year life. There are, however, considerable variations in fruit, oil and kernel yields because of climatic and soil conditions. Although there are peaks and troughs in fruit production, oil-palm produces yields throughout the year and a permanent work force is required.

Extraction rates of 21% for refined oil and 4% kernels can be expected from a well-run factory. Empty bunches are burned to provide an ash rich in potash that can be used as a fertilizer. Dried fibre and kernel shell are used for boiler fuel. Palm-oil is a fluid that can be pumped into tankers for transport and it can be stored for several months if care is taken to avoid excessive exposure to air, heat, or impurities. The handling of crude oil does not present the same problems as do the more perishable products produced at great distances from the final processor. Kernels are usually packed in polyethylene-lined sacks and, provided care is taken, they can be stored for prolonged periods.

From 200 kg of fresh fruit bunches, 67 kg of fresh fruit is obtained and this fruit yields 64% crude oil and 36% pressed cake. The crude oil when finally processed yields about 50% pure oil or about 21% of the fresh fruit bunches. The pressed cake is

about 17% kernel which can be processed for its oil content and meal. The remainder of the pressed cake is dry fiber, shell and some water.

The oil palm kernel is a stone fruit resembling a peach. Oil can be extracted from the pit as well as from the fruit. EMDEPALMA does not itself extract oil from the pits. Rather they are shipped to a private firm in Lima which converts them into an oil (44-53% by weight of the pit) that is high in short-chain fatty acids--about like coconut oil and generally used for soaps and cosmetics. The cake from oil palm pits is 19% high-quality protein and is in strong demand for animal feed.

Oil palm fruits are composed of a thick yellow-red oily pericarp, a hard shell, and a relatively hard small kernel. Commercial palm oil is the oil of the pericarp. The shells are cracked in the local factories, and the pericarp oil and kernels are the products of these factories. Kernel oil is usually extracted elsewhere, with the residue of kernel meal being used for mixing in cattle foods. The extraction of the pericarp oil does not yield a meal useful for livestock feed but a dry fiber that can be burned.

4. Market Demand

World demand for palm oils is expected to increase for several specific reasons. First, during the 1970's and early 1980's, palm oil prices in the world market have been traditionally, lower in price than other edible oils. Palm oil imports in the major world markets have been projected to grow at an annual rate of 8.6% during the middle 1980's years. Palm oil finds its major market in the principal importing countries for use in the manufacture of edible products. The demand for fats and oils will probably keep pace with rising per capita income in the developing countries, magnified by population increases.

Most developing countries consume 3-5 kg per capita a year while industrialized countries consume 27-30 kg per person. When consumption is in the 3-5 kg range, a rule of thumb holds that for every $100 increase in per capita income, a 0.5 kg increase in the consumption of fats and oils results. It is expected that countries such as China, India, Japan and Pakistan will increase both population and per capita income and that imports of fats and oils will rise rapidly.

It is likely that the major developed countries with rising incomes will remain as major demand sources and that world trade in palm oil will expand in response. The interchangeability among the oils suggests to some observers that palm oil might well be used for some purposes for which soybean, cottonseed, or peanut oil have hitherto been considered best suited.

As demand expands throughout the world, the supply response is expected to grow also. It is reported that palm can produce more oil per hectare than any other oil seed, and this indicates that the competition to supply the increase in world imports will be strong. The world market conditions appear to be favorable but this should not detract from the requirement that the exporting countries be efficient producers and take steps to assure that the high quality of their product will give it a place on the quality demanding world market.

Palm oil is expected to increase its penetration of the world market because of its price advantage and substitutability for other oils. These two factors will make it particularly attractive to developing countries whose incomes and population are both expected to increase.

5. "Nucleus estate" concept

The "nucleus estate" is an agribusiness which includes a processing plant, a wholly-owned core farm which guarantees to the factory a continuous supply of high quality raw material in an amount generally less than total demand, and a relationship with a number of independent producers (usually a fairly large number) who already live and farm in a defined area adjacent to the core farm or who may have been settled in this area by a public agency. Clearly, the nucleus estate is just a refinement of an old practice of contracting for the purchase of crops, before or at harvest, on the part of food and fiber processors.

The system has many advantages. The company is assured of substantial production, generated under its own control. A considerable tactical benefit is derived from creating a constituency of farmers whose self-interest is to identify with the company. The production risk is spread, both in terms of area and ownership. Labor relations become more peaceful, and quality control can be maintained, because the nucleus estate easily serves as a combination research station, training center and processing site.

A farmer contemplating the economics of entering into a nucleus estate agreement will need to inform himself as to the agronomic requirements for production of the crop and the high initial costs of planting. Installation costs will approach $2,000/ha. Labor requirements for installation, maintenance, and harvesting may be a major consideration in the area. The following table presents estimates of average labor inputs by year.

Table IV.C-1. Labor inputs in man days per hectare.

	Years						
	1	2	3	4	5	6-10	10-25
Installation	26.4						
Maintenance	64.8	70.8	48	30	22.8	22.8	22.8
Harvesting				16.8	21.6	27.6	38.4
Total	91.2	70.8	48	46.8	44.4	50.4	62.2

6. Recommendations

A system of satellite farms around a nucleus estate is recommended for the Tocache-Uchiza area for the production of palm oil under contracts with the two major estates now in operation in that area. An important observation in support of this recommendations is that a high priority has already been placed on the production of palm oil by EMDEPALMA and Palma del Espino. The existing plantings total in excess of 8,000 ha, and there are firm plans to extend plantings to more than 11,000 ha. One processing plant is in operation, and the second expects to have its new plant ready soon for the first harvest of its plantation.

The capacity of the processing facilities will exceed the expected plantings in the plantations. It will therefore be necessary to expand production of fresh fruit bunches as these processing plants become fully operative. On the basis of the relationship between plant capacity and expected plantation production, new plantings appear to be justified. Small farmers in the area are expected to benefit from participation in the growth of this industry, and the satellite system contracts are a feasible way to expand the benefits.

The market potential is favorable. Peru has a deficiency in its production of edible oils, and an import replacement activity will gain national support. The world market has been growing

and is expected to grow in relationship to growing population and incomes. Palm oil is expected to compete favorably in the coming years as it has during the past decade.

Due to the technical inputs required for the production of palm fruit, and the specialized care in harvesting and handling the fruit which is required for high-quality palm oil, there must be established an effective extension information distribution system. This extension service might well be expected to come from the nucleus estate processing firms, but to initiate it with the intention of specifically benefiting the small satellite farmers will require an effort that goes beyond any such service that may now be provided by the nucleus firms.

Much of the research work will be done by the nucleus estates, but visiting consultants will benefit the industry in a direct and immediate way. The firms may also welcome consultants prepared to help them in their organizational management problems and contracting arrangements with satellite farmers.

7. Strategy Statement

a. A top priority with an immediate time activation is assigned to establishing a nucleus estate arrangement among the processors and plantation producers in the Uchiza area and the independent small potential producers in the immediate area near the processing facilities. A special consultant with experience in palm oil production and nucleus estate management should be engaged to prepare a feasibility study and draft specific recommendations including contract arrangements. Before bringing in a consultant, a close collaborative and cooperative environment must be created with the two palm oil companies expected to process the fruit and with the third firm sponsored by PEAH to bring small producers into the industry.

b. An extension specialist should be employed to start detailed specialized training in palm oil production and nucleus estate structures. At first, he might be employed by the extension service but later may become an employee of the processing firms. Because of the anticipated training time, this specialist should start his training without delay.

c. The credit constraint must be approached by making provisions for intermediate type loans. Large sums for individual farmers are not anticipated, but relatively small loans for many farmers are expected to be necessary. With the assumption that oil palm tree installation will cost about $2,000 per ha and that the first year 100 farmers will each add 2 ha, the credit required would be $400,000. The next year an additional 100 farmers could be added and again the third year making a total of 600 ha of oil palm and a need for $1,200,000 medium-term credit. This assumes that each producer will be capable of financing the maintenance costs for 4 years after which he can expect a cash inflow that will permit him to start loan repayment.

d. The proposed nuclear estate-satellite producer model is patterned after similar models in other countries for a variety of products. Characteristics of the model of particular relevance include the need for substantial control by the nuclear processing plant over the raw product production and harvesting. The need for control centers around the urgency of quality control, and product flow to the processor in addition to the need for supply expansion. Formal contracts between processor and satellite producers a market outlet for specialized products and the price or an appropriate pricing formula is established. The processor is assured a regular supply of quality products compatible with processing needs. Provision of certain inputs such as fertilizers, seedlings, insecticides, credit and labor at

harvest time are included in the contractual arrangements. Also technical assistance, research, and training may be stipulated.

The oil palm nuclear estate model proposed has the advantage of bringing small and medium-sized producers into a profitable program made feasible only through close collaboration with a processor who must operate with a large volume in order to capture economies of size.

Although the nuclear estate processor is expected to provide needed technical assistance to producers, it is reasonable to assume that the extension service and experiment stations must provide assistance in the early stages of the project period.

D. CACAO PRODUCTION AND PROCESSING

Cacao is a crop well adapted to production in the Huallaga Valley. It has a high unit value and the world market prospects are good. Consequently it is recommended that the production areas of the crop be expanded. However, improvements are needed in fermentation and drying practices to improve quality.

1. Production

Cacao in the Upper Huallaga Valley has a long standing production tradition. Visiting technicians report that there is a reasonable amount of technical information at the experimental station and that farmers generally know the production principles of the crop. As with all crops, there are opportunities for improvement. However, the long history of production on the established infrastructure of the Naranjillo Cooperative provide a firm base for a development project.

Although cacao plantings and production levels have fluctuated, they have been more constant than most other products in the area. In the province of Leoncio Prado where about 1/3 of the cacao in the PEAH zone is produced, the fluctuation from year to year over the past 10 years has not been over 2% above the 1972 production figure or under 87.4% of the base year. In the PEAH area, the number of hectares in production is increasing --1,505 ha in 1981, 1,768 ha in 1982 and 2,021 ha in 1983. A recent survey by the extension agents in the 9 extension districts of the area reported 2,692 ha in production and an additional 602 ha in development. This survey reported 268,939 plants in nurseries. Yields over the four-year period in the PEAH area showed a substantial upward jump from a low in 1981 of 180 kg/ha, to 350 kg/ha in 1982, 303 kg/ha in 1983 and an estimated 400 kg/ha in 1984.

It is clear that cacao production and yields are on the increase. An IRI consultant recently reported to PEAH that "The plan for renovating old cacao plantings and increasing the acreage of this crop in the Upper Huallaga valley appears to be a very sound one from all standpoints". He reports that favorable prices and world demand for the product are positive incentives for expanding production.

The construction of a $ 4 million dollar processing plant near Tingo María by the Naranjillo Cooperative brings optimism and expectations for the future. The cooperative is large from the standpoint of its 5,000 or more members. Although most of the money for the new construction comes from outside funds, the members are to some extent participating with their own funds.

Using the value of production per ha as a comparison, cacao production yields greater economic benefits than do other products in the area. However, the costs are not comparable so the net returns are not so favorable. The costs per hectare of installation are high and amounted to a total of S/.3,530,450 for the first three years (1983 costs were $2,098). With high interest costs, this high installation cost represents a prohibitive constraint because about 2 1/2 years are required before the first production can be sold.

PEAH reported in 1983 that the value of production per ha of cacao in the PEAH area was 861,000 soles; 691,800 for rice; 476,000 for coffee; and 356,300 for corn. Unfortunately the costs reported per kg by PEAH for these crops were higher than the prices for the crops, and it is difficult to determine the net returns for each from the cost and price date reported.

From the production viewpoint cacao has definite advantages. However, there are processing and quality problems that must be dealt with. The first step in the processing is accomplished by

the producers and that is to ferment and dry the cacao bean. The combination of home-made equipment, lack of attention to details, and weather conditions result in a low quality product being moved into the marketing channels.

Cacao can be profitably cultivated only within 20 degrees north or south of the Equator; it requires a mean shade temperature of 26°C and an evenly distributed rainfall of 1,250 mm to 3,800 mm (50 to 150 inches) a year. The cacao tree thrives best in a rich, well-drained soil. It does not withstand droughts or do well without shade and protection from the wind. Shade is necessary for newly planted trees for 2 to 4 years, after that, shade is not as important.

The best planting stock is raised from hybrid seeds selected from the best yielding trees with disease resistance and other desirable characteristics. The pods intended for planting must be fully mature. The seeds may be sown directly in the field but preferably in nurseries. In the nursery the young trees grow rapidly, and a few months after planting they are ready for transplanting.

After 2 1/2 to 3 years the cacao tree begins to bear fruit. However, some growers try to prevent the fruit from maturing until the tree is older so that the tree will not be weakened from too early fruit bearing. Trees can produce for many years, perhaps longer than 50 years if properly cared for.

Average yields per hectare range from 350 kg/ha to 600. Soil conditions vary from sub-area to sub-area, as does the selection of planting material, and management practices. It is proposed that the experiment station can help by planting simple comparative plots for future reference and selection of trees.

Much of the cacao in the Upper Huallaga consists of plantings which were made as much as 20 years ago, but later abandoned. The process of renovating old plantations is not simple. Shade for new plantings, spacing, pruning and other technologies are important and farmers will benefit from help and guidance in proper management.

The problem of inadequate labor in the Huallaga Valley is of recent origin and is due to competition from the coca activities. The need for credit far exceeds its availability. Short-term one year credit is not the appropriate vehicle for those who seek to install new plantings because of the long wait before a crop is ready for sale. The high cost of credit and the almost complete absence of medium-term credit is the major constraint to cacao plantings and expanded production.

The soil in the Upper Huallaga area is appropriate for cacao production, but for high yields the proper use of fertilizers is required. It is assumed that the technologies of fertilizer use, insect control, and disease control are available and that these technologies will be disseminated among the farmers as their benefits are recognized. The lack of short-and medium-term credit again becomes the limiting factor. Annual crops have a definite advantage over perennials for this reason alone.

2. Market Demand

One of the most promising aspects of expanded production of cacao is the favorable situation relating to both the internal and external market. Cacao is produced exclusively by less developed countries. Five countries produce 80% of the world's supply--Ghana, Brazil, Ivory Coast, Nigeria and Cameroon. The bulk of the world's production of cacao continues to be exported in raw form. Although Brazil has made inroads into cacao

processing, the developed nations still dominate the processing of this product.

Europe, U.S., Soviet Union and Japan are the main importers of cacao and collectively account for 80% of the world's imports. Tariffs and non-tariff barriers imposed by importing countries were removed partially during the 1970's.

Studies have indicated that the demand for cacao is inelastic which means that changes in supply will cause a greater proportional change in price response. Also the income elasticity is inelastic which means that expenditures for the product will not increase proportionally with incomes but the relationship is positive.

World demand, although showing a long-run upward trend, shows year-to-year fluctuations that are disturbing to entrants into the market without reserves to tide them over the bad years. The world market does respond negatively to disturbances such as wars, recessions, political events and reductions in income.

In 1982, Peru exported US$ 18 million worth of cacao (in the form of butter, paste and beans). The US was the principal buyer, accounting for 75 percent of the purchases. The present world market for cacao in semi-processed form appears to be strong. However, this is a widely traded commodity, and in the past the market has been subject to cyclical fluctuations. (Table IV.D-1)

Table IV.D-1. Structure of cacao exports from Peru.

	1979	1980	1981	1982	1983
			Value (000)		
Beans	4891	1961	1207	729	1292
Paste	6055	7422	6521	7324	5220
Butter	3341	6910	8706	9893	7273
			Amount (MT)		
Beans			664	465	704
Paste			2456	3472	4004
Butter			1778	2164	1757

World cacao bean production for the 1984-85 crop year is forecast at 1.74 million tons, 14 percent greater than the drought-damaged 1983-84 output and slightly above the record harvest of 1981-82. The larger harvest is attributed to a recovery in West African production. Also contributing to the increased production figure are expectations for a recovery in Brazilian and Malaysian output. World stocks are expected to increase in 1985 following two years of inventory reductions. The International Cacao Agreement was extended until September 30, 1985, assuring that the intervention price range of $ 1.06 to $1.46 will remain in effect.

World cacao bean grindings in calendar 1984 are estimated at a record 1.67 million tons, compared with 1.65 million tons a year earlier. The forecast for grindings in 1985 is that it will closely approximate those of 1984. If production and grind estimates are realized, world stocks will increase by 58,000 tons in 1985, following 2 straight years of inventory reductions. Based on the current rate of consumption, world carryover stocks of cacao beans at the close of the 1983/84 season were estimated at about a 3 month supply, down from a 4-month supply, as of September 30, 1983.

Cacao bean prices (the average of the daily closing price of the nearest 3 active futures trading months on the New York market) averaged $2,398 per ton during the January-September 1984 period, up from $2,030 during calendar 1983 and well above the 1982 average of $1,640 per ton. Cacao prices were high during the early months of 1984 in response to a tight supply situation, but have since declined as the new crop season approached.

In Peru during 1984 the price to farmers went up to 5,000 soles per kilo which is a favorable price even after discounting for inflation. The international market is strong and an increasing volume is moving into it. Peru was a net importer of cacao up to 1976 at which time it became an exporter, and the volume has grown to about one third of the total internal production. During the recent 10-year period, Peru has increased its production of cacao beans by two and one half times, but the volume moving into the world market increased by three times during the same years including the derivative products of the processing. The export of the products of processing- powder, liquor, pasta and cacao oil- has been increasing faster than exports of the unprocessed bean.

The internal demand has been growing steadily and is projected in the next table to continue to grow in the future. (See Table IV.D-2)

Table IV.D-2. Projected Internal Demand for Cacao in Peru.

YEAR	kg
1981	7,817,000
1982	8,752,000
1983	9,688,000
1984	10,623,000
1985	11,558,000
1986	12,494,000
1987	13,429,000
1988	14,364,000
1989	15,299,000
1990	16,235,000

Sources: Ministry of Agriculture, Lima

3. Processing

Considerable optimism is generated by the activities of the El Naranjillo cooperative located in the Upper Huallaga. This cooperative has been the major buyer of cacao beans and coffee in the area, but it has provided a minimal intermediary function of receiving the products from farmers and sending them on to Lima for processing. It has not been the only buyer in the area, but it has been the major one, buying about 60% of the local production. However, the cooperative's function will change dramatically with the completion of the $ 4 million processing plant now under construction. This plant is designed to process 1,000 metric tons of beans per year based on one 8 hour shift per day. The milling process yields 80% product and 20% refuse. It is hoped eventually to increase the operating time to three shifts per day. However, the production in the entire Huallaga region last year was only 800 metric tons, so production levels fall far short of permitting efficient plant operation. The expansion of supply therefore becomes the most critical issue in the future success of this large cooperative.

Another important issue for the success of this plant is the quality of the beans coming to it. Quality is highly

variable. The need to establish a reputation for quality is essential if this new plant is to compete in either the domestic or international market. If they pay a premium for high quality beans, farmers will have an incentive to take care in the fermenting and drying on the farm. With this expected development in mind the cooperative has recognized the need to improve the quality of raw material available from the small farmers. An excellent opportunity exists for assistance to instigate better product handling at or near the producing farms.

a. Processing options. There are at least four options for processing cacao from the pod to the dry-fermented bean stage.

i. On-the-farm Processing. Individual farmers do their own work from breaking the pods through fermentation (if they so choose), drying, classifying (if at all) and bagging.

ii. Main plant processing. Farmers bring the "wet" beans to the Co-op for subsequent processing to achieve a standard, high quality product.

iii. Satellite Processing Plants. It has been proposed that a number (4 or 5) of satellite plants be established at, locations such as Tulumayo, Tocache, La Mansion, Aucayacu and Tarapoto. The idea here is that individual small farmers would not have to transport their beans for too great a distance. It is suggested that beans be purchased by volume. A box will be used measuring 20 x 20 x 12 inches holding 33.33 kilos of wet cacao; about as much as man can carry. Here, under the supervision of trained personnel, the beans would be properly fermented and dried for optimum quality.

iv. Collection Program. It has been suggested also that the cooperative would develop a fleet of small 4x4 pickup

trucks with wooden bodies to be driven out to different locations on different days to collect fresh cacao beans from farmers (who would know in advance of their arrival). These beans would be taken to one of the central centers such as El Naranjillo in Tingo María for processing.

Each of these collection and processing proposals has advantages and disadvantages, and in the beginning perhaps a combination will have to be utilized until the most satisfactory scheme is developed.

b. Quality. The key to everything above and what follows is quality. Present indications are that cacao beans from the Huallaga River Valley are not of top quality. In some cases they lose as much as 10 to 15% of top value when purchased because of poor fermentation (or underfermentation), inadequate drying, insect infestation, etc. Whether the beans are to be sold outright or are to be used in the Naranjillo Chocolate Factory, efforts must be made to upgrade their quality.

This is probably more true in the case beans used by the chocolate factory than in the case of dried beans. From its first shipment, of liquor, butter or cake, the factory must send out high quality material so as to establish its record or name in the trade. If it sends out poor quality items in the beginning, it will have a difficult time in overcoming this handicap.

It is the opinion of knowledgable experts that if properly processed, beans from the area of the Rio Huallaga Valley can produce a product whose quality is as good as any in the world.

The stages of proper and adequate processing are as follows: Breaking, anaerobic fermentation, aerobic fermentation, drying, classification and storage.

i. Breaking. This refers quite simply to opening the ripe (and hopefully undiseased) pods. Care should be taken to cut through only the husk of the pod and not through the beans themselves as this will alter the quality of the finished product. Furthermore, at this point, care should be taken to remove all extraneous material from the seed mass such as placentas, bits of pod, leaves and twigs, etc. In Colombia and other countries, this particular job is accomplished not with a sharp knife or machete, but with a wooden mallet so that the risk of cutting the beans is greatly diminished.

ii. Anaerobic Fermentation. This means that fermentation takes place under air-free conditions. This stage, lasts between 24 and 48 hours depending on the external environment. Micro-organisms utilize the sugars in the mucilaginous covering around each cacao bean and convert it to alcohol. In this process, heat will be generated and the mass will attain temperatures of at least 48 degrees C. The heat will first kill the germ within the seed and this, in turn, will activate the enzymatic changes within the cotyledons that are required for ideal chocolate aroma, bouquet and flavor. The entire mass should have a slight wine odor.

iii. Aerobic Fermentation. As the quantity of sugar in the mass of fermenting beans is reduced, a mucilaginous material will begin to run off the beans. An escape must be provided for this liquid, known as "sweatings". If there is a sufficient amount available, it may serve as the raw material for either vinegar or for jams and jellies. With the loss of the sugary material, air begins to enter the mass and a new type of fermentation takes place. This process is actually helped by mechanically turning over the entire bean mass by means of a wooden or plastic shovel. "Sweatings" are extremely corrosive and metal, except for aluminum or stainless steel, should not be

used at any of these earlier stages of cacao processing. Another procedure is to arrange the fermentation boxes so that material from one box can be tumbled into another by means of gravity flow.

In aerobic fermentation, a new type of micro-organism takes over, this time utilizing the alcohols produced by the first group as their energy source. The alcohols are converted to vinegar in the same manner that a good wine, left uncorked, turns to vinegar. Here, again, heat is a by-product, and this continues to assist in developing the enzymatic activity.

By the end of 3 to 4 days of fermentation, the beans should have turned from their original purple color to a characteristic chocolate brown color in the cotyledons. Actually, this color change is the basic visual test of well fermented beans.

iv. Drying. The weight ratio of fresh cacao beans to dry beans is approximately 2.2 to 1. One hundred pounds of fresh beans, when dried, will give about 45 pounds of dry beans or one kilo of wet beans will give one pound of dry. This implies that approximately 50% of the original mass will have to be gotten rid of in the form of water. This may be a difficult process, especially during periods of rainy weather. Furthermore, farmers are not at all loath to sell water at the price of cacao beans when they can. To process the beans into liquor and butter the, moisture content should be reduced to as close to 7% as possible. Seldom, however, do farmers achieve this range, but they must get it down close to 10 or 11% because if the beans have any more moisture than that, they are subject to rot and mold which will soon make them unusable for top quality cacao production.

Most of the drying done throughout the cacao growing world is by means of what is now technically referred to as solar

energy. Beans are spread out on the ground on mats, patios, or on wooden trays to dry in the sun. This immediately introduces a considerable margin of error. Dirt, bird droppings, insects, stones, and other foreign objects contaminate the drying beans and reduce the quality of the product.

Sun drying is fine - the best kind there is - if properly carried out with movable trays or movable roofs. It is even better if this system can be built in conjunction with some type of artificial drier. These too, however, add to the margin for error, since many of them generate heat for drying by utilizing some type of organic material which also generates a large volume of smoke. Cacao beans are extremely sensitive to smoke and can pick this up in even minute amounts, much to their detriment. Smokey or hammy beans are quickly rejected because of their disagreeable flavor and aroma.

v. Classification. Top quality beans should be classified after drying. This means eliminating everything but uncut and unbroken beans. Dried pod bits, placenta, leaves, cut or broken beans, flat beans, nails, stones and all extraneous material should be removed by mechanical separators or by hand.

vi. Bagging or Storage. Finally, beans should be bagged or stored in bins where they will not be subject to attack by insects. The coddling moth is to be found world wide in cacao growing areas and can quickly destroy a large volume of beans unless care is taken to eliminate or at least control their pest.

The Cacao, Chocolate and Confectionery Alliance has laid down the following standards for West African cacao. The essential points apply to cacao from other parts of the world:

1. Only beans from clean, well-grown, fully ripe and disease-free pods should be fermented.

2. Using beans from freshly picked pods, the fermentation should be carried out under the best conditions possible, preferably in lots of not less than 400 lb wet weight.

3. During fermentation, the beans are to be handled in such a way that the whole batch of beans is evenly fermented and adequately aerated.

4. Drying to be carried out immediately on the completion of the fermentation and to be conducted in such a way as to be complete and uniform. At the commencement, drying should not be conducted too rapidly as otherwise the testa shrinks and adheres to the cotyledons.

5. Drying should be carried out to the extent necessary to ensure the proper keeping of the beans, care being taken that the beans at no time thereafter become exposed to moisture or insect infestation.

A report from West Africa states that each farmer ferments and dries his own beans. There are many limitations to this method. In particular when the quantity of beans is small, fermentation may not be up to standard and the quality of the prepared beans may be bad. The main advantage of cooperative fermentaries is that the production of dry beans of standard quality is assured through the employment of standard equipment for fermenting and drying. The cacao industry should be developed under policies which offer no occasion for preparation of dry cacao by small growers.

5. Recommendations

Production of cacao in the Upper Huallaga is mostly on small farms and probably will remain that way. A wide area is adaptable to this crop, and technology is available to expand the output per tree as well to expand the plantings. Considerable extension education is needed to instruct farmers on fertilizer needs, new planting techniques, renovation of old plantings, harvesting methods and other technical requirements. Production expansion is basic to the success of the new plant.

It is recommended that additional extension personnel be provided to help meet the needs. For a long-run plan, the experiment station staff must be capable not only of providing comparison plots but of contributing to the more fundamental research dealing with adaptable varieties, fertilization, disease control, and other agronomic questions.

It is suggested that steps be taken to improve the equipment and farmer organization, and management in the fermenting and drying function. This recommendation is based upon the paramount importance of providing a high-quality product which will ensure the successful beginning of the new processing plant. The first step towards success begins at the farm level. A pricing system to compensate farmers for producing better quality must be established.

It is recommended that funds be made available to establish several assembly points in the production area with appropriate equipment for the efficient preparation of the beans for delivery to the processing plant.

The successful operation of any business entity depends upon capable management. But such skills do not automatically evolve as capital is added. It comes from formal training and good

learning experiences. The El Naranjillo cooperative may benefit from consulting services provided by experts in management as well as experts in the processing of their specific products. In addition, the cooperative may need assistance in meeting the challenges of both the internal and external markets for the processed products they will be producing. These markets are complex and not easy for newcomers to break into.

It is recommended that three experts be brought in to consult with the cooperative on the three topics mentioned and that they each spend 4 to 6 weeks during each of the first 3 years of operation.

As mentioned previously, production expansion is needed before the processing plant can approach a capacity operation. As previously established the high cost of installing new fields of cacao trees is the major constraint facing farmers.

It is recommended that loan funds be made available to farmers for the specific purpose of expanding tree installation on additional land and renovating old fields of trees that are not currently producing. The amount of loan funds provided is a direct function of how rapidly the production expansion is to take place. New plantings require 2 1/2 to 3 years before the first harvest. Therefore credit must be arranged for a medium-term period of three or more years. (Installation of trees costs around $2,000 per ha).

6. Strategy Statement

The new El Naranjillo processing plant is well along in construction, and funding for it is already arranged. Because of the many favorable aspects of cacao production expansion, that are present, it is a rational strategy to move quickly and to give top priority removing the constraints that still exist.

This calls for immediate attention to the recruiting and training additional extension agents and a cacao plant research specialist for the area.

It is important for the processing firm to establish a high quality. The date when the plant is to begin operation is rapidly approaching, and so it is an appropriate strategy to move quickly into a feasibility study for the establishment of fermenting and drying facilities in close proximity to clusters of producers.

Alternative proposals for the Upper Huallaga dealing directly with other specific crops and processing operations are not as promising as the proposal for cacao. It has a favorable benefit/cost ratio, and income generation will be extensive. Although specific figures cannot be presented, the available data and careful logical analysis provide justification for recommending action.

Only mini-processing proposals are advanced here. Major new processing investments are not justified because of the expected over-capacity of the plant now under construction. Efforts to bring the present investments into a paying position are preferable to investment in additional major processing facilities.

Cacao beans and their products are primarily export commodities. This presents an opportunity for the development of a grading and pricing system that will encourage the producers to come up with a quality product suitable for the world market. The grading system must be tied to the standards necessary to insure a quality product. The pricing system must be such that the beans produced meet the standards of high-quality. One possibility is to pay the producers only for the portion of their crop that meets the requirements for processing. There are

several ways to dispose of the off-quality beans. One possibility is to pay the producer the value of the cull beans. Another is for the Coop to use the revenues from the sale of the culls and other by-products to help finance its operations.

The establishment of a grading system and a quality-based price structure will create an immediate demand for information concerning the most effective methods to ferment and dry cacao beans. This demand could be met by extension services from PEAH, from the Coop, or from other sources. However, if this demand for information is to be created, it presents an opportunity for PEAH to have a major impact on the producers in the region. It will, however, require a substantial planning effort and coordination of activities with The Naranjillo Cooperative.

A detailed study of what will be required to institute a grading procedure should be carried out in cooperation with the cooperative. If additional funds are required to implement such a system, they should be provided. There should be at least three grades. The producer should receive a bonus for superior beans and some kind of penalty for inferior beans. The producer should not receive anything for beans which cannot be used.

Quality and grading standards may also have national implications. The basis for measuring both the quality of the beans and the final processed product should be determined.

One recommendation is to provide assistance to Naranjillo to insure that as the new plant becomes operative, the appropriate quality controls are instigated and maintained during processing. The lab at the plant must be equipped and operated professionally. There must be adequate trained personnel available. Technical assistance could be provided during the start-up phase as well as training for the Naranjillo staff.

This matter should be discussed with the management of the cooperative.

Another high-priority measure that should be implemented in the near future is a strategy for expanding cacao production to facilitate the efficient processing of chocolate by The Naranjillo Cooperative. It is proposed that the cooperative serve as the focal point for implementation and as the conduit through which funds are administered. A doubling of the present hectarage in cacao is proposed as an objective over the next five years. This would add 800 TM to the cacao supply. With the activity generated by this output thrust, enough additional supplies would be produced to permit the chocolate plant to operate two 8-hour shifts every 24 hours.

To accomplish the desired goal, 200 producers must add 2 has. each year for 5 years giving a total of 2,000 ha which will be added to the 2,000 now in production. Thus up to 1,000 out of the present members of the cooperative 5,000 might participate in this program.

A line of credit for $800,000 per year for 5 years would be required (400 ha times $2,000, the cost of installation per ha) Assuming that the seedlings will be sold by the cooperative at minimum cost to the producers, the costs would increase from $1700 to $2000. However, these funds would be available to finance fertilizer applications and thus a saving of about $300 per ha might be realized from the estimates presented. (It is assumed that an international agency will provide the seedlings to the cooperative at no cost). (Tables IV.D-3, IV.D-4, and IV.D-5)

Table IV.D-3. First year cacao planting costs per hectare at 3 x 3 Meters.

Input	Quantity	Man/Days	Value	Total
Land Preparation	--	20	$ 4.00	$ 80.00
Cacao Seedlings	1,250	--	1.00	1,250.00
Permanent Shade Seedlings	50	--	1.00	50.00
Fertilizer	20 qq.	--	12.00	240.00
Lime	20 qq.	--	15.00/Ton	15.00
Labor-Fertilizer and lime application	--	10	4.00	40.00
Labor-cultivation	--	30	4.00	120.00
Labor-Planting Seedlings	--	20	4.00	80.00
Total First Year				$ 1,875.00

Table IV.D-4. Second year cacao planting costs per hectare at 3 x 3 Meters.

Input	Quantity	Man/Days	Value	Total
Replanting Seedlings	125	-----	$ 1.00	$ 125.00
Fertilizer and Lime				280.00
Labor Costs				250.00
Total				$ 655.00

Table IV.D-5. Third year cacao planting costs per hectare at 3 x 3 Meters.

Input	Quantity	Man/Days	Value	Total
Fertilizer and Lime				$ 300.00
Labor Costs				280.00
Harvest Costs				50.00
Total				$ 630.00
Grand Total				$ 3,160.00

Note: These figures are substantially higher than those of last year for this same effort. The principal reason for this is that the cost of the cacao seedlings and the permanent shade tree seedlings. On the following page it can be seen that without such high payments, the amount involved is considerably less.

An additional sum of $7,000 for a small 4 x 4 pick-up truck to be used for the country assembly of cacao beans will be needed to accommodate the proposed satellite assembly points. An investment of $800,000 for 4 fermenting and drying assembly points should be funded by a long term loan. These facilities should be located near the producers for rapid processing and quality maintenance.

These facilities are estimated to cost $200,000 each for fermenting bins, washing trenches, drying sheds, drying trays and bagging equipment.

It is recommended that the central El Naranjillo cooperative operate the assembling truck and the fermenting facilities, for this purpose, a special loan of $807,000 should be advanced to the cooperative. The truck costs include the building of a wooden box for the truck and the building of four 20" x 20" x 12" wooden boxes for receiving and measuring the fruit. It is expected that producers will pay a fee for the fermenting and drying service. Therefore, a cash flow is created to permit the borrower to pay the interest costs and reduce the loan.

Table IV.D-6. Costs of planting one hectare with interest at 60%.

1st. year Costs		$ 1,865.00
1st. Year Interest		1,120.00
	Total	$ 2,985.00
2nd. Year Costs		$ 655.00
2nd. Year of Interest ($3,640) x 60%		2,180.00
	Total	$ 2,835.00
3rd. Year Costs		$ 630.00
3rd. Year of Interest (6450) x 60%		3,870.00
	Total	$ 4,500.00
	Total 3 years/ha	$ 10,320.00

Note: Farmers will never make it at 60% interest as the total returns for the first 5 years from the best farms will average about 1,150 - 1,350 Kg at $2.20 per Kg return. This is not enough. Hence, obtaining cost-free seedlings and concessionary credit is essential.

The high priority strategy for the cacao proposal can be justified because it meets a number of basic criteria for high priority projects. Market conditions are favorable. Processing capacity will shortly be adequate. Technology levels for processing and production are reasonably high. Current agency support is positive. Significant sums of capital have already been generated. A long tradition of production exists. Soils and climate are suitable. Additional land is available and farmers need to use a greater proportion of the adaptable land. In addition to a strong local market, the world demand is growing. No production quotas have been imposed by the international cacao producers' organization. The constraints remaining include the urgent pressure for expanded volume of raw material for the processor, the need to extending technical information to new as well as old producers, a more precise control over quality, high credit needs for installation of new trees, and a continuing supply of good seed.

Efforts expended to help in the removal of the constraints will yield high marginal benefits that will be distributed among producers, processors and related agribusinesses. Peru needs more export earnings and cacao will make a major contribution toward filling this need.

V. PUBLIC SECTOR--PRIORITY PROJECTS

A. Transportation

1. Summary

The recommendations of the priority transportation projects for the Huallaga region and preliminary estimates of costs are summarized below in seven possible projects:

Table V.A-1. Proposed transportation projects for the Huallaga region.

Project		Estimated Costs (US$ millions)
No. 1	Rock crushing and road maintenance	
	Seven rock quarries fully equipped	$19.0
	Seven (7) sets of general road maint. equip.	2.8
	Road emergency repair equip. (1 set/each of six divisions)	3.0
No. 2	Upgrading of Northern Marginal Highway (two alternatives)	
	Finish paving	
	Moyobamba to Olmos	330.0
	Tarapoto to Juanjui	79.0
	Resurface the same sections with gravel	12.9
No. 3	Resurfacing with gravel the Central Marginal Highway from Aucayacu to Juanjui	6.0
No. 4	Construct all weather secondary road from Tarapoto to proposed new port site at confluence of Marañon and Huallaga rivers near Jeberos	10.95
No. 5	Construct all weather secondary road on west bank of Huallaga from Tingo María to Tocache	22.6
No. 6	Construct dirt feeder roads from No. 4 and No. 5	40.9
No. 7	Construct dirt trails from No. 6	9.0

This report has concluded that a network linking paved roads to feeder roads and trails is needed and an important factor in the economic development the Huallaga region. Realistically speaking, however, limited resources are likely. In this case, the following limited resources scenario is presented.

Table V.A-2. Project funding recommendations for limited resources-transportation.

If funds avail. Total Only (millions)	Recommended project funding
$ 25	Rock crusher, road maintenance equipment, and mechanical training.
$ 50	Above + upgrade of northern Marginal highway with good gravel surface
$ 75	Above + road from Tarapoto to proposed port site
$100	Above + bridge improvement on Central Marginal Highway
$125	Above + upgrade of Central Marginal Highway with good gravel surface
$150	Above + secondary road on west bank of Huallaga from Tingo María to Tocache
$175	Above + network of feeder roads and trails

2. Introduction

The study assesses the critical role of transportation in the development of the Huallaga Region. It appraises the transportation needs associated with both agricultural and agro-industrial expansion.

Each improvement in roads stimulates almost all of the development in the region. A region will develop an excess of ancillary public assistance programs as soon as a road or rail system connects an area of production potential (agricultural,

forestry, or other industry) with markets. A completed network of roads in Peru will enable the country to maximize its agricultural and industrial growth and minimize its dependence on imports.[1]

The following assessment is not limited to the borders of the Huallaga Valley. The region's transportation needs extend much beyond; being influenced by the demand for transportation into the surrounding jungle, as well as a network linking the study area with all domestic and export outlets.

This assessment of transportation cannot and should not be separated from the region's existing and potential production and marketing infrastructure. For this reason, recommendations will relate to the region's anticipated long-term economic development which directly relates to available resources, the growing demand within the area and within Peru, and the potentials for future exports.

Given this introduction, the ensuing analysis covers the following:

(1) A brief description of the current transportation system serving the Huallaga Region;
(2) Current freight rates;
(3) Priorities for improvement in the transportation system;

(4) A strategy for location and use of rock crushers and road maintenance equipment;

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[1]Air and water transport capacity, although important components in regional development, are more restricted in their impact. Rail, in the case of the Huallaga Region will not be considered in this analysis. Railroads could have had a major economic impact on the region at one point in history, but have now been surpassed by a more modern road transportation network.

(5) A strategy for maintaining rock surface roads;

(6) Proposed projects;

(7) The potential for water transportation from the Huallaga Region; and

(8) Strategies for road development.

The economic setting for which a desired transportation system is recommended is one of a growing population, and growing agricultural and industrial development. Peru, a country with limited capital investment resources still is fortunate to have valuable natural resources, and an abundance of still undeveloped land.

Road systems create a positive impact upon land development. They provide access to market for the producers who in some cases are at considerable distances from the actual road. Zones of influence have been estimated in order to measure the approximate impact as roads penetrate new lands in developing regions such as the Huallaga Valley. The following six rules of thumb will be used in this analysis:[2]

a. The impact on agricultural production, will extend about 5 km along each side and from the end of an all-weather road;

b. The zone of influence with respect to passenger travel will extend for about 15 km along each side and from the end of an all-weather road;

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[2]For further information on the use of zones of influence in an economic development analysis, see Vandervoort, Charles G., Peru, Evaluation of the Feasibility of River Transport to Provide Access to the Pelcazu Valley, AID/Peru memo report, July 10, 1984.

c. The zone of influence for cattle that are brought on hoof to the road will extend as much as 40 km from an all-weather road;

d. Investors in plantation-type agriculture, who desire to reach large areas of fertile land will build private all-weather feeder roads of up to 30 km in length in order to connect to a public sector road;

e. The zone of influence for feeder roads is approximately 3 km for agricultural production and 20 km for cattle ranching, this distance being limited by mountains and mountain streams in many cases; and

f. The zone of influence for trails is about 1 km for all uses.

3. Present Transportation System

a. Air. Air transportation consists of the two major Peruvian Airlines- Aero Peru and Faucett- interregional air taxi service, military aircraft that occasionally transport civilian freight, and charter planes.

The Department of San Martin has about 12 small landing strips in addition to the Tarapoto airport; Huánuco has three in addition to Tingo María. The major airports are Tingo María and Tarapoto. In addition, Iquitos to the north and east of the Huallaga Region has an international airport. Presently the Iquitos airport importance to the region is only for limited agricultural and industrial trade and the tourist industry. No roads connect Iquitos and the Huallaga Region. The two transport connections are by barge up the Amazon, Ucayali, Marañón, and Huallaga Rivers.

Interregional air shipments of fruits and vegetables, meat, chickens, and wheat flour occur in the area. Air freight will definitely have an impact on this land-locked region as it develops.

Assuming that the study region will produce some legitimate, high-value crops and industrial goods, the Peruvian Government should consider the changes necessary to raise the Tarapoto Airport to international status. Longer range plans should include pavement of the Tingo María runway.

b. Water. The Huallaga River originates in the upper part of the study area. It widens as it flows north, but does not become of navigable importance until it reaches the Yurimaguas area. Water is important for local passenger transportation, the local fishing industry, and to a limited degree for irrigation water. Also, limited amounts of intra-regional commerce flow via water. However, the shallow draft seriously limits major commercial travel in the Central and Upper Huallaga Region. Yurimaguas offers the only viable commercial port.

The Huallaga River has an average velocity of only 3 km/hr. and a draft of less than 3 feet in places, making it suitable only for smaller craft, usually canoes with outboard motors, above Yurimaguas. Wide, flat-bottom barges can navigate the river as far as Yurimaguas. Because of its slow speed and minimal drop, silting is a serious problem. Thus the idea of dredging a deep channel is dismissed.

Nevertheless, the Huallaga River does handle some commerce from the region. According to Tarapoto rice millers, about 10% of the Lower Huallaga rice is transported to Iquitos and Pucallpa by barge. In turn, oil and some machinery are barged up-river from Iquitos into the study region.

The water distance from Iquitos to Tarapoto is over 1,000 km. Barges take 3 days going down stream and 4 to 5 days on the return trip. During the rainy season, when the water draft is highest, two 3,000 ton barges (chatas) navigate the waterway.

A second water outlet for the Huallaga Region is via the Tingo María - Pucallpa highway to the port at Pucallpa. The highway to Pucallpa is partially paved and in need of repairs and maintenance (290 km). Port Callao, at Pucallpa, is used more for commerce coming into the region from Iquitos than for shipping downriver.

Peru claims 9,000 km of navigable rivers. Currently, about 776 carriers with a capacity of 10 tons or more and a total registered capacity of 93,981 tons are cruising the rivers. Of this capacity, however, over 70% is based in Iquitos.

Barge costs vary with the supply and demand and with the amount of back haul. The rate for a shipment of rice from Yurimaguas to Pucallpa was S/.170,000/Mt (1984). In comparison the cost to the coast was quoted at S/.580,000/Mt

At present, one of the bottlenecks to using water transportation is the road to Yurimaguas. Most of the river traffic moves to and from Tarapoto by surface transport. While the distance is only 135 km, the trip takes 8 hours to complete. Essentially an additional day is lost, plus the cost of intermodal transfer.

At present, the use of water transportation for moving agricultural products is limited mainly to in-country needs. Lumber and cement currently dominate river traffic. A potential for increased use of water transportation from the Huallaga Region is discussed later.

c. Roads. The region's roads are classified as: (1) national, (2) departmental, and (3) local. They are further generally considered to be: (1) primary (between major cities, regions or ports), (2) secondary (those connecting small towns and villages with the primary roads), and (3) tertiary (those narrow feeder roads that reach into rural areas). In addition, trails and paths play an important role in the Huallaga Region. Finally, roads are of three types: (1) asphalt, (2) gravel, and (3) dirt. The depth of the roadbed will vary considerably depending on whether it is a graveled primary road or a graveled secondary road. Likewise, the cost of construction and maintenance varies. Figure V.A-1 shows the major road system in Peru at present.

d. Condition and time. Exact distance means little in mountainous terrain. Road condition is the factor that determines travel time and cost. On the road from Lima to Tingo María which is paved, travel time by truck is estimated at approximately 12 hours. Truck speeds of 60 - 70 km/hr. are common on level stretches.

The Marginal Highway from Aucayacu to Tarapoto is a major problem, worsening about half way between the two towns which are about 465 km apart. From Pto. Pizarro to Bellavista, for example, not only the road, but also 15 bridges are in bad shape. From Tarapoto to Lima by the southern route may take several days because of mud slides that may halt traffic.

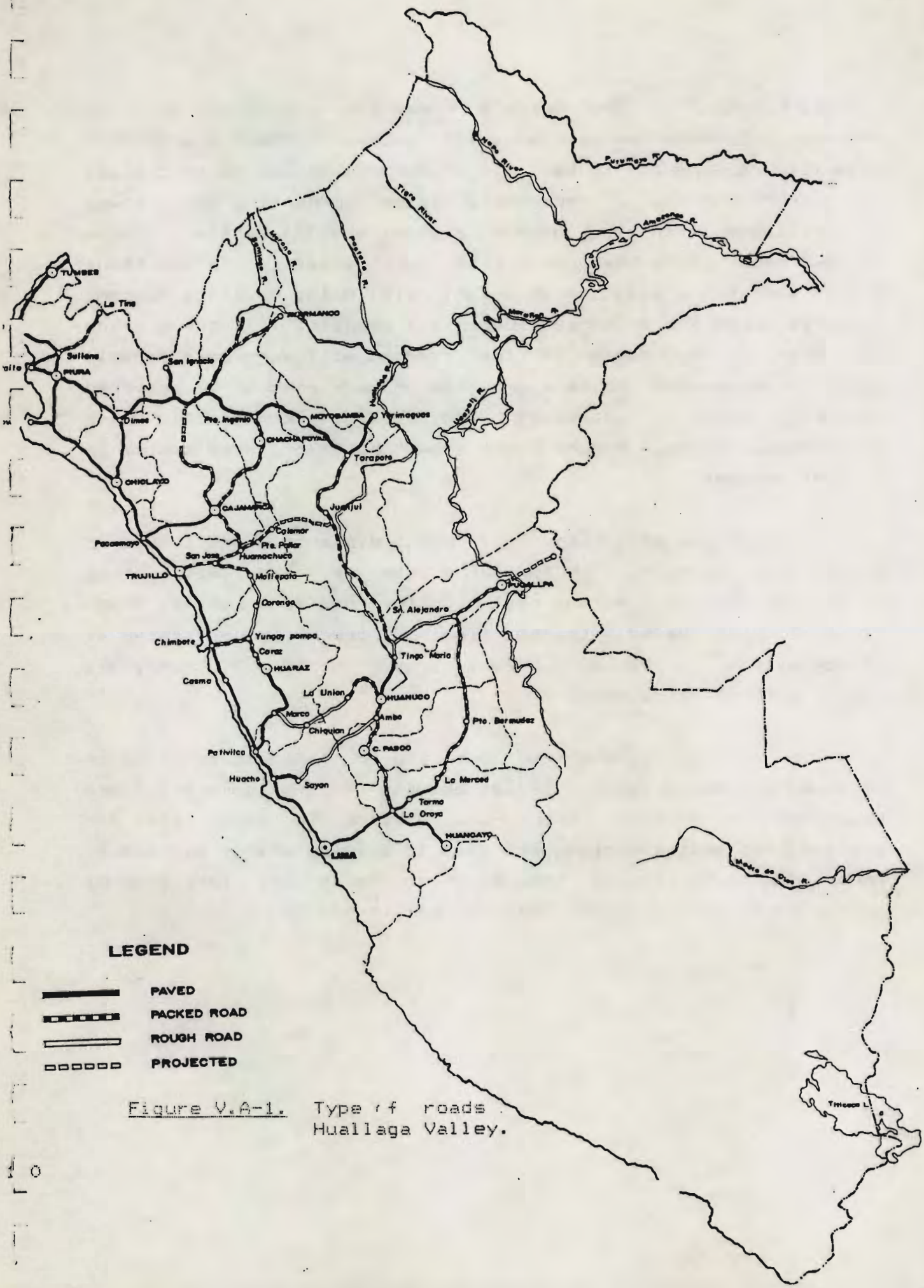


Figure V.A-1. Type of roads Huallaga Valley.

The Marginal Highway from Aucayacu to Tarapoto is considered to be a primary, graveled road. In fact, it is a series of pot-holes, slowing traffic to 20-25 km/hr. The problem appears to stem from several factors:

(1) The sheer length of the Highway in some respects overwhelms the existing maintenance system;
(2) The divided responsibility for maintenance (responsibility is divided according to political organization i.e. MTC, PEAH, Dev. Corp., rather than political jurisdiction, i.e. national, departmental, and local);
(3) the lack of proper construction materials--use of river rock instead of crushed rock; and
(4) the lack of rapid response to troubled spots such as mud slides.

The road from Tarapoto to Moyobamba should be paved by the end of 1985. This section is engineered for 60-ton trucks and should be able to withstand current tonnages without problems. The remainder of the northern Marginal is in need of pavement since it is the major road to the coast and Lima. Presently it takes 24 to 30 hours to Lima from Tarapoto. This will be shortened in 1986. However, it is still considered too long a period for the transportation of some perishable commodities.

The Olmos to Lima Panamerican Highway observed in June 1984 was still in need of repair following the disastrous 1983 flood. Many missing bridges and washouts were noted at that time. Sufficient time has elapsed for repairs to be made. Obviously, other factors were involved. Such delays in maintenance are viewed as a problem of priorities although the author understands the economic problems of the times. Transportation is so vital

to the economy that expenditures for road improvement will generate far more in income than they will cost.

Bridges also are a factor related to the condition of roads and the time required to traverse them. On the Central Highway from Tingo María to Tarapoto, many bridges are rated as 25-32 ton capacity. Many are being by-passed because of their disrepair and inability to support rated tonnage. This practice works until the streams rise and they cannot be forded, halting truck movement. At least one bridge was rated as having a capacity of only 2 tons. This situation has existed for several months and still no effort has been made to repair it.

e. Distinguishing trade areas. In a practical sense, the condition of the Central Highway and its bridges reflects a natural division in the development of the Huallaga Region. It may be considered as two distinct trade zones. One zone is around Tingo María and the other around Tarapoto.

First, the Tingo María area, reaching perhaps up to the palm oil area near Tocache, has a natural product flow to Lima, the nation's population center. Obviously the existing paved highway draws traffic towards that city.

Second, the lower Huallaga area being farther from the population center has drawn trade to Tarapoto, and subsequently has developed a fairly complete market infrastructure. Products are channelled over the shortest and quickest route to the Coast--the Northern Marginal Highway. This trade area extending south to Saposia and beyond and north to Yurimaguas accounts for a large tonnage of traffic to the North Coast and Lima. The current paving project under way on the northern highway is a recognition of its importance.

Finally, each trade area has its own distinct transportation outlets: (Table V.A-3.)

Table V.A-3. Transportation outlets in the Huallaga Valley.

Road	Water	Air
Lower Huallaga Northern Marginal	Yurimaguas Port (East) Salaverry Port (West)	Tarapoto airport
Upper Huallaga paved to Lima	Pucallpa Port (East) Lima Port (West)	Tingo María airport

f. Type and costs of construction. A brief description of the existing road will provide the basis for much of the ensuing discussion. The Department of Huánuco has 165 km of gravel roads, 355 km of primary roads, and 552 km of secondary roads. The National Highway is paved from Lima eastward into the Huallaga Region. Pavement extends to Aucayacu about 50 km north of Tingo María.

The Department of San Martin has 11 km of asphalt roads and 751 km of gravel roads, 506 km of primary roads, and 245 km of secondary roads. With the paving of the road between Tarapoto and Moyobamba, the kilometers of asphalt should be increased to 124 km while the number of km of gravel roads should be reduced to 52 km. The project is scheduled for completion by January 1, 1986. The approximate cost/km is S/.4,000,000,000 or $666,000/km. From Moyobamba westward, the Northern Marginal is a primary graveled road. It joins the paved Panamericana at Olmos.

Cost estimates obtained for other road construction include:

Table V.A-4. Road construction estimates

	Soles/km	Dollars/km
Primary gravel	800,000,000	133,000.00
Secondary gravel	600,000,000	100,000.00
Feeder gravel	450,000,000	75,000.00
Feeder dirt	270,000,000	45,000.00
Trail (2.0 m) gravel	144,000,000	24,000.00
Trail (1.2 m) gravel	84,000,000	14,000.00
Trail (2.0 m) dirt	48,000,000	8,000.00
Trail (1.2 m) dirt	24,000,000	4,000.00

g. Cost of maintenance. The Planning Department - MTC is well aware that the condition of the road network has a direct impact on the costs of transportation. Factors affecting these costs include speed of travel, delays due to temporary road closings, fuel consumption, added vehicle maintenance, and shorter vehicle life. According to the Planning Department of the MTC, the costs of vehicle operation are at least 20% less on good asphalt highways than on poor ones full of breakups. On the carretera afirmada, the cost variation from good to bad will vary by 25%, yet annual appropriations for maintenance remain extremely low. For example, the capital allocated for maintenance in 1980 was S/.11,851 per km of road quoted at 1973 prices (see Table V.A-5). However, it is estimated by the Planning Department that in order to keep the roads in an acceptable state of repair the total allocation should be S/.32,000/km. This would amount to over S/.17,000 million soles based upon the value of the sol in 1980.

Government plans for road construction and maintenance called for work on 263 km in 1984 and 285 km in 1985 on the Marginal de la Selva.

Table V.A-5. Estimates of expenditures for road maintenance-Huallaga Valley.

Item	Cost
Maintenance of primary asphalt	S/.500,000/km ($813.00/km)
Maintenance of primary gravel from	S/.35,000,000 to 50,000,000/km ($5,700 to 8,130/km)
Maintenance of secondary roads*	S/.20,000/km ($33.00/km)
Major upgrading (resurfacing of primary gravel roads	S/.120,000,000/km ($20,000.00/km)
Maintenance using river rock*	S/.600,000/km ($100/km)

*These expenditures are reflective of the level of present road maintenance findings and generally poor conditions of the Huallaga Valley road system. These expenditure levels would not be adequate to maintain an up-graded system and for this reason, are not used in arriving at the priority project list shown in the summary of project cost estimates. The maintenance estimates were obtained from the MTC office in Tarapoto and the PEAH office in Aucayacu.

h. Road construction underway. Four or five road projects are currently underway. They include:

i. Pavement between Tarapoto and Moyobamba (134 km);

ii. Construction of secondary road between Yurimaguas and Jeberos (70 km);

iii. Bridge over Huallaga River near Picota and connecting secondary road between Cuzco and Huánuco roads (km unknown); and

iv. Under consideration is the construction of a west-bank road from Tingo María to Tocache which will greatly help the Palma de Espino plant.

i. Need for load limits. Highway systems are subject to destruction when abused. Primary and secondary roads and bridges are designed by engineers to hold only a limited tonnage. When trucks with larger than permissible gross weight use the system,

they cause the road to break up, create large pot-holes and weaken the bridges.

The MTC has some regulations on gross allowable tonnages. The maximum permissible gross weights according to the of vehicle, are as follows:

Table V.A-6. MTC regulations of grow allowable tonnages for trucks.

Item	Weight (tons)
-Trucks of 2 axles	17
-Trucks of 3 axles	24
-Tractor trucks & semi-towing of 3 axles	28
-Tractor trucks and semi-towing of 4 axles	35
-Tractor trucks and semi-towing of more than 4 axles	45
-Tractor trucks and towing of 4 axles	39
-Tractor trucks and towing of more than 4 axles	45

For the first offense, the sanctions for infringement of the regulations should be, a fine equivalent to ten minimum vital salaries of the industry and commerce of the Province of Lima; and for the second offense, twenty minimal vital salaries. In practice, these regulations do not appear to be enforced. Trucks run overweight. Roads and bridges suffer.

To control the gross weight of vehicles, transporters should exhibit total weight of the load on their invoice. When a number of items are hauled they should carry a list of the cargo indicating the total weight they are transporting and the dry weight of the vehicle. Furthermore, the dry weight load should appear clearly and visible at the right side of the vehicle.

The Ministry of Transportation and Communication, through its regional office should be able to control the traffic of vehicles that exceed the dimensions or gross weights established in the regulation.

j. Need for weigh stations. Without official government operated weigh stations, truckers will abuse existing regulations, causing the government added expense of road and bridge repair. It is therefore recommended that two (2) weigh stations be constructed between the Huallaga Project region and the coast. One should be located between Tingo María and La Oroya and the other one between Tarapoto and Moyobamba. These stations would be of immediate economic benefit to the Government and of long term benefit to the truckers themselves.

4. Transportation Rates

Following in Table V.A-7 is a comparison of producer prices and transportation costs (figures as of June 1984):

Table V.A-7. Comparison of producer prices and transportation costs as of June 1984- Huallaga Valley.

Commodity Price	Producer Price (S/./Mt)	Transp. Costs (S/./Mt)	Transp. Cost % of farm
Coffee	3,000,000-dlvd	340,000 (Lomas-Lima)	11.3
Corn	410,000-dlvd	300,000 (Tarapoto-Lima)	73.2
Rice	759,000-dlvd	289,000 (Tarapoto-Lima)	38.1
Cotton	2,000,000-frmgate	100,000 (to gin)	
		432,000 (Tarapoto-Lima)	
		532,000 Total	26.6

As expected, relative to farm prices, it costs far more on a percentage basis to transport low-value crops from the Huallaga Region than it does for high-value crops.

a. Truck rates. Transportation costs vary according to distance and the type of cargo. Some representative costs are

listed below to show the cost above production costs that must be considered when estimating the competitiveness of Huallaga region products in domestic and export markets. All costs are given for approximately January 1, 1985.

Table V.A-8. Truck rates by product for various trips.

Crop	Trip	Cost/Tm	US$
Cotton	Tarapoto to Coast	S/.800,000/Mt	($ 130.00)
Coffee & cacao	Tingo María to Lima	S/.170,000/Mt	($ 27.60)
Rice	Tarapoto to Lima	S/.580,000/Mt	($ 95.00)
Corn	Tarapoto to Lima	S/.571,000/Mt	($ 92.85)
Corn	Tarapoto to Trujillo	S/.474,000/Mt	($ 77.10)
Corn	Tarapoto to Chiclayo	S/.438,000/Mt	($ 71.20)
Gen. Cargo	Lima to Tingo María	S/.288,778/Mt	($ 46.95)
Liq. Cargo	Lima to Tingo María	S/.426,374/Mt	($ 69.30)
Gen. Cargo	Lima to Tarapoto	S/.593,954/Mt	($ 96.60)
Liq. Cargo	Lima to Tarapoto		
Bananas	Tingo María to Lima	$1200/truck load	
Basic food prod.	Iquitos to Yurimaguas	S/.122,000/Mt	($ 19.85)
Basic prod. non-food	Iquitos to Yurimaguas	S/.153,000/Mt	($ 24.90)
Gen. Cargo	Iquitos to Yurimaguas	S/.184,000/Mt	($ 29.90)
Gen. Cargo higher value or danger	Iquitos to Yurimaguas	S/.281,000/Mt	($ 45.70)
Cement	Iquitos to Yurimaguas	S/.165,000/Mt	($ 26.85)

b. Water and air rates. An interpretation of these rates shows that while the rates from the Lower Huallaga Valley via the North Coast are higher than the rates from the Upper Huallaga, they are not proportional to the added distance.

Table V.A-9. Approximate distances between major points in the Huallaga Valley.

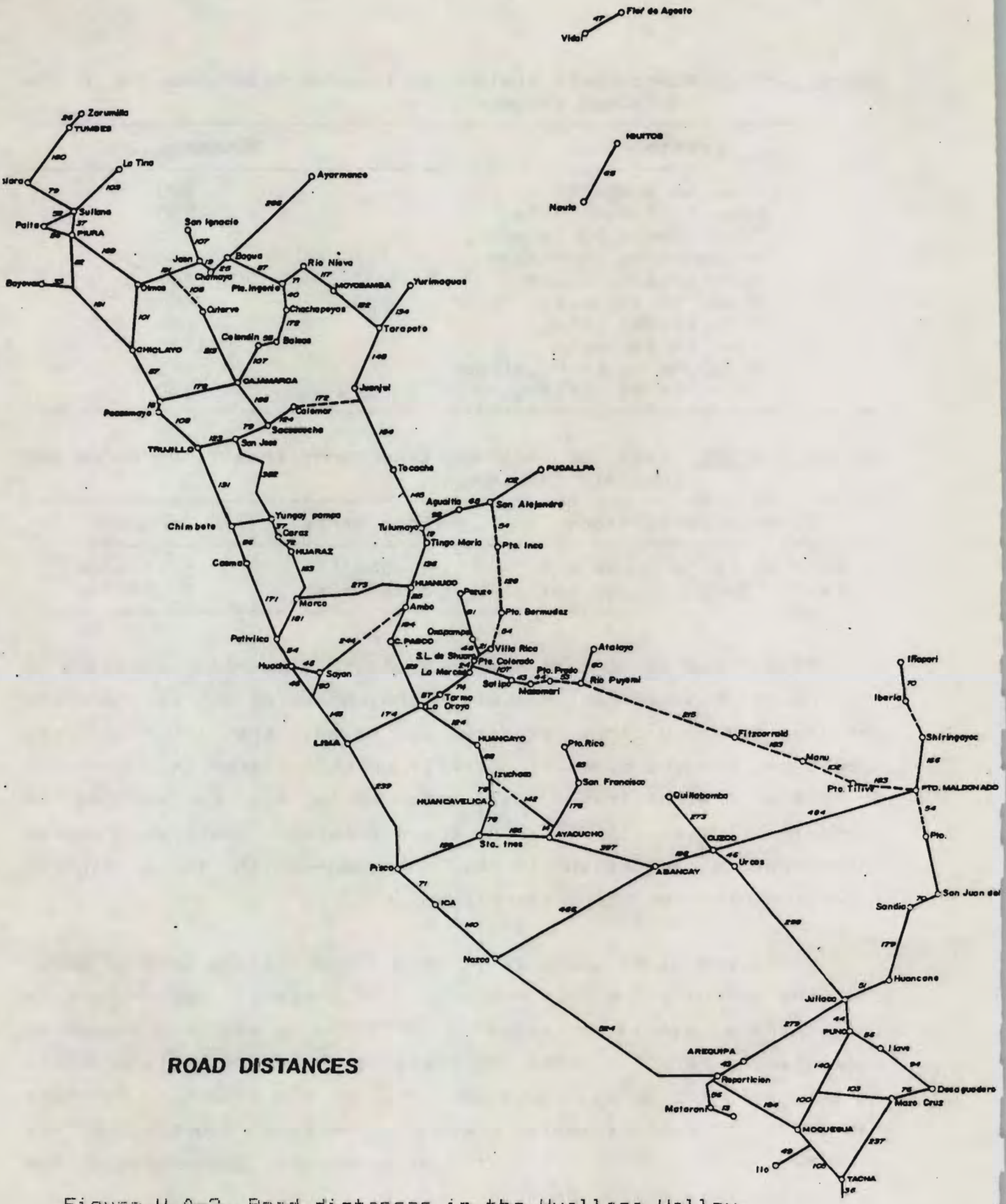
Points	Distance (km)
Lima to Huánuco	400
Lima to Tingo María	520
Tingo María to Tarapoto	485
Tarapoto to Moyobamba	130
Mayobamba to Olmos	500
Olmos to Trujillo	480
Trujillo to Lima	630
Lima to Tarapoto	1740
Tingo María to Pucallpa	375
Tarapoto to Yurimaguas	130

Table V.A-10. Cost of transporting cargo from Tingo María and Tarapoto to Lima.

Cost/km comparisons		Tingo María	Tarapoto
General Cargo	Lima to:	S/.555/km	S/.341/km
Liquid Cargo	Lima to:	S/.820/km	S/.492/km

Sixty-four percent of the Tarapoto to Lima road, consists of the paved Panamerican highway, the remaining 36% is graveled. When the Tarapoto-Olmos section is paved, the trucking costs should be reduced by half. It will be shown later in the report that the freight rates via this route may be reduced by approximately 18% (36/2). As transportation costs are reduced the marketing margins should be narrowed--which is a sign of marketing efficiency and improvement.

There are cases where it is more economical to ship by water down the Amazon and by air freight. At present, air freight is on a space available basis. A follow-up study is needed to estimate the relative costs of shipping non-perishable products to the Atlantic Coast for export. Given the potential for back hauls on certain vessels presently serving Iquitos, it is expected that there could be some economic justification for developing this trade channel.



ROAD DISTANCES

Figure V.A-2. Road distances in the Huallaga Valley.

c. Trucking industry. Transportation rates increase along with other costs in an inflationary time. But they are not the leading indicators because at times they lag behind other rising costs in a rapid inflation any situation. Therefore, transportation costs, which are an integral part of the total marketing costs, should be looked at as a fixed cost of marketing rather than as a variable cost. The greatest impact on transportation rates can be made by providing improved roads, waterways, and airports.

5. Road Improvement Priorities

Based upon field observations, interviews, and an analysis of available data, several improvements in the road system appear desirable. The model used to set priorities for further development is a simple but effective one:

a. Appraisal of the existing system--what is
b. Determination of regional objectives--what ought to be
c. What does it take to get from a to b.

Considerable attention was given to the marketing infrastructure that has already evolved in the Huallaga Region, the channels of trade beyond the region (domestic and export), costs of transportation, and the potential for developing new agricultural and forestry lands and industry.

Based on these criteria, the following development projects, in order of priority, appear warranted:

a. Establishment of rock crushing sites
b. Pavement of the Northern Marginal Highway
c. Improved maintenance of Central Marginal Highway

d. Construction of a secondary road to the confluence of the Marañón and Huallaga Rivers

e. Construction of a secondary road on the west side of the Huallaga River from Tingo María to Tocache

f. Construction of feeder roads

The economic impact of each of these projects and estimates of their costs follow in the next sections of this report. An illustration of a possible road upgrading strategy is shown in Figure V.A-3.

6. Strategy for Location and Use of Rock Crushers and Road Maintenance Equipment.

A major rock crushing activity appears to be the vital link in road construction and industrial growth. Additional benefits include the production in the Huallaga Region of agricultural lime for soil acidity problems. The potential demand is high for these products. The possible potential pay-off to donor agencies and to the Peruvian Government is believed to be higher than any other capital investment that can be conceived in the region.

The proposed plan of action for rock and lime quarrying goes hand-in-hand with the priorities for transportation improvement. Presently, one rock quarry is functioning near Tingo María. One crushing site is far from adequate for the Huallaga Region. A minimum of 7 new quarries is considered necessary. The supply of limestone is plentiful throughout the region from Tingo María to Tarapoto.

Schematic of Road System, Huallaga Region

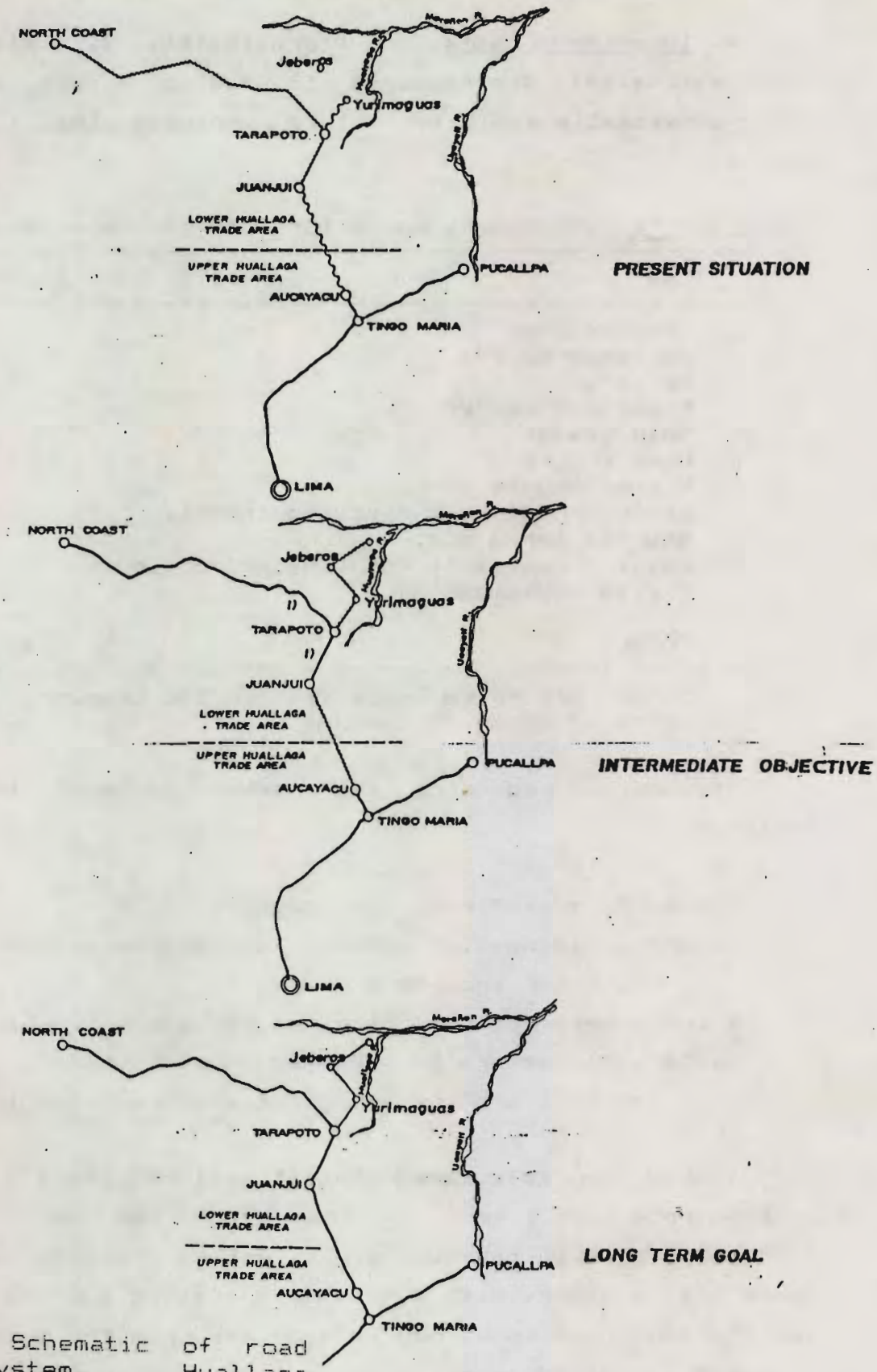


Figure V.A-3. Schematic of road system, Huallaga Region, Peru.

1) Alternative is to maintain sections on upgraded primary gravel road through intermediate time period.

LIMA

a. Investment costs. Approximately $2.3 million dollars (1985 estimates) are required to develop a rock quarry into a fully serviceable facility. This includes the following line items:

Table V.A-11. Investment costs for road maintenance equipment.

No.	Item	Cost in dollars
1	Rock crusher	600,000
2	Bulldozers, D-6	278,000
2	Rollers	180,000
1	Front-end loader	140,000
1	Road grader	110,000
9	Dump trucks	675,000
2	Pickup trucks	30,000
	Air compressors & misc. equipment, storage tanks etc.	172,000
	Bagging equipment for lime production	85,000
	Office equipment	30,000
	TOTAL	$2,300,000

*Rock crusher has rated capacity of 100 tons/hr. and effective capacity of about 70 tons/hr.

Assumptions regarding the number of dump trucks are as follows:

Assume 2 tons/m^3 rock weight/volume

Assume 6 inches(.15 meters) of rock on a 6-meter road with 1/2 meter shoulders

1 cubic meter of rock required for every lineal meter

1,056 cubic meters of crushed rock tons/m^3. Each truck can haul 6 m^3 or enough crushed rock for 18 linear feet

It has been calculated that it will require 176 loads to lay crushed rock over 1 km. If one truck can haul 10 loads/day (6m^3/load) it will take the equivalent of about 18 trucks/km/day. Therefore, a quarry with 9 trucks operating 200 days/year could surface 100 km of roads (50 km each way from the quarry) per year to build a roadbed comprised of 6 inches of crushed rock, or the

same surface with 3 inches of crushed rock twice a year, thereby maintaining a very good primary rock road. Or, it could apply one 3-inch surface to the primary road and apply rock to secondary roads for an equal number of kilometers.

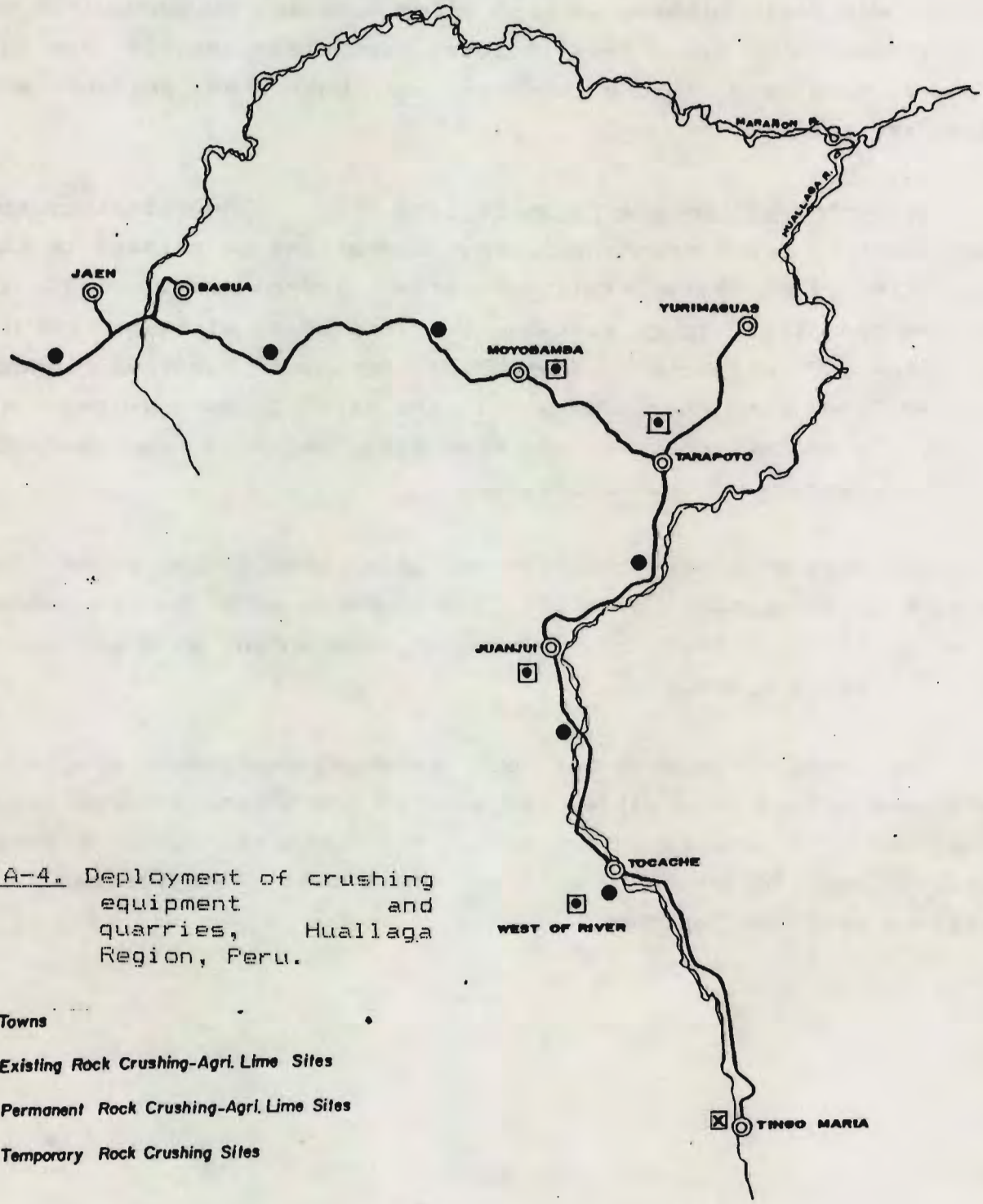
Three quarries could adequately service and maintain the Central Marginal Highway section from Aucayacu to Juanjuí which is just over 300 km. This includes immediate service for the primary road and future service for both the primary and secondary roads.

b. Deployment of quarry operations. The strategy for deployment of rock crushing/quarry operations is related to the priorities for transportation system improvement. It is recommended that four systems be located at strategic points along the 800 kilometer stretch of Northern Marginal Highway between Olmos and Moyobamba within the first 2 years in order to supply the crushed rock for the road base which is necessary to precede pavement of this highway.

The eastern most quarry proposed should be capable of producing agricultural dolomitic limestone as soon as the demand is established. This quarry should be planned as a permanent site. (Figure V.A-4.)

The other three sets of rock crushing equipment should be relocated within the valley as soon as the Northern Marginal is completed. Two should be located on the Central Highway between Tarapoto and Tocache. The third one should be relocated to a location south of Tocache.

Deployment of Crushing Equipment and Quarries



igure V.A-4. Deployment of crushing equipment and quarries, Huallaga Region, Peru.

- Towns
- Existing Rock Crushing-Agri. Lime Sites
- Permanent Rock Crushing-Agri. Lime Sites
- Temporary Rock Crushing Sites

It is proposed that the fifth new quarry be located at another point south of Tocache for use in constructing a secondary road connecting the bridges at these towns and which would help open a sizeable new area for croplands. The sixth new quarry should be located south of Juanjui so that work can be commenced on short-term maintenance on the Central Highway in that general area. The seventh quarry should be located on the Tarapoto-Yurimaguas road for immediate use in road construction.

If a decision is made only to resurface the Northern Marginal Highway from Mayobamba to Olmos, due to limited economic assistance, then the quarries originally located along this section should remain there. In this case a total of 10 sets of rock crushing equipment will be necessary.

c. Total project cost. At $2.3 million cost per quarry, the total equipment capitalization cost for the seven quarries is calculated at $18. million. In addition, the following start-up funds are required.[3]

Table V.A-12. Start-up costs for rock quarry establishment.

Item	Cost in dollars
Parts inventory	$1,500,000
Fuel	600,000
Labor	375,000
Misc. materials	500,000
Total	$2,975,000

To establish seven turnkey rock crushing sites it is estimated that the total capitalization costs would be US$19

[3]Special acknowledgement is given to Loring R. Cook for providing cost estimates for establishing rock quarries in the Huallaga Region.

million. Since this activity is absolutely necessary for acceptable roadbed construction and maintenance, it is recommended that funds for this purpose receive top priority consideration.

Cost of supplying crushed rock is roughly estimated at $11.50/ton, not inclusive of a profit margin. Rock crushing could well be a business performed by the private sector. As a stimulus to attracting investment capital, the Transportation Department (the major purchaser of crushed rock) could buy the rock at a price that represents an attractive return on investment over cost for a specified period of years. The selling price for crushed rock delivered on the road, would be about $15/ton at 1985 (January) costs.

7. Strategy for Road Maintenance of Rock Surface Roads

a. Routine maintenance. The main objective is to organize an efficient plan for routine road maintenance and an effective plan of action for rapid response to emergency conditions. An efficient system is one that includes the deliberate placement of men, materials, and machinery for day to day maintenance. The selection of rock quarry sites should correspond to MTC's Roads Division Departments. For example, MTC has four divisions in the San Martin Department.

Carret.: Pte. Rio Nieva - Pte. Bolivia (Rio Mayo)
Carret.: Puente Bolivia - Tarapoto - Bellavista
Carret.: Tarapoto - Yurimaguas
Carret.: Bellavista - Juanjui - Pte. Pizana

One rock quarry should be located as close as possible within each division. Rock can be handled directly from the quarry and spread on the roads or it can be stockpiled at strategic points along the road. Using this strategy, each

quarry will supply crushed rock for about 100 km of roads, plus help supply crushed dolomitic limestone for agricultural use.

Stockpiling allows more flexibility in quarry location and also could result in doubling or tripling the km of roads serviced by each quarry as the region's road system develops. Furthermore, as distances of road responsibility increase it may be necessary to have a complement of machinery in each area to service the stockpile. The equipment may include:

Table V.A-13. Equipment requirements in Huallaga area.

Equipment	USD
1 road grader, 12 ft. blade	$ 128,000
2 dump trucks	150,000
1 front end loader	140,000
1 pick-up	15,000
Total	$ 433,000

b. Emergency road maintenance. In addition to equipment used for maintenance of machinery and department-wide level each MTC headquarters location should own two bulldozers also. The purpose of this heavy equipment is for use in major road repair projects and for emergency repairs, i.e., landslides. In event of a landslide bulldozers and other equipment can be deployed rapidly to the problem area. Using this strategy roads will be closed for only a few hours rather than for a few days. Emergency road crews can be drawn from other work assignments and must be on 24-hour call. Rapid deployment plans and procedures should be well defined so that responsibilities are understood and tasks undertaken quickly.

Costs for the specialized equipment are estimated as follows:

Table V.A-14. Cost of specialized equipment needed.

Equipment	Cost (USD)
1 D-8 Bulldozer	$ 303,000
1 D-6 Bulldozer	139,000
1 Low-boy	125,000
1 Welding - service truck	25,000
Total	$ 592,000

c. Bridges and culverts. A separate road crew should be assigned responsibility for maintenance of bridges, culverts, and draining and clearing roadsides. In a jungle area this work is an ongoing task of monumental importance.

d. Maintenance of equipment. Equipment maintenance for each MTC Department should be performed at the Department Headquarters at Tingo Maria and Tarapoto. This strategy should include plans for service, repair, and replacement. A low=boy (truck) should be used to transport equipment to the Department maintenance shop and back to operational sites. A portable welder and service truck will be necessary to make repairs in cases where it is not feasible to move equipment to the Department's maintenance shop.

e. Training. Intensive training programs for mechanics should be provided. Training programs can be held either in country or at the nearest factory representative training center for their particular pieces of major equipment. Training of management and highway supervision chiefs can best be accomplished in country. Preparation of an operations and strategies manual for highway maintenance programs is highly recommended as part of the training effort.

f. Equipment replacement. The need for rock crushing technology and gravel distribution does not end with the pavement of primary roads. It is an on-going activity, and will continue

as the Huallaga Region develops and additional km of secondary feeder roads continue to penetrate the jungle. Moreover, equipment will be needed also to maintain paved roads. Long-term assistance may be necessary to assure a proper program of equipment replacement.

g. Budget plans. Maintenance costs vary with so many factors that it would be presumptuous to make a long-term estimate of assistance. Maintenance costs ranged widely in 1984 depending on the degree of improvement and the starting point. The Development Corporation at Tarapoto reported a 1984 cost of S/.25,000/km for 93.5 km of road improvements. PEAH estimated 1985 maintenance costs for 291 km of Central Highway at S/.12,000/km. Department of Transportation estimates for the resurface work on the Yurimaguas road was S/.20,000/km for 110 km in 1984. Inflation will undoubtedly make all cost estimates in this analysis obsolete within a short period. Therefore it is important to plan a road improvement strategy that reflects step-by-step improvements, not just one in terms of projected annual monetary outlay. This approach would appear consistent with AID's economic development goal.

8. Proposed Transportation Improvement Projects

a. Upgrade Northern Marginal Highway. Five road improvement projects are discussed in their order of priority. The first objective is to complete pavement of the Northern Marginal Highway and the road, south of Tarapoto to Juanjuí by January 1, 1988. Given the stage of market development, and the potential for expanding production in the lower Huallaga region, pavement of this road should have the greatest socio-economic impact.

The issue of upgrading a farm-to-market road is directly related to the accrued savings in time. Trucks can travel at

average speeds of only 20-25 km/hr on gravel roads; on paved roads, speeds of 40-50 km/hr can be attained. Currently it takes an average of about 26 hours on the Northern Marginal Highway from Tarapoto to Olmos. If speeds are doubled then the travel time is cut in half.

Based on the costs for the Tarapoto-Moyobamba road, it is estimated that the cost to pave over the existing rock road will be $ 660,000/km (1985 USD). The cost for the 500 km stretch from Moyobamba to Olmos is estimated to be $330 million. Pavement of the Tarapoto-Juanjuí highway would cost an additional $79 million.

It is assumed that the following costs per ton/km are reasonable for an average truck hauling 20 tons of produce: Paved highway - 10 cents, good rock road - 13 cents, rough rock road - 20 cents, and dirt road - 25 cents. Then using these cost differences the savings accrued per round trip over 500 km of road (1000 km round trip) would be:

Table V.A-15. Cost of road construction.

Item	Cost (USD)
Rough rock road	20 cents x 20 T x 500 km = $2,000
Paved highway	10 cents x 20 T x 500 km = $1,000
Savings	$1,000/trip

Further assuming 14,500 trips/year, the savings in truck operating costs alone would equal $14,500,000. In addition, savings are accrued through a use of one-half the man-hours to haul a given tonnage.

A spin-off benefits not only occurs from increased economic activity within the current area of development, but also from added secondary and feeder roads that will be generated. The

payback in terms of generated economic activity and cost savings should occur in approximately 8 years.

b. Improve Central Highway. The second objective is to improve Central Marginal Highway using screened river rock during 1985, 1986, and 1987. After completing the Northern Marginal Highway, the rock crushing equipment can be relocated and a major resurfacing project could commence.

Needed improvement of the Central Marginal Highway, receives a much lower priority than the pavement of the Northern Marginal Highway. Even though the distance from Tarapoto to Lima is much shorter via the Central Marginal Highway the poor condition of the bridges throughout this section of the road poses a major constraint to the flow of commodities along this vial. Moreover, it is important to note that not all the commerce that flows into and out of the Tarapoto area along the Northern Highway ends up in Lima markets, or vice versa.

c. Maintenance strategy. Immediate economic aid is needed to finance improvements necessary to keep the road passable for light commerce, and to construct adequate bridges to support eventual heavier traffic. Maintenance work is required: (1) to maintain drainage systems, (2) to clear vegetation growth, and (3) to resurface occasional trouble areas (either extreme pot-holes or soft spots). Some new culverts are also needed. Foremost in this intermediate effort should be the practice of screening river rock so that rocks larger than 3 inches in diameter are not used on the road. Rock larger than 3 inches contribute to pot-hole development, vehicle repair costs, and reduced speed. It is estimated that the cost of this maintenance activity should not be more than $100/km. The total cost of road maintenance from Aucayacu to Juanjuí is estimated to be only $30,000 annually. It is assumed that this cost can be borne by

MTC's Transportation Department, by PEAH, or other agencies with road maintenance responsibilities.

d. Needed bridge improvement. Outside financing is needed to bring the bridges on the Central Marginal Highway up to a minimum load capacity of 32 tons to 60 tons, if the highway is ever to be used for heavy traffic. Presently, 21 bridges in Huánuco Dept. alone are rated below this capacity.

One bridge was observed to limit gross weight to two tons presently. In several cases it was observed that trucks were by-passing the bridges and fording the rivers. It is obvious that several bridges are in bad repair. It was learned that at least 15 bridges in San Martin Department have similar limitations.

Reliable cost estimates obtained for bridge construction were not available, but estimates obtained from PEAH indicate that the repair of existing bridges in the project area would cost S/.159,000,000 (December, 1982 figures).

e. Inland Port Access Road. The third objective is the construction of the road through Yurimaguas to Jeberos and on to the confluence of the Marañón and Huallaga Rivers. The ultimate goal for this road should be pavement, however, for the immediate future a good secondary gravel road is recommended. This project warrants immediate attention if development funds are available or there are "stage-two" funds available after completion of the Northern Marginal Highway. Its importance is three-fold: (1) access to a river system with more draft than within reach at present, (2) the development of an estimated 350,000 hectares of new cropland[4], and (3) access to previously untapped forest

[4]Some feeder roads would be needed to open the entire area of 350,000 hectares.

lands. An additional 120,000 hectares could be accessed in the area north of Tarapoto by the extension of feeder roads from the Tarapoto-Yurimaguas road.

The proposed road extending from Tarapoto to the confluence totals about 285 km. It is recommended that three rock crushers and associated equipment would be needed to establish quarries for construction of a road system. Total cost of this project is estimated at about $6.75 to $9.75 million.

f. Construction of an all-weather secondary road. A fourth objective is the construction of 170 km secondary road on west side of Huallaga River from Tingo María to Tocache.

The rule of thumb referred to previously for zones of influence is used to estimate the impact of this road. However, consideration must be given for construction of the road in areas adjacent to the river and where the terrain is not suitable for agricultural use. It is assumed that the 5 km zone of influence is applicable to only one-half the distance of 170 km. Nonetheless 85 km of road may bring as many as 102,425 hectares of land into productive use. The proposed road also would connect the Palma del Espino plantation, located near Uchiza, to a primary road at the Tocache bridge. The zone of influence for extensive livestock production, assuming it extends 35 km beyond the zone of influence for crop production, may effect 716,975 hectares. This does not take into account the potential for grazing livestock on pasture lands which otherwise are too steep for cropping.

Feeder roads and trails extending outward to the west eventually will expand this zone of influence. Based upon 1985 rates of $133,000/km for secondary road construction this project would cost $22.6 million plus bridges.

g. Deep penetration of new areas. Objective 5 proposes new feeder roads. New areas are not opened fully for economic development simply by constructing a single secondary road into them. As discussed, the zone of influence impacts only on a limited area on either side of the road. Typical of mountainous areas, valleys or flood plains will extend for many kilometers from a centrally located road. For this reason it is necessary to add an additional network of farm-to-market roads.

To complete this analysis of the Huallaga region transportation needs, the role of feeder roads and trails is discussed. In terms of economic impact on the region's agriculture and industrial development, feeder roads and trails have less impact than a good secondary road into a new area except when feeder roads access major forestry resources. A lower priority on this type of transportation network is proposed except where valuable timber resources exist. A more in-depth follow-up study is highly recommended in the Lower Huallaga Region north of Tarapoto where forestry production has a potential.

The terrain in the Huallaga Valley Region makes feeder roads an appropriate extension of secondary roads. These farm-to-market roads are needed to reach like "fingers" off of the secondary roads into fertile mountain valleys.

For every 100 km of secondary roads an average of 200 km of feeder roads are needed to develop fully a mountainous region like the Huallaga. Based upon a zone of influence of only 3 km on either side of these tertiary roads the potential for accession additional cropland is enormous.[5] For each km of feeder road system an estimated 1,446 hectares of cropland is

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[5]The zone of influence is less than for secondary roads because of the narrowness of some valleys and the barriers caused by mountain streams.

accessed, and for rangeland use an estimated 9,640 hectares can be accessed.

For the 170 km of proposed secondary roads west of the Huallaga River between Tingo María and Tocache an estimated 340 km of feeder road system is recommended. For the 284 km of secondary, or proposed secondary roads, from Tarapoto through to Yurimaguas and on to Jeberos and the Port site an estimated 568 km of feeder road is recommended. The most appropriate feeder roads are believed to be those comprised of crowned dirt which are approximately 4-5 meters in width. The cost of dirt feeder roads is about 40% less than for gravel feeder roads or approximately $45,000/km. Therefore it is recommended that initial feeder road systems not be graveled. The cost of construction for the proposed Tingo María-Tocache network is estimated to be US$ 15.3 million, while the Lower Huallaga system is figured to cost US$ 25.6 million.

Due to the important relationship between the Marañón-Huallaga delta and the production and movement of Peruvian agricultural commodities it is recommended that the described network of feeder roads be planned and financed in conjunction with the lower Huallaga road and port side plan.

Feeder roads like the ones needed to service Tingo María-Tocache west bank road the Tarapoto-Jeberos-Port road should, as Vandervoort found, yield a 25% internal rate of return. Furthermore, in many instances the proper development of the forestry resources along will overwhelmingly justify the extension of the feeder road system.

9. Potential for Water Transportation

The principal rivers that serve the Huallaga region include three Amazon tributaries, the Huallaga, the Marañon and the

Ucayali. Their navigable lengths and draft at low and high flow are in Table V.A-16.[a]

Table V.A-16. Navigable lengths and draft at low and high flow in Peru.

River	Navigable Length (km)	Draft (feet) Low Water	High Water
Amazon (in Peru)	687	15	25
Marañón	913	4	6
Ucayali	1,465	5	8
Huallaga	250	4	10

A summary of navigable distances and river characteristics are shown in Table V.A-17.

The draft from the confluence of the Huallaga and Marañon Rivers is closer to 5 feet at low water time. This is an important distinction when considering location of a major inland port at this point. The depth of the river determines how much tonnage/boat can be transported. The additional 1-2 feet of draft increases significantly the amount of tonnage that a barge or boat can transport.

Table V.A-17. Summary of navigable distances in miles.

Section	Huallaga	Marañon	Ucayali	Amazonas	Total
Yurimaguas-Iquitos	216	135	---	64	415
Pucallpa-Iquitos	---	---	480	64	544
Iquitos-Ramon Castilla	---	---	---	307	307
Iquitos-Atlantic Ocean	---	---	---	2,000	2,000

a. Commerce in the Iquitos area. Iquitos is important to the economy of Peru and the potential for increased development of the Huallaga region. Transportation demand in the

[a]Source: Minister of Transportation and Communication, Long term National Plan of Development, 1970-1990. Dec. 1979, p. 11-30.

Iquitos region increased 26% from 1976 to 1982 (see Table V.A-18). In 1982, the flow of cargo was as follows: Iquitos to Yurimaguas - 17,128 Mt, Iquitos to Tarapoto - 9,924 Mt, Iquitos to Pucallpa - 31,685 Mt, and Iquitos to export - 9,130 Mt. Growth in commerce appears to be limited only by the absence of an adequate link between the developing Huallaga region and the Amazon.

Table V.A-18. Trends in transportation demand in Iquitos region 1976-1982.

Sector	Water	Road	Air	Water-Road	Total
		- Increase of 1982 over 1976 -			
Agriculture	0	+ 1	-	0	0
Industry	+52	+ 57	-	+38	+39
Energy and mineral	-26	2	-	+21	+11
Food	+18	+101	-21	+31	+38
Other	+23	- 8	-95	+26	+71
Total	-12	+ 54	-46	+35	+26

b. Costs of shipment. Freight tariffs published by the Peruvian Amazon Line from U.S. Gulf of Mexico and U.S. Atlantic Ports to Venezuela, Brazilian Amazon River Ports, Iquitos, Peru, and other ports show the following rates per 1000 kilograms:

Table V.A-19. Rates for items shipped from Atlantic ports to Peruvian and others ports.

Item	Cost (USD/Mt)
Food stuffs, not specified, in boxes	$160.00
Corn or soya meal in bags	103.50
Soybean oil, in drums	125.00
Tractors, skidders and parts	125.00
Wheat in bags	103.50
Lumber	

Table V.A-20. Rates for items shipped from Iquitos to Atlantic ports.

Item	Cost (USD/Mt)
Cargo, not specified, non-hazardous	$200.00
Lumber not specified	200.00
Lumber, mahogany	150.00
Lumber, cedar	135.00
Plywood, in strapped bundle	140.00

Water transportation has a role in the development of the Huallaga region. The Amazon provides an economical outlet for this land-locked region, principally because agricultural and industrial products can be carried as back-hauls eastward for export. Presently, an in-balance exists in water commerce on the upper Amazon. More cargo arrives into the area than leaves the area. This fact, coupled with the growth potential for the area around Jeberos, makes the location of an inland port at the confluence of the Marañón and Huallaga Rivers an important step in the development of the Lower Huallaga Region.

Development of this part of the region depends on the availability of funding for roads and construction of port facilities. The project should be planned in three stages: (1) improvement of road from Tarapoto to Yurimaguas (135 km), (2) construction of a road from Yurimaguas to Jeberos to the port site (80 km) and (3) construction of the port facilities.

This is a highly desirable project since it not only provides an alternative mode of transportation from the Huallaga Region, but also opens a large area to agricultural, forestry and industrial development. In terms of development aid it is ranked second in priority to completion of paving the Northern Marginal Highway.

Construction of a secondary road through Jeberos to the port site is estimated at $19,950,000 ($133,000/km for 150 km). The

cost of two quarries, one for construction of the new road and one for upgrading the 135 km road from Tarapoto to Yurimaguas plus the cost of the upgrading (135 km at $10,000/km) and the cost of port facilities are given in the following table (V.A-21.)

Table V.A-21. Costs associated with construction of road from Tarapoto to Yurimaguas.

Item	Cost in Million Dollars
2 rock quarries fully equipped	4.60
Road upgrading Tarapoto to Yurimaguas	1.35
Port facilities (warehouse, docks loading and unloading facilities)[7]	2.00 - 5.00
Total	7.95 -10.95

10. Strategies for private sector road development

When economic incentives for production exist, legally or illegally, entrepreneurs will assume the function of road building and the construction of other transportation facilities otherwise left to the public sector to construct.

In the Huallaga region at least, three types of production meet the criteria for self-help transportation. They are the illegal coca industry; and others are plantation farming (palm oil and cacao), and forestry. In this section, each will be briefly addressed. Then the evaluation of road development will be discussed, showing the role of the private sector in the initial stages of development.

Coca production is still the major crop grown in the Upper Huallaga region. As coca production is pushed further up the mountain sides or further from the main road by law officers it

[7]Rough estimate: project needs follow-up engineering study.

will enhance the regions' transportation network. As long as it maintains its high level of profitability producers will participate in the development of feeder roads and in some cases secondary roads, which will eventually open the Selva to more socially acceptable types of agriculture. Eventually, these interior roads will link the regions' transportation network and the hectares cleared for production will be integrated to the Peruvian overt agricultural sector.

Investors in plantation operations already are beginning to build reasonably good feeder roads in order to provide access to productive land far from the existing road system. Palma de Espino, west of the Huallaga River near Uchiza has constructed an all-weather road about 10km in length to the plantation. A ferry to link the plantation to the Marginal Highway has been constructed.

One such all-weather road was observed just south of Tocache which appeared to be superior in condition to the Central Marginal Highway nearby. These private "farm-to-market" roads are travelled far less than the Marginal Highway. In all likelihood they will become a part of the region's secondary public system as agriculture penetrates deeper into the jungle. Historically plantation agriculture provides a nucleus for the development of a viable marketing system.

According to the Upper Huallaga Valley Progress Report and Work Plan dated January 9, 1985:

> "A high priority should be placed on the establishment of a long-term permanent logging and milling industry where forests are managed in large blocks and a systematic reforestry program is followed. The strategy would be to block together thousands of hectares of forest land for this purpose. It most

likely would be publicly-owned forests, but nothing should stop a private firm from gaining ownership. The source of funds should come from large firms of an international nature who can manage such resources over an extended time period. The products produced may be pulp wood or dimension lumber, or specialty products."

Forest harvest are retarded because of unfavorable economics of the lumber industry. In many cases small saw mills have exhausted supplies near their sites of operation and they cannot move further into the jungle because of the lack of roads, also the labor supply in the Upper Huallaga is not available. An estimated 2,515,000 hectares of forests exists in the San Martin and Huánuco Departments.

According to the Minister of Forestry report, sustained yield management of these forests could yield 40 billion board feet of sawn timber annually with a gross value of about $2 million (1961 values)! The total value of potential lumber production over the 20-year period, 1961-81, was estimated at $100 million.

A timber industry which is used as a basis to initiate a feeder road construction project will result in penetration to all accessible parts of a region. These roads, of course, lead back to markets, which eventually will open much of the land to higher economic pursuits that are hopefully conservation oriented and ecologically sound.

a. Appropriateness of initial roads Initial roads into a new area do not have to be asphalt roads. In the U.S., for example, the first rural roads were no more than a trail. Later they were upgraded to an engineered dirt road. Often, these roads were both built and maintained cooperatively by the farmers

they served. Later these roads were upgraded to gravel; then, some to asphalt. Many are still gravel. Few are still dirt.

One distinct difference should be noted between road development in the U.S. and road development in Peru. In the 18th and 19th century when much of the road system was plotted in the U.S., transportation was slow relying upon horse drawn transportation. Trails and dirt roads were an appropriate technology. Peru's development, coming in the 20th century, must accommodate motorized vehicles carrying loads. The country also needs feeder trails, but not of the same type as used in the U.S. Animal draft is nearly non-existent in many parts of the Huallaga region. In its place are motorcycles, a few tractors, pickups, and small cars. All-weather secondary roads are essential.

Despite these current day needs, Peru should start the development process in the Huallaga Region by building feeder roads. Many of these do not need to be hard surfaced initially. Producers can use river rock in swampy areas and depend on drainage to keep trails or narrow roads open most of the time. Their needs are not as pressing as the everyday needs of a primary or secondary road. These trails can be low cost, measuring no more than two meters wide in many cases. They can be traversed by motorized three-wheel carts, tractors, and wagons, and by foot power, as previously mentioned. As production in this area grows they can be upgraded to full-fledged feeder roads.

b. Road motivated development. First order motivation for rural transportation can best be triggered by the construction of all-weather secondary roads into the heart of areas with agricultural or forestry production potential. Zones of influence were discussed earlier. First-order motivation should be privately induced. It can be public sector induced.

Second-order motivation may come from a variety of governmental policies. In other words, second-order motivation is totally public sector induced. Four methods are discussed.

i. Gifts of land, in return for private sector efforts to build roads and clear land of tillable slopes, terracing when necessary. This procedure was used in the U.S. to motivate coast to coast rail transportation. It is workable as long as public lands are penetrated.

ii. Low-cost, long-term leases of forest land having commercial potential whereby the leasee is required to construct feeder roads, agrees to replant for sustainable yield, and agrees to certain erosion prevention measures.

iii. Subsidized processing plants (or assembly plants) for agricultural products, thereby creating a favorable economic climate for agricultural investment. The public sector in this case, provides low-interest loans for building processing plant and constructs initial trails or feeder roads into new lands suitable for supplying products to the processing plant. These roads are then maintained by the producers.

iv. Subsidized crops, again to stimulate private investment in agriculture and necessary rural roads. Again the public sector may construct the initial roads, but producers properly motivated will maintain the network until it connects into a public system.

B. RESEARCH AND EXTENSION

A strong research and extension program is essential for agribusiness development in the Huallaga Valley. This should be an applied, production oriented program on problems of major economic importance.

1. Research and Extension Programs

Using past performance as evidence, researchers have found that the pay-out for research and education inputs into agriculture is the highest among all inputs into Agriculture. The return on investment is higher than inputs into most other sectors of the economy. Numerous studies in different parts of the world confirm the conclusion that for each additional dollar spent on research and education, the returns will range from $1.30 to as high as several fold the original expenditure.

In the Huallaga River region almost every agribusiness proposal falls back on the need for additional raw material supply and more profitable production before the processing venture can be expected to pay off.

The various products that can be produced in the area must be viewed as competitive for limited inputs such as land, labor, and capital. It is irrational to recommend an expansion of production of a particular product without knowing the relative profitability of that product compared with products that will be directly affected.

The agricultural experiment stations in the area are making impressive contributions to the technology of production and the demonstration of proposed changes, even though the programs were virtually abandoned during the 1970's. But with such a wide variety of adaptable products for the area, the experiment

stations have hardly scratched the surface of potential accomplishments.

The extension service is an absolute necessity in order that research results are disseminated to the potential users. This is the most direct and most productive method of disseminating information if funds are sufficient to do the job correctly. Other, more innovative, approaches may be applicable only for special situations. Even though the extension service has had limited funding and inexperienced personnel, their success over the past four years is commendable.

There is no question but that the land grant system adopted in the U.S. merits the bulk of the credit for the technification of agriculture in the USA and the capacity to produce quantities far in excess of the domestic requirements.

Research and extension are the building blocks for agribusiness. It is usually necessary for the research scientists working with small plots in the field to determine which of the inputs of seeds, fertilizers, lime, herbicides, insecticides, etc. will give the maximum return for each dollar invested. The extension service's role is to take this information to the leading and innovative farmers who will try the new techniques under his own environmental conditions. Once the leading farmer proves the profitability of the new technique, his neighbors will usually follow <u>provided it is profitable</u>.

Agribusiness should support research and extension efforts to the maximum extent possible. The role for agribusiness should be the delivery of the essential inputs of seeds, lime, fertilizers, pesticides, tractors, and other equipment to the farmers in the most efficient manner possible. In addition, agribusiness should assist the farmers in the efficient processing and marketing of their products.

The Tulumayo Experiment Station is the main station in the Upper Huallaga Valley with sub-stations at La Divisoria and Tocache. There were 27 experiment station staff members in 1982 of which 6 were technical specialists. To reinforce this effort PEAH reported that their program supporting research contracted 25 technical staff members in 1983. Research work covered a wide range of products including: rice, corn, yuca, plátano, soya, cowpea, native fruit, cacao, coffee, spices, rubber, tea, potatoes, pasture, cattle and cuyes.

Operating funds for the Experiment Stations in the Alto Huallaga area are provided by PEAH under agreements between INIPA and PEAH. The University (UNAS) also carries out Agricultural research, much of which is student thesis work. There is also a three way agreement between INIPA, UNAS and PEAH for developing research studies at UNAS as a service, to the Tulumayo Experiment Station on problems of vital interest to the Station, but for which the University has more suitable technical and physical facilities. It is reported that there has been a 500% increase in the number of experiments being conducted since PEAH started to support research in the Upper Huallaga. Training programs are being conducted but mostly for short periods of time. However, two-year degree scholarships are planned for 13 researchers for the 1985, 1986, and 1987 years at Tulumayo. The UNAS has trained (including those presently studying) 13 professors (2 PhD's and 11 MS's). Short and long-term training for extension workers is planned for in the coming three years. Further upgrading of the UNAS, extension and experiment station staff is highly desirable.

The extension service staff in the Upper Huallaga includes nine extension agents (one for each of the nine agencies), nine 4-H club specialists, 9 home economics agents, and 40 sectorists. They have conducted many demonstration plots on farmer's field, formed over 35 4-H clubs, and over 20 home

economics clubs. Considering the fact that for 13 years the extension service was non-active, one might conclude that they have been doing very well during the past two years. This is especially impressive in view of the social unrest in the area that has made staffing particularly difficult and the execution of extension programs with producers and rural families almost impossible.

The extension service also operates under an integrated agreement between INIPA and PEAH. UNAS has a major responsibility for the training of extension staff. There have been technical training events. Topics of these sessions included:

- Research Methods
- Farm Management
- Food Technology
- Livestock Management
- Small Animals
- Grain Storage
- Energy and Non-traditional Crops

Thesis research for students at the university seeking the Ing. Agrónomo degree is often sponsored by PEAH and done at the Tulumayo station. This activity included studies in the following areas:

Agronomy	25
Animal Science	25
Food Technology	17
Total	67

Researchers who are working on advanced degrees or have completed them include:

Ph.D	2	(Brazil and Kansas State)
M.S.	10	(Brazil-6, Peru-2, Costa Rica-1, Mexico-1)

The Alto Huallaga and Central Huallaga are separated by a stretch of hills and poor roads of approximately 200 km. In the latter case, the altitude is under 400 meters, and the valley is generally wider and more flat. It has a greater extension of agriculturally suitable land. Row crops such as corn, cotton and soybeans area grown on a more extensive scale, as is livestock production. The experiment stations for the Central Region of Huallaga are located near Tarapoto and Moyobamba. The Extension Service has 14 agents and approximately 52 sectorists. Continued and expanded support for the education, research and extension functions will bring net returns greater than any other activity in the Huallaga Valley.

The education function has two obvious components. The first is the formal academic training to be found at the universities and through special training programs. This includes graduate training at reputable institutions. A continued program of scholarships is required if a continued supply of trained people are to be made available to the public institutions and also to the private technical sector of the economy. Occasional thrusts of resources going to technical training will not be sufficient because the turnover of personnel and the drift to other more profitable pursuits soon deplete the corp of technically trained people.

The second educational method is the on-job training programs typified by the extension service. The extension service personnel need continued training in order to provide the continuing educational services to producers, marketers, food processors and the rural family. Extension service expertise must be broadened to include agribusiness and financial aspects of agriculture. The success of producers may depend more upon their capacity to utilize credit efficiently and to maximize benefits within the total agribusiness complex than on their

ability to apply the technical aspects of production. The extension service needs to broaden its scope to include all those activities that do impact upon the farmers welfare.

A course of action with a high priority strategy might well be innovative implementation of extension and educational programs beyond the traditional. The success or failure of businesses and agribusiness in particular, depends upon the management abilities of those operating the businesses. Good management skills are the most scarce of all resources in a developing country and the best way to make this resource more abundant is through continual training programs to improve the management capabilities of those associated with processing firms, marketing agencies, and others related to the agribusiness firms. The success of this strategy would depend to a great degree on a team of well trained, experienced and motivated Extension Specialists.

2. Recommendations

Specific needs of the research stations and extension service can be identified in relationship with the recommended product expansion proposals and the associated agribusiness activities. First, recognition should be made of the serious handicap to researchers and extensionists as well, if they do not have access to good library facilities. Reports indicate that the library facilities at Tulumayo are inadequate and that funds and efforts to correct this problem are critically urgent.

The lime production and distribution proposal will require both additional researchers and extension specialists. The soils and fertilizer experts should be prepared to provide basic plot demonstrations as well as new research dealing with lime and all fertilizers relevant to the soils in the areas. The extension service will have the major task of informing farmers of the

availability of lime in the area, the responses they can expect, and the economic benefits of using lime and other modern inputs such as hybrid seeds and better plant protection. Some applied, appropriate technological research is needed to develop some practical, low-cost system for the application and incorporation of the lime into the soil. In addition, more field research is needed to determine economic levels of lime required for different soil types and the most economic levels of fertilizer responses. The same services will be needed in both the Upper and the Central Huallaga areas. Therefore it is recommended that there be four soils/fertilizer researchers be on the staff. Two for each of the areas and four soils/fertilizer extension subject matter specialists be on the extension staff. Two for each of the areas are recommended.

The palm oil plantation operators are expected to provide adequate in-house research to serve their basic production needs. However, for specialized soils, disease, insect, or other problems, the respective experts at the experiment stations would be available to provide assistance in their respective fields of expertise. It is anticipated that additional extension agents will be required to help promote and organize producers in the satellite arrangements in the early stages of development. The processor companies might participate in the costs of this service and eventually absorb the extension agents to be the company's field men.

The cacao processing activity with its requirements for sizeable production growth will be aided materially by a couple of additional researchers devoted to the production problems of this crop. About four extension agents should be assigned to work with the cacao producers. It is further recommended that the Cooperativa Naranjillo be provided short-term management and cacao processing experts. These two short-term advisors might establish a continuing relationship with the firm and return from

time to time as the operations mature. Particular emphasis would be given to organization, management, and quality control.

A tea expert is needed immediately to work with processors and producers. This advisor should be a long-term advisor, knowledgeable about the agronomic aspects of production, tea processing technology, and the specific problems of the market for tea. Two new extension specialists are required to work with the cooperatives and assist in the development of the nucleus estate project.

The poultry and formula feed manufacturing activities are one of the most dynamic activities in the Central Huallaga. Additional researchers and extension workers will be called on to assist more and more as the industry becomes more sophisticated and competitive. The private sector is carrying the thrust forward but applied production research work into animal nutrition, and particularly the economics of marketing and farm management is needed.

What happens to the spice and essential oil agribusiness activities will depend upon the research realized at the experiment stations more than any other factor at this time. Much additional work is needed on the production aspects; especially varieties, fertility requirements, and cultural practices. The marketing characteristics of spices needs further identification. The market demand for quality and reliable quantity have been emphasized, but the ability of the producers in the study area to meet these stipulations is very much uncertain. Variety trials take considerable time for tree crops. Considering the promising preliminary results with a number of spices and essential oils at Tulumayo, it is believed that additional research effort would provide a good pay-out. It is recommended that two researchers be assigned the responsibility for applied development activities in this area.

A short-term advisor on cold storage should be assigned the task of not only identifying the need and problems associated with expanded cold storage, but working with the poultry and other sectors to explain the operation and utility of cold storage facilities in a modern marketing structure. The poultry industry will not expand out of the regional mode until slaughter, chilling and cold storage/freezing facilities are developed to handle the marketing aspects.

The economic aspects of farm management production and marketing has been one of the neglected areas in the Huallaga Valley. Every production activity can make a strong claim for additional research and extension effort and the associated funding. However, there must be a prioritization to make sure that the benefits are the greatest for the expenditures. A review of the present research areas of emphasis reveals a noted absence of staff working on economic problems, and economic research data is clearly lacking. The need for farm management, and marketing research and training must move forward at the same time agronomic and biological research proceeds. The majority of the agronomic and animal research effort is relevant only if it makes economic sense in the context of the program objective being to expand income to the participants of a development program.

The addition of two agricultural economists, to the Tulumayo and Tarapoto Experiment Station staffs is strongly recommended. At least one of the economists should have an advanced degree. Until such specialists can be trained, short-term consultants must be employed to help fill the void now present.

Similarly, the extension service needs to improve the training of selected specialists to work in the economic analysis of marketing and farm management programs. In addition, a

management specialist should be added, particularly in the Upper Huallaga, to work specifically with the cooperatives and the other processors as they expand their production and marketing activities and are faced with the multitude of financial, personnel, and organizational problems inherent in growing and changing organizations. Until a local management specialist can be trained, short-term foreign experts will be required as consultants for this requirement.

Training at the graduate degree levels must be a continuing process. Because of the normal attrition rate of trained personnel others must be forthcoming to keep a staff of capable people. The number of technicians with advanced training is frightfully inadequate because of the short time that the experiment stations and extension service have had to rebuild their staffs and due to the hesitancy of personnel to move to the Huallaga areas. A strong effort must be made to upgrade the training through an enlarged scholarship program, including all of the major disciplines. This is an AID program of long standing and the positive benefit/cost relationships are well known. The point of emphasis is that the particular area of upgrading technical staff is worthy of a high priority strategy with an urgency timing. Virtually every activity in agribusiness designed to improve income from the area hinges upon the requirement for expanded production of raw materials for the processor or handlers and this in turn is tied to the technology available to producers which is tied to the applied research, extension, and training inputs.

To assist in orienting the research and extension programs toward the problems of major economic importance that will have the maximum impact on increasing incomes, it is recommended that long-term research and extension advisors be stationed in the Upper Valley and Central Valley regions. It is recommended that one long-term research advisor and one long-term extension

advisor be stationed in each of the regions. These individuals will assist in coordinating the activities of the short-term assistants and the training of the counterparts both on-the-job and through formal academic training in-country and abroad.

Table V.B-1. Summary of activities and requirements of extension and research short- and long-term advisors.

Specialty	Expatriate Short-Term Adv.	Expatriate Long-Term Adv.	Local Staff Research	Local Staff Extension
Limestone application			4	4
Oil palm	1			1
Cacao	2		2	4
Tea		1		1
Transportation	2			
Grades, stds,	2			
Market news	1			
Credit	2			
Livestock			1	1
Poultry & cold storage	1			
Rice			2	
Corn				
Coffee				
Spices	1		2	1
Aquaculture	1		1	
General cross product				
Marketing & mgt			1	1
Farm management			1	1
Research administration		2		
Extension administration		2		
Totals	13	5	14	14
Training*			16	16

*Immediate additions to existing training programs. Start 4 researchers and 4 extension specialists in each of the next 3 years.

Table V.B-2. Estimated costs of assistance program.

Specialty	Cost/yr $USD
Short-term advisors	$ 400,000
Long-term advisors (5) w/funds for equipment and supplies	1,000,000
Local research and extension staff	600,000
Training	600,000
Total	$ 2,460,000

The evolution of agriculture moves from a substance, self-sufficiency system to a specialization and trade system. Technology of production must be paralleled by technology in marketing, processing, distributing and management. A transition from research, extension and training oriented to production to a more comprehensive program that provides assistance in management, economic analysis, marketing and financial management must occur. Peru had advanced in agriculture to the point where expertise in management and the other economic research functions are as fundamental as production technology. Therefore added research, extension, training and consulting programs are justified for specialization areas.

Extension programs must include management training for agribusiness firms and cooperatives in addition to farm managers. Universities can assist in this training. Undoubtedly there is a causal relationship between agribusiness failures and inadequate training for management. It has been documented that many times in many places that farmer cooperative failures are a direct consequence of poor management. Other agribusiness firms likewise suffer from inadequate management.

Questions have been raised concerning the adjustments and innovations that can be made in extension and research programs

to cope with the worsening security situation in the Upper Huallaga. A back-up plan that could bring forth appropriate research and extension functions can not be conceived easily. One alternative is to transfer personnel from the danger zones to more tranquil areas. A shift from personal contact with clients can not be replaced through mail or radio contacts but a least it may partially off-set the losses.

C. CREDIT

1. General Background

Economic development of natural and human resources requires an expanding capital input. Capital accumulation from production before it is essential in a growth environment is difficult. A credit service making it possible to add capital assets and operational funds facilitates a more rapid growth and more economically rational combination of resources in an operational unit.

The employment of capital owned by others, the same as land and labor has a cost associated and therefore several fundamental questions must be addressed. Will the contribution of credit capital be greater than the cost of credit? How does the productivity of credit change as additional units are added? Are the terms of credit compatible with the production cycles in agriculture? How is risk affected by credit commitments? Are there adequate sources of credit? Other questions must be answered before lenders and borrowers can arrange beneficial agreements and mutually solve their individual problems.

The questions of credit demand and credit supply involve all the same relationships found in the market for specific commodities. The amount demanded of credit is a function of the price of credit. If the costs are high, then borrowers back off and bid for smaller amounts. But if price is low relative to the productivity of credit then the amount they will petition for will be greater. On the supply side the lending institutions have a service to sell and they must show a profit to remain in business. The costs to the supplier include their administrative and distributive costs but they in turn must turn to the money markets and pay a price for capital funds before they can make loans in turn. Their costs therefore are tied directly to the

money markets that serve all sectors of the economy and even responds to the world credit markets. The credit supply becomes complex as national and international credit institutions provide credit at less than market costs for selected development programs. Therefore the supply of credit drifts into the political realm adding analysis complexities.

2. Huallaga Valley Credit Situation

For many years the national policy of Peru has been to assist in the economic development of the jungle areas of the country. The assistance has taken the form of making land available at minimal costs, building infrastructure, adding technical assistance, encouraging migrations into selected areas, guarantying prices, granting tax concessions, sharing in the transportation costs, creating special development agencies, establishing and operating processing plants, building and operating marketing facilities and arranging credit for producers and agribusiness firms. The argument may continue as to how much of these special programs can be economically justified and what combination of them are essential and for what period of time they are required.

There can be no question about the functions of credit to facilitate the realization of any and all parts of the economic system but the questions will remain how much credit, at what costs, for whom and how should it be administered. The entire development complex of Huallaga valley can benefit directly from improved understanding of credit and an improved market for credit in the area. This area is somewhat isolated from the major credit sources of the country. The private, as well as, institutional credit sources naturally focus attention on the centers of economic activity in Lima. But the fundamental questions found in every credit market still must be addressed

specifically for the Huallaga area and the participants in the economic growth environment.

No one can rationally determine their effective demand for credit until they know the productivity of credit and this has not been determined nor studied in sufficient detail for the project area. Credit suppliers have made limited attempts to meet the specific needs of borrowers in terms of matching repayment periods to the cash flow variations of producers, or risk costs. Nor have studies adequately measured the quantity of credit that could be distributed at alternative cost levels.

Credit markets in a high level inflation scenario manifest disturbing distortions and inequities. On a theoretical note one might assume that debtors gain from inflation and creditors lose, hence borrowers would be rational to borrow as much as possible. But from a practical point of view, an attempt is made through the interest rates charged to compensate the lenders. Neither lenders or borrowers can accurately estimate the rate of inflation for future time yet the credit market is based on the time value of money. The inability to project into the future with confidence has brought a serious maladjustment in the credit markets. Credit has been shifted to a shorter and shorter time period leaving the intermediate and long term credit supply totally inadequate. Much of agricultural production and agribusiness capital assets require intermediate and long term credit, therefore, the distortion in agriculture is creating highly significant shifts in the systems of farming and causing marketing and processing inadequacies.

The great majority of the activities (crop production, marketing and processing) considered in this project have credit constraints that restrict growth. Some participants in these activities may perceive there to be inadequate credit when in reality they lack sufficient information to rationally determine

the amount of credit they could use. All who emphasized the credit rationing problem complained about the high cost of credit, the shortness of time funds are available, the unknown risk factors and the administrative problems associated with credit distribution.

Jose A. Salaverry in his special study for the Central Reserve Bank titled, "El Crédito Agrario en el Perú" said, "Economic development and financial development are intimately tied together". He reported that only 7% of the farmers in Peru obtain credit from official institutions, leaving 93% who are not served by the public sector with credit access. It is reported that fewer than 6% of the farmers in the Huallaga valley use official banks for credit. Credit is not uniformly distributed among the various regions of Peru, with 72% of the agricultural credit going to the coastal area.

Small farmers are not adequately served by the official banks. About 72% of the agricultural borrowers and 90% of the credit granted goes to those classified as commercial agricultural borrowers. Commercial banks have been leaving the agricultural credit to the Agrarian Bank (Banco Agraria del Peru or BAP). In 1960 to 1964 commercial banks provided 40% of the agricultural credit and the Agrarian bank provided 60%. By 1980 to 1982 the commercial banks had dropped to only 7.5% leaving 86% for the Agrarian Bank. Over that same time comparison the Agrarian Bank increased its average annual growth rate from 9.4% to 22%. But the commercial banks increased from 3.2% to 76.0%.

Dr. Salaverry reported the characteristics of agricultural credit as follows:

1. Low share of farmers have access to credit.

2. Restrictions on the amount of credit offered and the financial services offered to agriculture.

3. Absence of adequate financial institutions to mobilize the savings generated in the rural sector.

The solutions suggested were:

a. Decentralize credit;

b. Form new credit channels such as savings and loan associations and cooperative credit associations; and

c. Get the commercial banks more involved in rural credit.

The Agrarian Bank reported that their agricultural loans in the Upper Huallaga area for 1982 to 1984 were distributed as follows:

rice	37.6 %	poultry	2.6 %
corn	29.0 %	Capitalization .	1.8 %
banana	4.0 %	Banco Nac. Coop.	8.7 %
cacao	4.0 %	yuca	3.0 %
coffee	2.7 %	All other	6.6 %

The Agrarian Bank in the Upper Huallaga made 74 loans in 1982 in conjunction with PEAH, and 494 loans in 1983 and 493 in 1984. The hectares involved in these loans increased from 263 to 1791 to 1858 in 1984. The Tingo Maria BAP is a full service bank. Agency offices of BAP are in Aucayacu and Tocache. The BAP reported only 4.7 % of their 1983 loans to be intermediate term loans. The Cooperative Bank in the Upper Huallaga has been virtually inoperative for the last 18 months.

In the PEAH report of 24 Sep 84 the following credit problems were identified in the Upper Huallaga area:

a. Lack of technological projects that can afford to pay the present rate of interest;

b. Interest rates are very high;

c. Most farmers produce some coca and thus are not eligible for some lines of credit;

d. Lack of credit promotion by the credit institutions;

e. Lack of technicians to help promote technical agriculture and wise credit use;

f. Problems of marketing, results in low returns to farmers;

g. Credit sources do not serve small farmers;

h. Long delays after credit requests before credit is available;

i. Requirements for land certificates of ownership make many ineligible; and

j. Difficulties in applying for credit.

3. Sources of Credit

The sources of credit for the purposes of agricultural development research, extension, training, agroindustry, marketing, promotion, irrigation and other similar purposes are impressive. The wide range of sources is matched by a wide range of purposes and a wide range in amounts available. A complete

listing of sources and their programs is not within the scope of this project but a brief reference to the principle sources will provide necessary background for further consideration in this report.

The main sources of credit for agricultural producers, agroindustries, and private marketing firms are the non-public, non-institutional sources. Private individuals loaning funds to other private investors is the main source of credit in developed and some developing countries. This source of funds often make the difference between success or failure of private enterprises. Nothing should discourage the initiative to use private funds as much as possible. The means for bringing this source of credit into use are person to person informal loans, partnerships, cooperatives, joint ventures, and corporations selling stock shares.

Official government credit institutions in Peru include the Banco Agrario del Peru (BAP), Banco Industrial (BIP), Banco de las Cooperativas, (BANCOOP). There organizations are charged with credit functions for agriculture and agroindustry. There are many other official banks that have their own specific functions. The Central Reserve Bank regulates the total banking sector and established special agencies to administer special funds. COFIDE is such an agency and it administers certain funds provided by foreign agencies in addition to the required GOP matching funds associated with the lines of credit.

The Banco Agraria de Perú (BAP) provides for two main types of loans. Short term loans for crop and livestock production, extending for less than 12 months. Repayment involves collecting the first quarter's interest in advance while the remaining interest and amortization are paid when the loan comes due. This results in an effective annual rate of interest substantially above the quoted rate. The second type loan is

intermediate or long-term loans primarily for cattle and pasture but can be used for capitalization of facilities as long as agricultural production is a part of the activity. Terms of loans depend upon the borrower and lender arrangements and the collateral required depends upon the special situation. Short-term loans require the crop produced as a collateral. Long term loans can be for up to 15 years but such loans are rare indeed. Less than 5% of the BAP loans are for periods of time greater than one year. The Ministry of Economy provides budgeted funds to support promotional loans to small farmers where concessionary interest rates fail to cover costs. Under some conditions up to 100% of credit needs can be provided for capitalization projects that are tied to agricultural production.

The Banco Industrial (BIP) should be a major credit source for agribusiness. However, several constraints limit its usefulness to agribusiness. First the bank lends only 70% or less of the installation costs for a new plant. Second interest rates are high in both real and relative terms. For example, BIP reportedly charges 142% interest on agribusiness loans. The cost of money to the bank was 108% to 110%. This spread was reportedly justified because of unusually high loan repayment failure.

BIP does have a special promotional loan at 90% interest but less than 1% of their loans are in this category so their losses are minimal in this category and easily covered by their normal operational income. The bank reported no attempt to promote their credit among potential agribusiness borrowers. Their credit is directed to those users most likely to be most profitable and therefore loans to coastal borrowers and non-agribusiness borrowers are preferred.

Commercial banks play an important role in agricultural credit in many countries and have had a much more important role

in the past than at the present in Peru. Discussions with commercial bankers indicated shortage of available soles particularly for agricultural or agribusiness type projects. To get the commercial banks into this area probably will require some type of discounting arrangements at concessional rates.

International financial institutions are one of the major sources of credit for agriculture. Their funding does not go directly to the producer borrower but goes through official agencies such as the BAP who in turn administer the delivery. Table V.C-1 presents data that indicates the importance of these funds and the agencies that administer them within the country. The most surprising aspect of these data is that such a small share of the lines of credit have been disbursed. This is suggestive of a major administrative problem. Further discussion of administration will follow later in this report.

Table V.C-1. Lines of credit, provided by major financial institutions, Peru. (millions of dollars).

Project		Loan	Disb.	Int.	Date	Bal.	Time
Interamerican Development Bank							
Pichis. Cattle dev.							
428-OC PEPP		24.0	5.4	10.5	12/9/82	18.6	2002
Pichis. Forest, road const., land, extens.							
697-SF PEPP		22.0	4.7	2.0	12/9/82	17.3	2012
Sub-total	BID	46.0	10.1			35.9	
	GOP	40.7					
Total		86.7					
Jaén Bagua Project							
445-OC MAP	BID	42.8	6.4	9.5	4/23/84	36.4	2004
	GOP	52.2					
Total		95.0					
Agrarian Credit Cattle Develop.							
125-IC	BAP	102.0	11.2	9.5	4/23/84	90.8	2004
	GOP	123.0					
Total		225.0					
Jungle Emergency							
420-OC		1.0		4.0	12/9/82		2002
106-IC		3.0		10.5	12/9/82		1997
686-SF		7.2		2.0	12/9/82		2012
Sub-total	BID	11.2	1.2			10.0	
	GOP	4.8					
Total		16.0					
World Bank - BIRF							
Agrarian Credit for agroindustry and livestock. 2301 Peru agencies							
	BIRF cont.	130.0	43.1	var.	4/26/83	86.9	2003
	GOP cont.	104.8					
Total		234.8					

Intermediate and long term credit does not seem to be in short supply according to the lines of credit reported in the

table. However, the potential borrowers in the Huallaga valley report inadequate supply. It may be that the credit delivery delays and administrative constraints are rendering the lines of credit virtually inaccessible to those who are in need of credit at a specific time. The World Bank and the Interamerican Development Bank are not sources of grants but must operate much as commercial banks to recuperate their loans and cover their costs. However, special promotional provisions are made and interest charges are generally less than those charged by commercial agencies. Even though BID normally makes funds available to official banks within the country it is reported to be forming an agency called the Interamerican Finance Corporation that will deal directly with the private sector with agribusiness type credit with specified constraints. These international agencies deal with COFIDE in Peru for the administration of some of their funds but go directly to the BAP with other funds.

Most of the financial institutions have agreement with the Corporación Financieras de Desarrollo--COFIDE through which they can avail themselves of a number of export development credit lines from foreign countries and from development financing agencies. Objectives are to develop export credit lines for capital goods and services being exported to Peru, and facilitate the exports from Peru to other countries. International financing agencies provide funds for administration of COFIDE as well as specific countries. USAID has a line of credit of $10 million designed for the private investment sector. Borrowers must provide as collateral a standby letter of credit from a US bank or 25 to 50% of loan as liquid collateral plus other collateral such as urban property, or mortgage guarantee. Loans from this fund might go to well-to-do farmers with urban property or agribusiness with substantial equity. As of March 1985, $5 million of this fund had been disbursed through 92 loans in the agricultural sector each averaging $53,000. The major international development agencies of donor countries play a key

role in agricultural and agribusiness credit. Canada, Federal Republic of Germany, Holland, Switzerland, France, England, EEC, Italy, Belgium, Japan, and the U.S. are the main participants in credit funding and fund grants in Peru. These development agencies provide soft loans in addition to grant funds, therefore they play a dominant role in promotion and instigation type expenditures for agribusiness.

U.S.AID makes grants, funds, special projects, and provides lines of credit. They are partially funding The Rural Development Agribusiness Fund (FRAI), and supporting, to a great extent, the PEAH operations. For the PEAH region, a $4.8 million credit fund was established. About $1.0 million has been disbursed leaving an available balance of about $3.8 million.

The Andean Corporation for promotion of economic activities among its member countries sponsors CAF which assists in financing of purchases of machinery, equipment and other imports. The country from which the equipment is purchased provides the necessary funding. Similar to this is credit provided by countries that ship exports to Peru and arrange to cover credit needs of the importers for those specific imports.

An additional source of credit not easily measured in terms of total amounts is the merchants, suppliers, buyers, processors and other intermediaries that extend credit to agriculture for short time periods.

4. Credit Administration

The foregoing section of this report on sources of credit established evidence that there are many sources of credit to serve agribusiness and agriculture. The quantity of credit available, as indicated by the large share of credit lines still not dispersed, suggests the need for further analysis to explain

the apparent unsatisfied demand for credit. Some of the problems identified earlier in this report are results of faulty credit administration. Ineffective and inefficient delivery of credit at the farm level is a consequence of administrative problems at every level of the credit institutions.

Ideally the free market model for credit brings forth an adequate supply of credit and the services associated at a price sufficient to cover costs but without excess profits. In addition it satisfies the needs of users in terms of time, place and nature of credit terms that are compatible with their unique demand. Thus there must be minimum frictions, lags and uncertainties, associated with credit delivery. The ideal model may never by attained but a continued effort to approach it is essential for progress.

a. Processing Time. The time required for processing loan application is high among the complaints of credit users. This results not only from low management capacities of credit managers but from a host of regulations in the banking system as well as within each loaning institution. A number of credit studies in Peru have identified these constraints and have made meaningful proposals such as the need for decentralization of the banking functions. Decision making must be centered as close to the credit applicant as possible and a minimum of approvals, check-offs and signatures will contribute to a reduction in the time lag. The cost of credit and the value of credit is a function of time and yet those in the professional business of selling credit waste time as though it were valueless. A borrower should not lose time waiting for action on his application nor should he be disillusioned concerning the cost of credit or the amount of credit that can be expected. Those not credit worthy can not expect the same services as those who have proven themselves and no amount of credit reform can make the bad loan risk into a good one. But the credit worthy borrower

should sit down with his banker and work out his problems with no lingering uncertainties or time delays.

b. Supervision of Credit. Supervised credit has several implications, all the way from depriving the borrower from making production decisions on to the simple function of providing useful information to the borrower with no further obligation. Loaning institutions should provide a service in addition to credit. They have some responsibility for assisting their clients make good use of credit, plan their operations to assure repayment on time and to obligate themselves only within their economic potential. A banker counseling his client should be in a position to recommend the use of more or less credit, shorter or longer terms, appropriate collateral, risk contingency management, ways to reduce the costs of credit and the rational way to manage credit and equity combinations. Most lending institutions fail to provide these services. It is claimed that lending institutions in Peru fail to provide the technical services that are badly needed by borrowers and do not have an appropriate liaison with the extension service that could fill the need for technical assistance in many situations.

Supervised credit means providing some or all of the needed services and do not necessarily imply that the farmer is forfeiting his might of decision making. Improvement in the provision of technical assistance--supervision--to borrowers must remain high on the list of potential reforms in the agricultural credit delivery system in Peru.

c. Risk Sharing. The inability to identify and measure adequately the costs of risks may be the major deterrent in satisfying credit demand among agribusiness firms as well as farmers. Uncertain yields, production costs, prices and repayment capabilities add up to such a risk factor that credit commitments are avoided. The first and foremost way to reduce

risk in any economic activity is to increase information available concerning every aspect of operation. Accurate estimates of costs, price predictions with market facts, and use of the best technical information on production reduce the uncertainty of the future substantially. Agribusiness must have meaningful estimates of the supply available for processing, contracts for market delivery and capability to control product quality to meet the market demand.

Not withstanding these meaningful ways of reducing risk there still remains unknowns that must be recognized. Political action, climatic vagaries, economic recessions and other events over which neither the borrower nor lender have any direct control are risk variables. A serious proposal of this report is that the public sector and the major credit institutions must share in the assumption of this type of risk. Specifically, it is proposed that USAID, as an example, devise innovative ways to share risks that result from events beyond the control of the borrower. Changing repayment schedules is often an appropriate action taken by international lending agencies. However, adjustment of the loan magnitude, terms of payment, and recognition of the current events disturbing debt servicing are some of the factors that need further consideration by agencies better prepared to cope with risk and uncertainties.

The most obvious credit constraint among producers and agribusiness firms in the Huallaga valley is the extreme risk factor, not only resulting from the normal variables that create risks but the added social and political risk factor that defies even the best predictor from making accurate predictions. If national and international entities are seriously trying to influence economic and social events of the study area, then high on their list of things to do is to share in the risks and uncertainties of those engaged in economic activities in the area. This might take the form of grants instead of firm,

businesslike commercial loans to build processing plants and to expanded crops.

As pointed out in other parts of this report there seems to be an abundance of credit facilities available but what is somewhat puzzling is the large quantities of available funds which have still not been disbursed. The major reason for this seeming reluctance to make use of these supposed balances is the fact that these are loan funds and must be repaid. The channeling agency is always a bank, usually official (BAP, BIP, COFIDE etc.), and these represent supplemental funds to those already being used. The bank is now given the job of placing these additional funds but must do so only to credit worthy borrowers, because in case of loss, the bank will have to make good to the suppliers of the funds. The bank has quite likely already filled the credit demands of the really good credit risks when he received these additional funds to place. Therefore in order to place these funds he has to consider credit to increasingly less desirable risks in order to distribute these funds.

As long as the bank is responsible for the full return of the loan while simultaneously having profit responsibilities to his superior, it is unlikely that these funds will be placed quickly and the size and existence of these balances tend to distort the picture of credit supply. As stated a system where the credit risk is eliminated via donations of funds where the bank acts as a channeling agency only or where the credit risks are shared in some acceptable way seems to be an avenue for further study and further application.

d. Inflation - Payment in Kind. With the inflation scenario existing in Peru, borrowers, lenders and the credit institutions are confronted in the most direct way with the changing value of money over time. Inflation has an immediate

impact on the terms of credit. Rapid inflation makes money management complex and hazardous. Innovative ways to deal with inflation are required and the credit institutions are forced to be the innovators. Debtors usually gain from inflation and lenders lose. Land owners benefit and renters are disadvantaged. Those with fixed incomes are losers. This classification fails to deal adequately with the multitude of adjustments attempted to cope with the inflation factor. Adjusting interest rate is one but only one way of accounting for the changing value of money over time.

Innovative ways to cope with inflation include the proposal to accept loan repayments in the form of a share of the crop or product produced. As inflation causes the value of money to decline the price of the product should rise in direct relationship, but this may not always happen. The acceptance of payment in kind, or a share payment basis serves two purposes. First, it relates to the ability of the borrow to repay his loan with reduced emphasis on the relationship between the general price level and the specific price of his product. Second, the risk factor is reduced as the borrower need worry less about the price of his product and less about the volume of his production for a specific season. This proposal does not propose to change the size of debt in any way. If payments are light because of production problems then the debt balance will extend over a longer time period.

The payment in product concept is especially adaptable for products whose price is quoted on international markets. The contract with the farmer would be to purchase his product at a stated percentage of the international price for that quality product on the day of delivery. Both cacao and tea mentioned at length in this report would lend themselves to this concept.

The proposal to accept loan payments in kind is not administratively simple. Problems must be coped with. Previous attempts through BAP to activate this concept have not resulted in a workable system. Even though there are administrative problems they are not as bothersome as the constraints imposed by high levels of inflation. It becomes a choice between two difficult administrative problems and not a choice between one easy system and one difficult. A full realization of the undesirable aspects or credit administration with high inflation forces one to give greater consideration for alternatives. The payment in kind proposal is worthy of a better effort than has been given previously. A credit consultant could further analyze these problems and identify the most feasible alternative.

Another proposal coming from the Central Reserve Bank is for indexing. This proposal is to tie the repayments of a loan to the changing value of those items for which the credit was used. The purchase of a tractor was used as an example. The repayment would be in terms of the number of units of product required to purchase the tractor at repayment time. It is thus assumed that the value of items obtained with credit will change in direct proportion with the value of products produced. This is a rational proposal, however, it fails to adequately provide for expenditures that do not have a measurable market value.

For example, the installation of oil palm or cacao plantations have a continued value but it can not be priced in the market hence the indexing system is not practical in all cases.

An other way to cope with planning debt servicing under inflation is to tie debt to a relatively stable currency and also tie the product prices and repayment scheduling to this same currency. In this case, interest rates cover the real cost of credit, the administrative costs and the costs of risk under

normal conditions. The impact of inflation is reflected in the rising prices of the products being produced with the credit. A long-term loan can be paid off with products that have experienced price increases over the time period comparable to the general price index. It is assumed in this case that the rate of inflation affects the output prices the same as the input prices. This is not always the case but generally there is a close relationship. With the stable currency base system the costs of credit can be identified clearly and the inflation factor is not confused with the costs of credit.

e. Subsidized Credit. The question of subsidized credit through interest rates that are below the real costs of credit plus risk plus the inflation factor must be recognized for its contribution to credit delivery and also for its liabilities. From an economic rationality basis a subsidized interest rate can not be justified. It distorts the signals in the credit market that should reflect supply and demand for credit and serve to allocate credit to its best use. With higher interest charges more lenders will enter the market and fewer borrowers will compete for the supply. With lower interest rates fewer lenders and more borrowers will bring an equilibrium in the amount taken from the market at a given price. If the market is not used to give these signals then some other system must answer those same questions. To allocate credit by administrative decree has always been associated with a loss of efficiency in the credit market rather than an improvement.

The use of special non-market interest rates often bring distortions in the credit market that force some participants out of the market. Previous data were presented to show the flight of commercial banks from the agricultural credit business. It also leads to misleading interest rate distortions. For example, a subsidized interest rate of less than 100% in a situation where inflation is above 100% is attractive. However, the practice of

deducting the first quarter's interest charge prior to providing the loan results in an effective interest rate substantially higher. It is greatly different than the perceived rate quoted.

Promotional rates of interest can be justified in some development situations. However,their use should be minimized as a general policy. It appears that the extent of promotional subsidized credit in Peru probably has been overstated. For example, the Industrial Bank of Peru's promotional rates of 90% in early 1985 was provided to only about 1% of the borrowers.

An example of a possible justified subsidized interest rate would be program to promote the use of lime, fertilizers and other modern inputs. There is an inherent risk in adopting any new agriculture practice and the smaller the farmer the lesser is his ability to take the risk of a possible crop failure or lack of economic response from the new input. Consequently, sharing this risk could be justified in terms of accelerating the adoption of new practices and accelerating the economic development process for the area.

5. Recommendations

a. Credit needs Credit and investment needs for some of the economic activities identified by the agribusiness study are summarized in Table V.C-2. The justifications for these perceived credit demands are presented in each chapter. In this chapter some of the special aspects of each credit need is presented, and the likely source of credit is suggested.

b. Limestone crushing and distribution. The justification for providing lime to agricultural producers follows from the fact that most of the soils in the area are acid in nature, and that this is causally related to low yields which in turn is related to the problem of inadequate supplies of raw

material for efficient operation of processing plants. Fortunately dolomite limestone is abundant in the area and is appropriate for use on many of the soils. It is found in hard rock deposits and must be extracted and crushed with heavy equipment. The PEAH program has one crusher on site but an additional $400,000 will be required to complete the equipment required to make deliveries to the farms. This crusher is located in Tingo Maria and it is proposed that a second crusher be immediately installed in the Tarapoto area. These two sets of equipment will serve to instigate the lime delivery system, first to provide researchers and the innovators with the required lime and slowly expand as adoption of the technology occurs. In the early stage the crushers will be available to provide gravel for the road systems in these areas.

A line of credit especially identified for the purchase of lime, fertilizers, improved seeds and other inputs is proposed. The credit demand is expected to start somewhat slowly and might grow in accordance with the following table.

Table V.C-2. Summary of Credit and Investment Recommendations.

Activity	Credit Requirements	Investment Needs
Lime, fertilizers and other inputs	$300,000 1st yr growing to approx. $5 million in 5th yr.	$400,000 Tingo María $1,000,000 Tarapoto
Tea production and processing		$19,900,000 factory and satellite farms
Road Construction		Any amount available up to $600,000,000
Oil Palm Satellite production	$400,000/yr for 3 yr Total $4,000,000	
Cacao próduction and mini-proc.	$800,000/yr for 5 yr Total $4,000,000	$807,000 mini-proc.
Poultry-Cold Storage		$300,000 in year one $300,000 in year two
Livestock and pasture	$210,000/yr for 5 yr Total $1,050,000	
Corn Drying	$100,000/yr for 5 yr Total $500,000	
Coffee fermenting and drying		$900,000 ($225,000x4)
Spices Lab.		$150,000
Aquaculture ponds		$500,000
Research Staff	Funds to add 14 new specialists--$230,000 Funds to train 12 to adv. deg.---$240,000	
Extension Staff	Funds to add 14 new specialists--$230,000 Funds to train 16 specialists----$160,000	
Consultants	13 short-term (39 person-months)-$400,000 5 long-term advisors----------$1,000,000 Total $2,260,000	

The $1,800,000 required to establish the first 2 sets of lime crushing equipment probably will have to be provided by a public type credit source. Every effort should be made to make

the operational aspects attractive to a private investor at the earliest possible date. It seems appropriate for USAID or a similar agency to provide this fund and administer it through PEAH and the Special Project in Central Huallaga. However, it is also possible that CAF (the Andean Promotional Corp.) might provide funds for the purchase of this equipment considering that much of the equipment will be purchased from abroad. At the present time BAP reports that they have access to $10 million of unused CAF funds.

Table V.C-3. Estimated Credit Demand for Lime, Fertilizers, Improved Seeds and other Inputs.

Year	Est. Hectares	Credit per ha	Total Credit Required
1	2,000	$150	$300,000
2	5,000	$150	$750,000
3	10,000	$150	$1,500,000
4	20,000	$150	$3,000,000
5	40,000	$150	$6,000,000

The line of credit for farmers to purchase lime, fertilizers and other inputs is appropriate for the BAP in its normal function. However, some concessional interest rates and/or risk guarantees might be needed in the initial period. There should be sufficient funds available to handle the initial demand from the AID/PEAH line of credit of $4.8 million of which only about $1.0 million has been disbursed. This first priority development activity should be advanced without delay. The pay-off for this credit input is expected to range from a benefit/cost ratio ranging from 2 to one on up to 5 to one for different crops.

The synergistic relationship between road construction need for road-bed gravel and the lime for soil application should

result in improved efficiency in the production of lime. Additional crushers and delivery equipment will be required for the lime requirements in years to come but the cost of additional units are not now projected because of the expected road construction requirements for the same type crushers and lime can be a by-product.

c. Tea factories and production. It is recommended that the factory of Jardines de Té be modernized at a cost of approximately $285.000. This would allow the factory to use its full capacity and would improve the quality of the tea produced. A sum of $15,000 should be provided for short training courses of cooperative and government personnel. It is also recommended that a tea nucleus estate and satellite farms be implemented in the Upper Huallaga Valley. There are two major components to the proposal. First is the construction of a large efficient tea processing plant capable of producing a high quality product and effectively competing in the world market. Second, the planting of a sufficient area in small satellite farms to provide the factory with the required volume of tea. The Factory nucleus estate component will have about 200 hectares owned and operated by the factory management. An additional 800 hectares of tea will be owned and managed by small-holders with technical assistance from the factory. The small holder will have contracts for their production to be paid at a percentage of world market price.

The approximate $6.5 million required for the factory establishment theoretically should be provided by the private investment channels and credits. However, in view of the unsettled conditions existing in the area it is unrealistic to presume the existence of private investors willing to undertake such a project under the usual procedures. On the other hand, it is conceivable to think in terms of finding an entrepreneur investor who could be encouraged to undertake the project with

the understanding that he would not have an unreasonable financial exposure in the enterprise at the outset.

A prospective tea factory investor should undertake an extensive feasibility study of the project and if this study confirms the recommendation of the agribusiness study then it would be appropriate to organize a company for the purpose of initiating the various steps needed to obtain the necessary official approvals and to proceed with the search for required capital.

As an alternative to providing funds by donor countries, a system of loan guarantees might be utilized to allow the newly formed tea company to acquire and install the plant and equipment and to establish the nucleus plantation. Unavoidable and unanticipated factors might affect the ability of the company to strictly adhere to the repayment schedule resulting in adjustments in the schedule. It is believed that this guarantee system might be the most effective method to establish a tea plantation "de novo".

Specific details of a loan guarantee program and a sharing of risks need to be developed. The alternative combinations of institutions, both private and public, providing credit and their respective risk bearing functions cannot be adequately presented until further analysis is completed. At this point the idea is worthy of consideration but an attempt to finalize the details would be premature and presumptive. Each situation is distinctly different and what might work under one situation might not be the best for another. The first step in furthering this suggestion is to assign a qualified credit specialist to further examine the alternatives and after an appropriate study time come forward with workable details.

If such a guarantee were arranged, concessionary interest rates may be unnecessary. Straight commercial rates as determined in the credit market may be the most rational way to set the interest rates. Sharing of risk might be the most rational system to stimulate interest among the private sector investors.

Because of the vital role of the entrepreneur in all phases of this venture it is hard to imagine a viable operation coming into existence without the service of the entrepreneur company or individual starting at the inception of the project. Strong negative sentiments come from many sources concerning the creation of a publicly owned and operated processing plant. Until proven to be otherwise the basic philosophy of free enterprise efficiency and ingenuity should be the guiding force behind the proposal for the creation of a new modern tea factory in the Upper Huallaga area.

The second major component of the tea proposal is the establishment of 800 hectares of recommended variety tea production, owned and operated by small holders. The proposal presented in the agribusiness study identifies the installation costs to include a sizeable input of labor as well as technical help and the other required physical inputs. This labor is proposed to be provided by the small holders but with compensation so that they might pay their living costs while waiting for the first harvest. In other words the advance would cover all costs including labor. The justification hinges upon the fact that the small-holders will be fully employed in the process of establishing their tea production. They would have to depend totally upon the advance for their living expenses and the maintenance. Each would be the owner of sufficient hectares to provide him with an acceptable livlihood once full production is realized.

While labor costs are frequently included in calculating start up expenses for new crops the labor component in this approach goes well beyond the norm and would therefore put the proposal in a different category and possibly eliminate it from normal credit sources. The agribusiness study suggests donations to the small farmers as possible source of funds to establish the 800 ha of satellite production. An alternate approach would be that of the guaranteed loan to farmers in the amount suggested with the understanding that the credit institution had no credit risk in the transaction but merely would serve as the channeling agent for the project.

The bank might be available to supply a supervisory role as far as proper use of the funds is concerned, but on a fee basis. The guaranteeing agency would have to recognize that there would be a risk of having to make good on a portion of the loan guaranteed and consider that as a donation. The suggested approach of a straightforward donation might be less attractive because of the lack of incentive on the part of the recipient. The guaranteed loan combined with the payment in produce concept mentioned elsewhere, where the farmer signs a contract to deliver his tea for a pre-established percent of the world price and a portion of his production goes toward his debt is believed to be a system that could bring efficient tea production in the least amount of time.

The feasibility study mentioned above should consider as an alternative the initial establishment of a smaller but expandable factory, using the tea from the 200 hectares under the tea company's direct management. As production moved ahead, attempts would be made to encourage neighboring farmers to add tea to their plantings under purchase contracts. As additional production is contracted the tea company could make the necessary factory expansions. Under this plan the interested neighbor would be able to work tea production into his farm plan and

perhaps minimize his need for subsidized loans. The argument against this suggestion is that the tea producer must be specialized and produce nothing but tea, in which case his living costs must be considered during the time of tea installation. The diversified farmers who are beginning to produce tea could be more easily financed through the normal credit agency but those benefits might be lost if specialization brings special advantages.

After a brief survey of credit institutions in Lima it is obvious to conclude that the regular credit institutions do not have funds for the proposed grant. Donor countries or consortiums of countries willing to serve as the source of grant funds will have to be identified and brought into the early planning for the tea plantations. In the event such a source of funds is not found then other alternatives include the BAP through its normal capitalization credit programs or through special funds established specifically for this purpose. The extent to which small-holders can provide the labor for installation without funding is unknown, but the danger of expecting small-holders to cover part of the installation costs might well shift the nature of the small-holders to small diversified farmers instead of the specialized tea producers as recommended for the project.

Preliminary investigation into finance sources for investment in the tea factory as a private enterprise operation and international donor organization for the establishment of the satellite farms have met with positive interest.

d. Oil Palm satellite production. Credit requirements for this proposal centers around the need for production expansion. Small producers in the surrounding area near the existing plantations are expressing interest in participating in what appears to be a viable economic activity and the plants in

operation and under construction also have expressed the desire for expanding operational capacity by way of satellite producer participation. It is assumed that most of the producers brought into this arrangement will be small farmers with diversified production and thus not dependent upon this crop for their livlihood while waiting for a cash flow to result from harvests. A modest growth pattern is suggested--200 hectares per year. However, a 3 year or 5 year time span is only the beginning and a second 5 year credit flow is required.

The demand for credit for this activity is expected to grow as the first participants demonstrate its effectiveness, and as the processing plants get into operation showing the profitability of palm oil production in the area.

The supply of credit for this need is judged to be adequate. The normal BAP credit operations will cover this type of loan and if their lines of credit are adequate (and it is claimed to be adequate by BAP officials) there need not be special funding arrangements. However, because of the need for rapid implementation and a need to create a favorable credit environment, special credit lines might be set up with favorable results. The fact that the large processing entities are heavily invested and interested in the oil palm operations is a positive factor for additional credit provision to the project.

Budgets have been developed to demonstrate that small-holders borrowing to cover their cash costs for oil palm installation can repay their debt in 7 1/2 years assuming real interest rates at 12%. The rising price of the product is assumed to match the inflation rate. Table V.C-4 demonstrates the flow of costs, receipts and the payment of debt. Under the assumptions used a 28% net return on investment over 10 years is estimated and an I.R.R. of 11% after full debt servicing is calculated.

However, if the full costs of installation, including labor as well as the cash costs, are used then the debt required would not be paid off until the 9th year. For comparison a full cost debt was assumed with a 15% real interest rate and a 11 year repayment schedule was required.

The loan repayment schedule is presented only as a basis for evaluating the burden of debt management on the producers and is not presented as the most feasible debt management proposal. Obviously if retirement of debt in the minimum time is too great a burden on farmers then the debt will need to be distributed over a longer time period. If the producers have no alternative sources of income to cover living costs then the time period must be extended. However, under this model it is assumed that existing farmers with a diversified production system already have sources of income and the addition of small units of oil palm production could be added without threatening present sources of income for family living. Therefore debt retirement in minimum time is not an unrealistic proposal.

Table V.C-4. Oil Palm - Installation cash cost debt, and debt servicing, 10 year horizon, 12% real interest, one hectare.

	Year									
	1	2	3	4	5	6	7	8	9	10
Cost of seedlings	$1250	125								
Shade seedlings	50									
Harvest & misc.	0	0	0	200	200	200	200	200	200	200
Fert. & lime Insecticides etc.	255	280	300	240	240	240	240	240	240	240
Total cash costs	1555	405	300	440	440	440	440	440	440	440
Receipts	0	0	0	684	1140	1459	1824	1824	1824	1824
Net receipts	-1555	-405	-300	244	700	1019	1384	1384	1384	1384
Interest due (12%)	0	186	257	324	334	290	202	60	0	0
Interest paid	0	0	0	244	334	290	202	60	0	0
Paid on debt	0	0	0	0	366	729	1182	506	0	0
Debt balance	1555	2146	2703	2783	2417	1688	506	0	0	0
Value of installation at end of 10 years										3816

Debt retired in year 7 1/2.

I.R.R. after debt servicing 11%

Net return on investment - 28%, assuming total investment cost of $3816.

e. Cacao production and first step processing. Credit need is for the expansion of supplies to permit a more efficiently operated processing plant now well into construction with appropriate financing on line. The "pull-through" effect of this factory requires producer incentive to establish more hectares of cacao trees. The growth in raw materials supplies for the plant will come slowly because of the time required to bring new plantings into productions. The incentive to participate may be retarded because of this delay and the need

for special intermediate to long term credit. It is anticipated that as soon as the factory is operational and the prices paid for the product are favorable the needed supply will be forth coming. But the implementation and time lag are the problems that must be considered by those who have credit provision capacity. It is expected that the need for credit will extend well beyond the first 5 year planning period and credit funds are budgeted for the second 5 year period.

Sources of credit should not represent a limiting factor for this type of operation. But it is feared that the constraints as outlined earlier in this report may aggregate the implementation and time lag problems. The BAP is a significant source of credit for production expansion or capitalization. This might well be considered as the second type of loan. The BID line of credit is appropriate for this need but because of the credit risk constraint discussed elsewhere it is probably not a viable source.

The factory is organized under a cooperative form of business and El Naranjillo might well administer the credit directly without participation of other credit institutions. It is proposed that first an arrangement be attempted for El Naranjillo to obtain direct credit from BID and then administer its delivery to members of the cooperative, with all the appropriate provisions to demonstrate accounting and auditing dependability.

It is proposed that USAID consider guaranteeing loans made directly to El Naranjillo which will in turn be made available to farmers who agree to the payments in kind proposal previously explained. It might be appropriate to use a portion of the remaining $3.8 million fund under the USAID/PEAH arrangement. However, (A lingering question is will these funds be delivered more effectively in the future than in the past when

only $1 million was used over an extended time). To assist on this type of problem it is recommended that a long-term credit specialist be assigned to the project to aid in the implementation of the program.

Budgeting to determine the repayment time for debt to cover the full cost of installation shows that a total of $3100/ha would be reached during three years prior to the first harvest and a cash inflow. Assuming a 12% real interest (assuming that the rise in the price of the product would match the rate of inflation hence the inflation factor would be neutralized) it would require 15 years to retire the debt assuming the yield rates. If only the cash costs are covered by debt and the farmer provides his own labor for the installation the debt could be retired in 11 years. In either case the length of time for debt retirement is not attractive. However, there is a strong possibility that the seedlings, which is the major cash cost, can be obtained from a U.N. agency at minimum or no cost to the farmers. If one were to assume that the seedlings were obtained at only 1/2 original cost then the budget shows that the debt to cover cash costs could be retired in 7 1/2 years (4 1/2 years of production). (See Table V.C-5) The I.R.R. after full debt servicing would be 8%. If a producer has his own capital and no debt servicing costs then his I.R.R. would be 17%.

Table V.C-5. Cacao installation cash costs, debt, and debt servicing, 10 year horizon, 12% real interest, one hectare, assuming 1/2 cost of seedlings.

	Year 1	2	3	4	5	6	7	8	9	10
Land preparation	(80)									
Seedlings 1/2 price	625*	63*								
Shade seedlings	50*									
Harvest & misc.	0	0	50*	100*	100*	100*	100*	100*	100*	100*
Fert. & lime Insecticides etc.	255*	280*	300*	240*	240*	240*	240*	240*	240*	240*
Labor	(240)	(250)	(280)							
Total cash costs*	930	343	350	340	340	340	340	340	340	340
Receipts	0	0	175	700	875	875	875	875	875	875
Net receipts	-930	-343	-175	360	535	535	535	535	535	535
Interest due (12%)	0	112	166	207	189	147	101	49	0	0
Interest paid	0	0	0	207	189	147	101	49	0	0
Paid on debt	0	0	0	153	346	388	434	405	0	0
Debt balance	930	1384	1726	1573	1227	839	405	0	0	0
Balance for farmer								81	535	535
Value of installation at end of 10 years										3160

Debt retired in year 7 1/2.

I.R.R. after debt servicing 8%

Total investment cost including labor - $3160

Assume price of product will rise at the same rate as inflation

Assume 500 kg/ha and a $1.75/kg price.

f. Research, extension, and training. The public sector must make a sizeable investment in human capital. Research,

extension and training fall among the services provided by the public sector and the upgrading of these services will require funding not covered by the regular credit institutions. Table V.C-6 demonstrates a proposed chronology of training, adding new staff and consultant utilization with cost estimates.

USAID can make a major contribution to move these services ahead and thus implement the development processes. Certain professional capacities are critically absent among the present research and extension personnel. Specifically economic analysis, marketing improvement, credit and business management are functions that require additional training and staffing. The full benefits from the availability of limestone, and fertilizer use will not be realized until research and extension shows the way with technical inputs. In fact every activity proposed by this study can be realized only with substantial inputs of technical information that will be forthcoming from consultants, newly trained staff and a larger staff capable of meeting the increased demand for technical inputs.

Table V.C-6. Chronology of consultants, training, staffing of research and extension technicians--Huallaga Valley area--1985.

	Year 1	2	3	4	5	6	Total
Research staff							
additions	2	2	4	3	2	1	14
training	4	4	4	2	2		16
Extension staff							
additions	2	3	4	3	1	1	14
training	4	4	4	2	2		16
Consultants							
short-term (per-mon)	18	12	6	3			39
long-term (per-mon)	36	36	24	24			120
Cost estimates in $ 000	616	606	472	390	116	60	2,260

g. Pasture improvement and livestock development. Pasture improvement and livestock development require medium and long term credit. The existing credit lines should be expected to serve this demand but the demand is poorly defined until more information is available about not only the methods of pasture improvement but the budgeting to demonstrate the economic pay-off from credit used. The establishment of large scale cattle operations, not proposed for the upper Huallaga but feasible for selected outlying areas will require special funding but the funds now available to credit institutions specify cattle development and that area must compete with other areas for those funds. No special concessions are proposed at this time to promote large cattle operations in the area.

h. Poultry industry. The poultry industry has been growing from an extensive to an intensive system of production. A growth from small to bigger units has been funded mostly from the private sector and the continued development is expected to follow the same pattern. The modernization of the market channels to parallel the production changes in the Tarapoto area will require some agroindustry activities. A shift from selling live birds to selling dressed birds required bird dressing processors and this in turn requires cold storage facilities to accommodate a miss-matching of the supply flow with the demand flow. Also any effort to reach distant markets will require cold storage as well as refrigerated transport equipment. The private trade is expected to respond to market incentives and build the needed facilities. Credit will be required most likely and the CAF type of credit is a likely type of credit for the purchase of refrigerated equipment from abroad.

i. Milk processing. Although the new milk processing plant in Tarapoto has financing on line the efficient operation will depend upon sizeable increases in milk production in the area. This will occur by means of pasture improvement, greater

use of dual purpose breeds and careful management. Credit needs are for intermediate to long-term credit. In as much as the expansion in milk production will occur slowly, the credit delivery capacity of the BAP should adequately serve the needs. But that is not the main problem. It is the clarification of the demand aspect. Better information is needed on the potential economic payoff of credit used for pasture improvement and dairy cattle operations. Although no special credit promotional schemes are proposed there should not be discrimination against the development of the dairy industry in the Central Huallaga.

Although the BAP should adequately serve the needs for intermediate and long term credit required by livestock and dairy producers, there is concern about their performance. Only 4.7% of their loans in 1983 were for intermediate and long-term loans.

j. Rice, corn, and cotton. The production of rice, corn and cotton in the area is of great importance and all the typical credit problems are present. However, the unique aspect is that the public agencies have been involved in pricing, marketing and utilizing of these products and the credit problems come forward with special complexities that require special analysis.

k. Fruit marketing. Facilities for fruit marketing always are in need of modernization but debate continues as to the relationship with the private sector and income generation relationships. Because consumer welfare and producer welfare are rational to handle credit problems for market modernization by means of the public sector.

l. Coffee and spices. Coffee and spices, as any production and processing activities, require both short term and long term credit. Recommended amounts of credit and the best utilization of credit must be preceded by studies of the world market for these products and the best way for Peru exporters to

compete. Quality products only can compete in the world market and if Peru is serious about entering world markets then there must be investments to assure that the best qualities are produced.

6. Strategy Statement

The time has arrived when the Peruvian institutions servicing agribusiness and agriculture must make greater use of computers to function in a complex credit market. Technical assistance coupled with credit administration is essential. Selling of credit-promotion is appropriate where supply exceeds the amount demanded and wise credit use could contribute to development.

Subsidized--nonmarket determined--interest rates generally should be discouraged because of their distorting impact on the credit market. However, there can be some justification for concessionary rates for limited periods of time to accelerate the adoption of new techniques or technologies such as lime and other modern inputs. Innovative shifting of the inflation factor management away from the rate of interest charge demands a further study of the product share repayment proposal, inflation indexing and stable currency base system for managing repayment schedules.

Financial institutions, donor agencies and development promotion organizations must be prepared to share credit risks in the setting of social, and political uncertainties as well as economic fluctuations. Consortium ventures, grants, repayment adjustments and loan guarantees are alternatives worthy of further consideration.

Specifically it is proposed that the limestone crushing equipment be purchased with USAID funds as a means of quick

implementation. Credit to producers through normal BAP operations may need to be supplemented with the existing or supplementary credit lines established by AID. Immediate credit for new plantings of cacao and oil palm should first fully utilize the BAP funding and if inadequate be supplemented with AID credit lines or new funds.

The tea proposal is big enough to possibly merit grants from donor countries or a consortium of countries. The special circumstances of the tea proposal in view of the special circumstances of the area gives special credence to this approach at this time.

However, a proposal is that consideration be given to the guaranteed loan approach for both the tea factory and the installation of the nucleus 200 hectares of tea plus the development of the additional 800 hectares considered to be necessary for efficient of the new tea factory. Reliance upon an entrepreneur/investor arrangement is considered vital to this modus operandi. An alternative might be to develop the tea plantings in small increments as producers were able to manage the financial requirements without subsidization. Obviously this would prolong the time required to reach the desired volume and may introduce some inefficiencies in production that would be eliminated by the specialized plantation type production of small-holders.

The road building proposal is of such a magnitude that funding through the GOP with substantial support from the major international credit institutions is the only feasible avenue for attacking the huge funding problem. Dividing the task up among various organizations would be rational and AID may make its special contribution in funding early engineering studies and establishing rock crushing equipment at strategic locations.

One of AID's major contributions to the development of agribusiness in the Huallaga valley can be through the training of the human resource to provide research and extension technical services. The are is seriously deficient in research and extension capabilities. Not only provision of scholarships for advanced training but there is a need for on-job training, short and long term advisors and assistance in the funding of new positions at the experiment stations and extension agencies.

Table V.C-7 demonstrates a 5 year and a 10 year chronology of credit and investment needs to implement the agribusiness activities identified in this study.

Strategy for USAID participation in the credit market for agribusiness and production in the Huallaga valley area is to assist in the delivery of the $3.8 million balance in the special credit fund with PEAH with priorities first for the limestone project and second for the cacao production expansion proposal. Additional funding will be required to participate in the other credit needs stipulated for the other activities outlined in this agribusiness study.

All who read this report are well aware of the large number of donors who participate in economic development programs. The need is great and each donor organization can make meaningful contributions with credit, grants, investments and technical assistance. Maximum development results in the Huallaga Valley can be attained through collaborative efforts among USAID, CIDA, INNDA, INDA, Holland, Great Britain, Spain UNDP, IDB, World Bank, FAO, EEC, F. R. of Germany, Switzerland, France, Italy, Belgium, Japan and other agencies and nations.

Table V.C-7. Chronology of funds required to implement selected economic activities--Huallaga Valley--1985 USD.

	Year 1	2	3	4	5	5 yr Total	6	7	8	9	10	2nd 5 yr Total	10 yr Total
Limestone Extraction and distribution													
Equipment	1400					1400							1400
Credit to farms	300	750	1500	3000	6000	11550	9000	12000	15000	18000	21000	75000	86550
Tea factory		6500				6500	500	500	500	500	500	2500	9000
Tea plantings		3350	3350	3350	3350	13400							13400
Oil Palm Satellite		400	400	400		1200	400	400	400	400	400	2000	3200
Cacao Production	800	800	800	800	800	4000	500	500	500	500	500	2500	7307
Mini-process			807			807							
Poultry-Cold storage		300	300			600	300			300		600	1200
Livestock & pasture	210	210	210	210	210	1050	400	400	400	400	400	2000	3050
Corn drying	100	100	100	100	100	500	100	100	100	100	100	500	1000
Coffee fermentation and drying process	225	225	225	225		900				225	225	450	1350
Spices laboratory		150				150		150				150	300
Aquaculture		500				500		500				500	1000
Research, Extension, Training & Consult.	616	606	472	390	176	2260	400	400	400	400	400	2000	4200
Sub-total	3651	13891	8164	8475	10636	44817	11600	14950	17300	10825	13525	88200	133017
Transportation	25000	50000	50000	50000	50000	225000	50000	50000	50000	50000	50000	250000	475000
Total	28651	63891	58164	58475	60636	269817	61600	64950	67300	70825	73525	338200	608017

Table V.C-8. Official exchange rates and consumer price index, Peru, 1975-85

	Off. Exch Rate U.S.$	2Rate-Ann. or monthly	CPI (Lima)	Annual Avg. CPI	Rate-Ann monthly
Dec 75	45.00				
Dec 76	69.37	54.16			
Dec 77	130.38	87.95			
Dec 78	196.19	50.48			
Dec 79	250.13	27.49	122.1	100.0	
Dec 80	341.73	36.62	196.3	159.2	60.77
Dec 81	506.97	48.35	339.0	279.2	72.69
Dec 82	989.67	95.21	586.3	459.2	72.95
1983	1684.084	129.49	969.5		125.07
Jan	1061.54	7.26	631.1		7.64
Feb	1131.50	6.59	680.0		7.75
Mar	1238.57	9.46	747.6		9.94
Apr	1343.83	8.50	805.9		7.80
May	1460.12	8.65	848.9		5.34
Jun	1585.95	8.62	915.0		7.79
Jul	1727.31	8.91	989.8		8.17
Aug	1964.90	13.75	1077.0		8.81
Sep	2041.09	3.88	1150.6		6.83
Oct	2188.79	7.24	1206.5		4.86
Nov	2194.25	0.25	1262.4		4.63
Dec	2271.16	3.51	1319.6		4.53
1984 (Jan-Nov)	3422.76	112.39	1969.6		96.85
Jan	2371.11	4.40	1415.9		7.30
Feb	2482.55	4.70	1533.7		8.32
Mar	2685.45	8.17	1640.2		6.94
Apr	2909.21	8.33	1732.1		5.60
May	3132.98	7.69	1838.5		6.14
Jun	3335.08	6.45	1948.3		5.97
Jul	3573.27	7.14	2037.6		4.58
Aug	3825.00	7.04	2194.9		7.72
Sep	4067.10	6.33	2299.8		4.78
Oct	4444.80	9.29	2427.5		5.55
Nov	4823.80	8.53	2597.6		7.01
Dec	5695.98	18.08	2790.4		7.41
1985					
Jan	6497.98	14.08	3179.1		13.90
Feb	7230.00	11.12			

VI. ADDITIONAL AGRIBUSINESS ACTIVITIES

A. CORN

Corn yields are low in the Huallaga Valley. It is proposed that corn be one of the target crops for the campaign with lime and fertilizers. It is anticipated that with proper inputs, yields can be increased from the current 2,000 kg/ha levels to the 5,000 kg/ha range.

1. Production

Corn production in Peru has an interesting history highlighted by significant changes. From 1964 to 1977 due to a rapid increase in hectares there was an increase in output while maintaining about the same average yield (2700 kg/ha). A strong internal demand from the poultry industry was considered to be a major factor in this growth. From 1977 to 1983 the production dropped because of a significant reduction in yield per hectare, while the hectares harvested remained about the same. The area devoted to corn in 1984 was up from 340,000 to 390,000 hectares over 1983. A further increase is projected for 1985. The Department of San Martin is expected to increase its area more than the average.

The drop in yields is due mostly to a shift in the location of corn production from the northern and central coast areas to the selva areas where yields are much lower. The corn production of the northern and central coast dropped from 80 to 50 percent of the nation's total. Corn became an attractive crop alternative in the jungle areas because of the policy of guaranteed price supports and because of fewer favorable crop alternatives than the coast areas.

From 1977 to 1983, corn in Huánuco Department declined in total production by 22%. However, in San Martin Department the total production of corn increased from 32,076 Mt to 107,165 Mt increase of 234%. The increase in Loreto Department was similar in percentage but from a much smaller base. Four selva departments including San Martin increased their share of the nation's corn production from 7.4% to 30.4% (yellow corn).

Corn yields in San Martin Department are only 80% of the national average yield (500 kg/ha less). Corn is grown on land that has recently been cleared as a first crop. It is not raised on the best land which is usually reserved for rice or other crops. Fertilizers are not used extensively and hybrid varieties are rarely used. Also, corn is produced without irrigation in the selva, and because of this factor the costs may compare favorably with coastal corn production.

Harvested hectares of corn in Huánuco Department declined over the 14 years recorded in Table VI.A-1. Although 1984 showed some improvement, it was still only 58% of the harvested hectares compared to the 1970-74 period. Yields per hectare were definitely up over this time period but not enough to prevent a decline in total production. The recent year, 1984, was a bright spot for the 1980's but total production was still only two-thirds of the average for 1970-74.

In San Martin Department, great changes have occurred since 1970. Hectares harvested went up from 14,000 to over 65,000 starting with the 1970-74 average. Yields per hectare showed a steady upward trend and total production went from 24,329 Mt average for 1970-74 to nearly 130,000 Mt for 1984; an increase of over 400% within a short period.

Table VI.A-1. Corn (both hard and soft) harvested hectares, yield per hectare, and total production--Huánuco and San Martin Depts.--1970-84.

	Year	Harvested Hectares	Yield Per ha	Total Prod. (TM)
Huánuco	1970-74	17844	1347	24030
	1975-79	13312	1486	19788
	1980-84	9222	1156	10662
	1984	10397	1.539	16004
San Martin	1970-74	14100	1725	24329
	1975-79	21520	1859	40015
	1980-84	44906	1527	70600
	1984	65218	1.988	129671

Source: Oficina Sectorial de Estadística, Ministerio de Agricultura, Lima, Peru.

Two types of corn are produced in Peru: one is a yellow flint-type corn destined primarily for animal consumption and for limited human consumption; the other is a large-kerneled white or purple corn utilized almost entirely for human consumption.

It has been reported that the total corn production for Peru in 1984 was about 600,000 Mt. Imports of corn totalled about 400,000 Mt and cost approximately US$ 50 million.

2. Market

Corn is purchased by ENCI, the national marketing agency for corn. It buys corn at storage centers located in production areas and sells the corn to the formula feed processors and other direct users who locate primarily along the coastal areas. ENCI lacks sufficient storage facilities to handle the total production. There are other special problems such as delays in payment and logistical problems in getting the corn to ENCI facilities. Therefore, about 50 to 70 percent of the corn in the Huallaga area is sold to the private trade or used by the producer.

The estimated distribution of the supply among buyers in 1983 was as follows:

Table VI.A-2. Distribution of corn supplies among buyers in 1983.

Buyer	Percent
ENCI	43
Home consumption	10
Local feed mills	12
Private merchants	35

ENCI's share of the corn crop dropped from 70% in 1980 to 43% in 1983. This may be due to a lack of storage and drying facilities and the rigidity of the national price setting policy. The private buyers can buy at prices above the price set by the Ministry of the Economy. Also, with the high levels of inflation, farmers with adequate resources and facilities may hold over a portion of their crop for higher prices in the off-season.

Even though ENCI does not buy all the corn, there is reason to conclude that the official price it pays does have the effect of setting the price which other buyers pay. Furthermore, there is some evidence that leads to the conclusion that the private trade is offering more and thus attracting the supply. Other relevant factors influencing the distribution of supplies include timeliness of payments, location of buying stations, and pricing discounts for excess moisture content.

3. Drying and storage

Moisture in corn at harvest time is a major problem in the Huallaga Valley. Sometimes it is harvested at 22% to 30% moisture content. Buyers refuse to accept it if the moisture content is above 18%. Heavy discounts for excess moisture up to

the cut-off at 18% are used to guard against spoilage in marketing and storage. The discounts used are as follows:

Table VI.A-3. Weight discount for corn due to moisture content.

Humidity	Weight discount for each 100 kg of corn
15	0.5
16	1.6
17	2.7
18	3.9

On-farm corn drying facilities in the Huallaga Valley are almost nonexistent. Farmers spread their grain on the ground or any hard surface for sun drying. This is a low-cost system, but if the weather does not cooperate there often is a loss of quality and a problem of getting the moisture content down. ENCI has neither ample storage capacity nor drying facilities. Although some collaboration exists between ENCI and the rice mills for sharing the use of both storage and drying facilities, there is probably room for improvement. The harvest seasons are somewhat different for corn and rice so that facilities can serve double purposes in some locations.

Table VI.A-4. Grain storage capacity under ENCI ownership and control.

Location	Metric Tons
Tingo Maria	2000
Uchiza and Progreso	1500
Tocache	1550
Juanjuí	3000
Saposoa	1000
San Pablo	1000
Pto Rico	600
Chazuta	1000
Tarapoto	3000
Total	14600

Total production in the Huallaga Valley exceeded 115,000 Mt in 1983 so it is obvious that the facilities for storage and drying are inadequate. ENCI officials in Tarapoto expressed a need for more storage in that area because they reported that in April 1984, 1,333 tons of corn were being stored under contract with private firms and 1,030 tons were without storage of any kind. On February 14, 1985 a Lima newspaper reported a large amount of corn wastage due to inadequate corn storage facilities.

The following is the suggested additional capacity required:

Table VI.A-5. Additional corn storage capacity required.

Location	Metric Tons
Juanjuí	1000
San Pablo	1000
Pto. Rico	500
Chazuta	500
Tarapoto	500

ENCI in Tarapoto does not believe there is reason to expand the capacity of the drying equipment under their management. This may be because the rice mill drying capacity is serving adequately, or because the surplus is being rapidly transported to Lima without moisture damage. ENCI normally stacks the bagged corn without separation by moisture content. Large amounts of Malathion powder is applied to the layers of corn sacks.

It is reported that the Canadian International Development Agency (CIDA) is procuring four grain dryers to be installed at various sites in Alto Huallaga with a total drying capacity of 24 tons per hour. Allowing for loading, cooling, and emptying times, they would dry 96 to 98 tons in a 24 hour period. These will be used for corn, rice, and other grains and should provide adequate drying capacity in the Alto Huallaga for some time to come.

ENCI reported in June 1984 the following costs and losses in corn handling:

Table VI.A-6. Costs and losses of corn handling--June 1984.

Item	Soles/kg
Producer price in Tarapoto	410
Bagging	11
Warehouse cost	5
Transport, Tarapoto-Lima	300
Overhead	50
Total cost	776
Wholesale price in Lima	630
Subsidy	146
Subsidy/total cost x 1000	18.8 %

Source: ENCI, Lima, Peru

4. Market Demand

It is estimated that about 70% of the demand for corn is for balanced animal feed production. The Upper Huallaga area is deficit in formula feed. It is possible that the imports of formula feed into the area includes corn that was shipped out of the Huallaga areas to the coast. The continued expansion of corn production, particularly in the Tarapoto area, will be closely associated with efficient expansion of poultry, swine and milk production activities.

Imported corn has become a major element in the total supply in Peru. Since 1980 imports have accounted for about 50% of the quantity consumed in the country. A drop to 25% in 1984 was due to special unplanned events but the imports are expected to return to the high level. Until March 1982, prices for imported and domestic corn were under government control. Import quotas were set and buyers were obliged to purchase a stipulated

percentage of domestic corn. Since that date, however, buyers have had more influence on the amount of imports.

At present, the government has relinquished the pricing of corn to the forces of supply and demand on the coast and sierra areas, but does guarantee the prices farmers receive in the jungle area. The government is in effect paying much of the cost of transportation to the high use coastal area.

Assuming that the current levels of consumption are maintained, the demand for corn, measured in terms of the hectares required to meet national consumption, is presented in the following table. The data in the table were generated by assuming that the principal animal use of corn was poultry and that the per capita consumption of corn is 1.20 kg/month. As can be seen, demand currently exceeds production. If the population continues to grow, and the demand for poultry does not diminish, the demand for corn will continue to exceed production levels.

Table VI.A-7. Estimated number of corn hectares required to meet national needs with three yield assumptions.

Year	Pop. (million)	Ann. Consp. 000 Mt	Hectares Required 2800 Kg/ha	3500 Kg/ha	4000 Kg/ha
1985	19.69	1169.73	417.76	334.21	292.43
1990	22.39	1329.91	474.97	379.97	332.48
1995	25.45	1512.02	540.01	432.01	378.01
2000	28.94	1719.08	613.96	491.17	429.77
2005	32.90	1954.49	698.03	558.42	488.62
2010	37.41	2222.13	793.62	634.89	555.53

Note:

Pop growth rate %	2.6
Pop base year	1983
Base year pop.	18.707 million
Per capita corn cons.	1.2kg/Mon-2800 av yield Kg/ha
Per capita poultry cons.	2.5kg/Mon-157,200 current ha
Feed conversion	1.5 corn/poultry
P.C. demand	4.95 month

The production data above are based on the per capita consumption figures of corn and population growth. Presumably

the corn figure includes both yellow and purple corn. The hectare requirements, however, are based on the production of yellow corn. For this reason, the potential demand for land for corn production will be under-estimated as the yields of purple corn are substantially less per unit land than those for yellow corn.

5. Recommendations

It is clear that corn production plays a major part in the farming system in the Huallaga Valley area and is likely to continue as a basis of support for poultry production and to a lesser extent for other livestock activities. It will continue to be a major source of income and the best use for certain types of land.

Corn yields are lower than they should be in the area. Notable improvements can be expected from the use of lime, other fertilizers, hybrid corn seed and improvements in agronomic technology. Consequently, corn will be one of the target crops of the impact program for lime and fertilizers. Corn yields can be expected to increase from the current 2,000 kg/ha levels to the 5,000 kg/ha range with the improved inputs of lime, fertilizers, improved seed, and proper plant protection methods.

It is also clear that storage is not adequate to accommodate an efficient marketing system. Production flow cannot match the demand without the benefits of an improved storage function. The adequacy of drying facilities at the centers of storage is less clear but there is no doubt that on-farm drying facilities are seriously inadequate for handling the extremely high-moisture corn being harvested. Some propose that harvesting methods can be changed to reduce this problem, and all are aware that sun-dried grain is cheaper than that dried at a high energy cost, but the efficiency of grain drying must be measured in

terms of the quality of the final product as well as in terms of energy and handling costs.

It is recommended that on-farm grain drying facilities be improved. In most cases, this means starting with an original facility. These can be home built with minimal capital cost. A hard surfaced floor with a roof will serve most needs, while small wood burning home made oven-type dryers will serve best for others. The costs will be minimal because the work can be done by the farmer, but some credit will be required for the purchase of construction supplies. PEAH has circulated sketches of workable and practical on-farm dryers which will serve small farmers adequately.

Because ENCI, CIDA and others are already involved, a promotion thrust from other agencies for more storage facilities may be premature at this time. A careful watch of the problem may reveal an appropriate time to give support for corn storage facilities particularly in the Tarapoto area.

Credit plays an important role in most development situations, and the capability of the Banco Agrario to serve the corn producers as well as the marketing system needs to be improved. Small lines of credit for the construction of small on-farm drying facilities are critically important to help solve the corn moisture problem.

The corn sector of agriculture is closely integrated with the manufacture of formula feed, poultry production, swine feeding, and milk production. What happens to one has an impact on the other sectors. The development of these activities should be viewed as a composite activity with interrelated spin-off responses. Improving corn quality, increasing yields, and reducing costs to make this corn more competitive with corn produced in other areas where yields are substantially

better is fundamental to the total livestock/feed grain complex of the Huallaga Valley.

No major agro-industrial investment for corn processing is proposed at this time. Rational strategy, however, suggests that this decision must not be viewed as a permanent recommendation. The need for more storage and corn drying facilities has been verified, but the action to be taken by the official sector or the private sector cannot be clearly anticipated at this time. It seems wise, therefore, to remain in a holding pattern until such time as outside participation can be clearly justified.

B. COTTON

Cotton is a crop with agribusiness potential both domestically and internationally. Cotton gins exist in the Tarapoto area, but are under-utilized because of a lack of raw material. Lime is expected to be a key input in revitalizing cotton production in the Huallaga area.

1. Production

Cotton production in the Tarapoto area has been struggling to compete with alternative crops in the area. Cotton in the Huallaga Valley must also compete with cotton from the coastal areas of Peru. The domestic market utilizes two kilos of cotton for every kilo exported. San Martin Department provides less than one-tenth of the nation's cotton. The crop ranks about eighth in gross value among the crops produced in that department. However, its place in agribusiness in the area is significant because of the existence of gins, which are under-utilized. Furthermore there is a ready market for the cottonseed oil and the press cake for animal feeds.

The number of hectares harvested in San Martin Department was fairly stable until 1977 when that figure dropped to one-third of its regular area. Then planting increased rapidly until a high of 10,398 ha was harvested in 1981, only to drop back to a third of that area in 1984. Yields have maintained a rather consistent level for the last 14 years with minimal variations year-to-year. Total production in response to the changing hectarage shows a high average in the 1980's because of the big harvest in 1981 but the 1984 production was back to a more normal output. There is no cotton produced in commercial quantities in the Huánuco Department.

Table VI.B-1. Cotton harvested, yield, and production in San Martin Department, 1970-84.

	Year	Harvested Hectares	Yield Mt/ha	Total Prod. Mt
San Martin	1970-74	2307	.767	1515
	1975-79	1939	.811	1624
	1980-84	6748	.827	5662
	1984	3500	.798	2793

Source: Oficina Sectorial de Estadistica, Ministerio de Agricultura

Soils, climate, and technology are favorable for cotton production. Even though comparative advantages in production are not great, reasonable yields can be obtained. Cotton requires a high level of fertilization and insecticides. It requires substantial amounts of hand labor, especially at harvest, which makes it a crop suitable for family farm operations. Mechanical picking is a possibility for the future, but additional agronomic development on varieties and other cultural practices are needed before this step could be recommended.

The economic rationality of cotton as an agribusiness in the Huallaga Valley has several positive as well as negative considerations. First, the Central Huallaga area has a climate, topography, and infrastructure suitable for expanding cotton production. The soils have good productive capacity when initially cleared, but require inputs of lime and fertilizers to maintain productivity. Cotton is a relatively high value crop which can pay for these essential inputs. This provides an opportunity for agribusiness to provide these essential production inputs. The essential processing and marketing structure for cotton already exists, but additional raw materials are needed.

On the negative side, cotton is an internationally traded commodity and subject to the vagaries of world market forces.

China has shifted recently from being a cotton importer to being a cotton exporter. This has had a major effect on world cotton prices, along with the general international economic situation. Consequently, world market prices resulting from world-wide supply and demand relationships leaves the small participants in the market vulnerable to circumstances over which they have little control or influence.

2. Market

In Peru, cotton is acquired by ENCI (about 60% of the crop in 1983) and by the Grupo Romero which owns ginning facilities at Tarapoto and Santa Cruz. There are two other small privately-owned cotton gins at Shapaja and Juanjuí which operate primarily as agents for either ENCI or Grupo Romero. Other private traders are also active in collecting the cotton for resale to all of these entities. Since ENCI has no gin of its own in the area, the service is provided under contract by the private firms. One-third of the cotton fiber is exported. All of the seed produced in the area is sold to Selva Industria S.A. (Grupo Romero) which operates an cottonseed oil extraction plant at Tarapoto and sends the oil to Piura on the coast for refining. The cake is sold directly to cattlemen and poultry producers. The gossypol is not removed from the cake, but this does not appear to prevent its ready sale.

ENCI has not been expanding storage its facilities, moreover, it follows a system of payment which is inconvenient for producers who must rely on word-of-mouth as to whether the institution is currently receiving cotton. Once having sold the cotton to ENCI, the producer must then journey to an agency of the bank upon which the check is drawn. Grupo Romero, on the other hand has a more accessible network of warehouses and pays cash on delivery.

3. Processing

Cotton production in the area dropped in 1983 and 1984 to 30% of the 1981 high this has had an impact upon Selva Industria. They have a rated capacity of 750 tons of seed per year, but processed only 90 tons in 1983, yielding some 50 tons of cake and 35 tons of unrefined oil. Selva Industria has reacted by opening reception centers with some storage capacity at Lamas and Sisa and additional storage facilities at Shapaja. It is also considering replacing the Tarapoto plant with a solvent extraction system suitable for processing soybeans. Another alternative is to promote coconut production in the area. This would have the advantage of permitting the use of the existing Selva Industria's expressing and filtering equipment with little modification. ENCI reported the following cost structure for the cotton which it exported in 1983:

Table VI.B-2. Cotton Processing Costs and Profits, 1983.

	Soles/kg
Purchase price at farm gate	2000
Transport to gin	50
Fee for ginning	440
Sale of seed	(160)
Freight, Tarapoto-Lima	140
Loading-unloading trucks	123
Storage	102
Financial cost	40
Administrative cost	65
Export taxes, agents' fee	555
Total costs	3355
Sale price, FOB Callao	3770
Net marketing profit	415

Desmotadora Algodón, the cotton gin at Tarapoto, is functioning at only a fraction of its capacity. It has a 10,000 ton/year capacity for cotton ginning, but its 1983 volume

was only 700 tons. Even so, due to transportation problems the output stocks build up for lack of an accessible market.

A relevant operational technique found at Desmotadora Algodón is its vertical integration arrangements. They produce formula feeds as a way of merchandising their cottonseed meal and they operate a beef cattle, dry lot, feed yard to provide an outlet for their feed.

4. Market Demand

Cotton is a crop of controversy throughout the world. The demand for the fiber is widespread, the areas favorable for production are extensive, and the technologies associated with production and fiber processing are known throughout the world. In addition by-product, cottonseed meal, is an important source of animal feed protein giving cotton a new dimension in the Huallaga Valley where poultry and livestock production are expanding because of a deficit of protein sources.

Table VI.B-3. Exports and domestic use for cotton produced in Peru.

	1982	1983	1984 est.
Production	35,880	67,629	86,020
Exports	62,790	9,200	25,530
Domestic use	50,600	46,000	48,300
Ending stocks	61,410	73,830	86,020

Because of the unusual severe storms in 1982, production was abnormally low, but with the high carryover stocks which are characteristic of Peru, there was sufficient for high exports. The low 1983 exports are partly due to a timing abnormality which made 1982 appear to be high and 1983 low. It is should be of noted that there is considerable variability from year to year in both production and exports, while domestic use shows a little more consistency.

Since March 1984, world cotton prices have declined and Peru exports will probably remain well below previous highs. World cotton supplies for 1984-85 are projected to be high which will have a depressive effect on world prices.

5. Recommendations

Cotton production should be encouraged in the Central Huallaga area. It is highly responsive to lime and fertilizers and good yields are anticipated. However, considerable caution should be exercised in promoting expanded cotton production beyond the needs of existing ginning capacity. The under-utilized ginning and marketing capabilities represent a resource that can be utilized to increase incomes and economic activity in the Huallaga Valley.

It is anticipated that the expansion of cotton production in the Central Huallaga area will be related to the development of lime deposits in the Tarapoto area. Additional field demonstrations will be required along with intensive promotion by the cotton, fertilizer, insecticide industries and the extension service. In addition, the cotton industry probably will have to offer some guaranteed price or a purchase contract to encourage farmers to plant additional cotton. The crop is envisaged as fitting into a rotational pattern with corn, soybean, and possibly pastures.

Again, the substantial overcapacity in cotton ginning forces a delay strategy for further cotton processing investments. If the time comes that producers are seeking alternative crops for their land then cotton production must be given its due consideration but its feasibility will be tied closely to the road improvements and expected reduction in costs. This product, except for the by-products, must rely solely on the market

exterior to the study area. A low priority must be given to investments in cotton processing until transportation costs are reduced, available labor is more abundant, and existing facilities are utilized more fully.

C. SOYBEANS

Soybeans have been grown spasmodically and on a small scale in the Huallaga Valley since around 1960. Output reached 250 Mt in 1979 and 310 Mt in 1981. Climate and soils are more favorable in the Central Huallaga and its tributary valleys than in the Upper Huallaga where soybean production requires heavy expenditure in weed and pest control, fertilizers and lime. Average yields in San Martin department were: 1967 1320 kg/ha, 1981 1200 kg/ha.

1. Production

The beans produced have been processed mainly in an old press-mill at Shapaja near Tarapoto that is used, primarily for cottonseed oil extraction. The 1981 production area breakdown by Distritos Agropecuarios was: Tarapoto 180 ha, Picota 50 ha, Bellavista 80 ha, total 310 ha. Processing capacity and credit are key factors in soybean production. Although there may have been some crop financing by processors, the only significant credit source is the agrarian bank.

Under Decree Law 22140, the oilseed processors were subject to a special tax which partly offset the subsidy on imported soy oil and also provided the agrarian bank with funds for its Oilseed Promotion Program (Programa de Promoción de Oleaginosas: Proyecto Soya-Tarwi (*Lupinus sp.*).

This program, initiated in 1979 in Cuzco, Sicuani, Juliaca, and Huaraz, gradually extended to include Andahuaylas, Paucartambo, Tarma, Tumbes, and Jaén. In the Huallaga Valley it reached into Tarapoto, Rioja, Tocache, Aucayacu, and Tingo Maria. In the Sierra the main crop under the program was Tarwi; in Jaén, Tumbes, and the Huallaga it was soya. In 1984, the agrarian bank loaned S/. 215 million for an area of 500 has. In

1984 the fund attained S/. 384 million (about $75,000), enough for around 300 hectares. These funds were loaned at a subsidized interest rate of 44.5% plus 2% commission but there was no very pressing demand. In late 1984, when the subsidy on imported soy oil had been rescinded, the funds were no longer available for the agrarian bank's oilseed program, and it was suspended until further notice.

Palm oil, produced mainly in the Tocache-Uchiza areas, has become established in the national market. It is sold pure or blended. Cottonseed and soy oils are usually blended. No significant amounts of soy oil enter the national market. In areas where oil palm does well it is preferred to soybeans. Being a permanent crop, it is less subject to pest and climatic hazards. Once the initial investment for plantation establishment has been made, recurrent costs are lower than for an annual oilseed crop.

Oilseed processing in Peru is dominated by a few big crushers, notably at Pacocha, Romero, La Fabril (Bunge), and Copoa (ex. Anderson Clayton), which also dominate imports of soybeans for processing and of soybean oil for blending. Until recently soybean oil imports were subsidized. The volume of those soybean imports is declining as palm oil output takes up the slack.

Romero does, however, promote soybean growing and signed (in 1984) a 50 hectare contract with Erickson, a large landowner in the Biabo area. The reported price was S/. 650/kg in plant or about US$165/Mt. Freight cost to plant is not known, but the on-farm price would not be much above US$150/Mt. The soybean growers' committee of the National Farmers' Organization says this price does not cover production costs. In Bagua, also in 1984, the company Aricol & Monterrico S.A. offered to buy 7000 Mt

however, there were no takers as the farmers put their production costs at S/. 900/kg or US$270/Mt.

The following figures provided by the Banco Agrario (Table VI.C-1) give an idea of costs, yields, and earnings in the Central and Upper Huallaga, and in Jaén. (Ing. Hernán Ugarte V., Oficina de Presupuestos, Feb. 1985):

Table VI.C-1. Soybean production costs and earnings.

	Tarapoto Mid.Tech.	Tarapoto Empiric.	T. Maria Mid.Tech.	Jaén Mid.T.	Brazil Mid.T.
Land preparation	32	55	48	50	46
Planting & fertilizing	22	13	23	24	15
Applic. of herbicides, insec., & mech. cultiv.	24	10	66	67*	15
Harvesting	27	23	50	52	25
Transportation	17	9	22	23	21
sub total	122	110	209	216	140
Inputs					
seed & innoc.	12	6	17	18	26
herbic. & insect.	18	3	21	22	16
fertilizers & lime			32	33	28
bags	15	7	21	23	13
Sub total	45	16	91	96	83
Overhead & management	31	1	70	69	40
Total Cost	198	127	370	381	261
Production kg/ha	1500	1200	2000	1800	2000
price	208	181	221	240	200
Gross earnings	312	217	442	432	400
Gross profit	114	90	72	51	137

*Includes irrigation.
Before financial costs.
Sources:
1. Tarapoto (middle level and empirical levels of technology, 1984.
2. Tingo Maria (Middle level technology. 1984).
3. Jaén (middle level technology, Banco Agrario, 1984).
4. Average figures obtained during survey of Central Brazil 1973-75, updated (Adletec).

Table VI.C-1 indicates that the highest production costs were in Tingo Maria and Jaén, the former due to the need for more expenditure on pesticides, herbicides, fertilizers, and lime and, in the case of Jaén due mainly to the cost of irrigation. The yields shown by the agrarian bank in these two locations cover these additional costs, but leave a smaller margin than the lower yields in Tarapoto where growing conditions are more suitable.

In the Upper Huallaga, oil palm is more dependable (and more profitable) than soya.

2. Recommendations

From the foregoing it can be said that reasonable prospects exist for soybeans in the Central Huallaga Valley, provided that (a) the processors guarantee a fair price; (b) they or the agrarian bank offer credit on terms at least as favorable as those of the former oilseed promotion program; (c) technology transfer based on systematic variety selection trials and on-farm adaptive research is conducted, particularly in the Tarapoto, Picota, and Bellavista areas; and (d) large growers like Erickson in the Biabo Valley are encouraged to collaborate in this program, perhaps with the Romero group as processors and as suppliers of seed. Experience of SANBRA (Bunge) in NE Brazil has been very encouraging and could be repeated in the Huallaga.

D. RICE PRODUCTION AND MILLING

1. Production

The growth in rice production in Peru is most impressive, more than doubling in 20 years. Imports too have been rising with the exception of the unusual years of 1970-1974 when imports were basically cut off. The high levels of imports in the 1980's seem to be in conflict with the expanding internal production and the country in stated policy to reach self sufficiency in rice. However, this data does seem to indicate a rising internal demand.

In 1984 there was a drop in imports of rice. The time has arrived when it appears that internal production can match consumption. If the production trend continues the country might have a surplus. However, a preliminary analysis indicates that the surplus production would not be competitive in world markets cost wise and quality wise.

Traditionally, rice production has been located in the coastal region of Peru. During the 1960's 90% of total production occurred in this region. By 1981 due to the increase in production in the jungle area, this percentage was reduced to 70%. The jungle's expanded production has had a major influence on the 250% expansion of production since 1960. Significant increases in newly cultivated lands and increased yields per hectare jointly accounted for the expansion. Producers have been encouraged to plant more rice by the official price support policy and an assured market outlet for all they produce.

In San Martin Department, the number of hectares planted to rice in 1984 was 35,000 ha compared with 12,574 in 1979, yields went from 1,647 to 2,890 kg/ha for the last five years. Total production went from 14,198 Mt in early 1970's to 93,568 Mt in

1984, a growth of 300% in 5 years and 448% in 14 years. The Huánuco Department showed a growth from 1979 of 13% but the 1984 production was only 39% of the 1970-74 average. (Table VI.D-1).

Table VI.D-1. Rice production and yield in Huánuco and San Martin Departments, 1970-1984.

	Year	Annual avg harvested	Annual avg yield/ha	Annual avg production
Huánuco	1970-74	1888	1824	3458 Mt
	1975-79	658	1965	1618
	1980-84	1034	1891	1840
	1984	705	1932	1362
San Martin	1970-74	8448	1647	14198
	1975-79	8127	1935	18828
	1980-84	22042	2890	63628
	1984	35118	2664	93568

Source: Ministerio de Agricultura, Departamento de Estadistica.

Prices paid by wholesalers have been lower than those paid to producers. In June 1984 the following costs and prices were reported by ECASA:

Table VI.D-2. Rice production costs and prices reported by ECASA - Jun 1984.

Item	Soles/kg	US$/Mt
Price of paddy to producer FOB mill	759.00	227.60
Milling charge - to miller	54.50	16.30
cost of head rice assuming 67% yield	1,214.18	364.00
Storage in Tarapoto	5.00	1.50
Loss in storage (.083%)	3.66	1.10
Bagging	26.62	8.00
Transport - Tarapoto to Lima	289.00	86.60
Storage in Lima (4 months)	8.00	2.40
Overhead	50.71	15.20
Financial costs	185.46	55.60
Credits for bran and broken grains	(7.39)	(2.20)
Total costs	1,775.24	532.30
Sale price to wholesaler	1,044.00	313.00
Subsidy	731.24	219.30
Subsidy/Total costs x 100	41.19%	41.19%

The state subsidy to rice producers does not eliminate private trade even though the mandate to ECASA is to buy 100% of the rice. Actually about 35% of the production moves directly into the private trade in the Huallaga Valley, but much of this probably moves through the official agency in order to collect the subsidy. Practically, no price differences exist from place to place or different qualities.

In some cases paddy rice is sold to mills at about 30% under the official price. The economic rationality of this can be explained mainly by the pressures for cash to meet credit payments and the reported long delays encountered in getting payments from ECASA. Differences in discounting policies are also mentioned as a factor. In many cases, producers are not conveniently located to deliver to the mills contracted by ECASA. It becomes more practical to sell locally and not attempt deliveries at distant points. Part of the rice missing the official market channels is consumed at home of traded to neighbors. Very little is used for seed because of the successful program to encourage farmers to plant only improved seed and not home grown seed.

ECASA does not have funds to build rice mills and do its own milling so it is generally contracted out to private mills. Many rice mills are being built under private initiative throughout the area and there are about now 34 in the vicinity of Tarapoto. Some are being financed in part by foreign capital. Not all of the mills are now being used at capacity, and unless rice production continues to expand and construction of mill ceases it is likely that this under-utilized capacity will continues for some time.

Land, water and climate in the Huallaga area are favorable for rice production. Farmers, bankers, technicians, official agencies and all concerned with the area have been positive

toward rice production and have given it top priority. Experiment stations have made important technology contributions. However, the biggest single factor promoting rice has undoubtedly been the national policy of providing a guaranteed price for all rice produced. This price appears to be about 40% above production cost making it the most profitable crop in the area (not including coca).

2. Market

A workable rice market structure is in place. Its performance is generally acceptable even though complaints point out some problems and weaknesses. Measurement of market performance is not convenient under a pegged price system, but farmers do not complain in view of the favorable price assurance.

Farmers deliver their rice to mills contracted by ECASA, the official national rice marketing firm. The rice is classified according to moisture content and foreign matter. Farmers receive a discount in price if the rice does not conform to pre-specified quality levels. Although it may not always take place, policy dictates that the process of classification be done in the presence of an ECASA representative, the rice mill officer, and the farmer. Storage costs are covered by the mill, but compensation is made by ECASA, which also covers the costs of transportation to Lima.

The government's policy is to establish relatively higher prices for rice in the jungle area to compensate for assumed higher production costs and lower yields as well as to provide an incentive to colonize the region. Prices at the farm level and at the consumer level are fixed by the government. On November 16, 1984, prices paid to producers for rough rice was S/. 820/kg (US$170/Mt) for all other areas and S/. 1000/kg (US$207.30/Mt) in the jungle area. However, retail prices are fixed only for the

rice of lower qualities, and the higher-grades of rice reflect the free market prices. January 1985 prices to consumers were:

Table VI.D-3. Rice market prices -- Huallaga, January 1985.

Item	Soles/kg	US$/kg
Common	1720	0.344
Familiar	2120	0.424
Superior long	2900	0.580
Extra	3600	0.720

In the past the highest quality rice has been imported. Because of the strong influence of world rice prices on the cost of imports, the government has tried to keep its assured prices somewhat in line with the world prices. They have had to make frequent adjustments. Farmers have protested when these adjustments appeared to be slow and inadequate.

Peru has been a net importer of rice for 25 years or more. For the first four years of the 1980's, volume of imports grew to 26% of the internal milled rice production. Table VI.D-4 shows five year averages that point up the trends in production and imports.

Table VI.D-4. Trends in rice production and imports in Peru, five year averages 1960-1984.

Years	Milled rice production Mt	Net imports
1960-64	230,800	16,850
1965-69	251,700	49,512
1970-74	357,700	- 8,886 (net exports)
1975-79	370,100	54,845
1980-83	499,700	131,800
1984	575,000	48,000

The present pricing and marketing system for rice in Peru has some weaknesses. A price-subsidy policy tends to detract from the normal market functions of reflecting pressures from the

supply and demand sides and arriving at prices that send the correct signals to producers and consumers. An artificially high price has undoubtedly led to rapid increases in production, but the time may have come when the supplies of rice will be sufficient for export.

As the nation shifts from a deficit to a surplus producing country, one is justified in being apprehensive about changes in price support policies. Substantial losses on sales on the competitive world market may force a policy change that would reduce the incentive to continue the production growth. World output for rice in 1985 is projected at record levels.

The present pricing system may be giving rice producers an erroneous signal at a time when they should be exploring alternative crops in the event that internal self-sufficiency results in a free market pricing. Some problems associated with the official buying agency include the time of payment, location of buying stations to serve all producers, and its policy of handling the moisture problem. A moisture content of no more than 14% is allowed by having the price reduced. The farmer is penalized for any moisture percentage above 14%. This has resulted in late harvesting to avoid high moisture and sometimes the rice is too dry for efficient milling and contains a high percentage of broken kernels results.

Rice mills lack sufficient incentive to process a quality product under their contractual arrangements. Only the minimum standards are required and as a result the milling quality is less than desired and the broken kernel percentage rises. Even though the reliance upon the private sector to provide the milling facilities is generally viewed as a step in the right direction, the contractual arrangements with the official agency should be improved.

3. Market Demand

Rice is an important consumption item in the Peruvian diet. In terms of production, rice is second only to potatoes in importance. Current estimates of national per capita consumption of rice are over 2 kg/month.

Some preliminary projections indicate that the increased plantings or increased per hectare yields will be required to meet the increased demand resulting from population growth. The projected population, its demand for rice, and the number of hectares required to meet the projected demand, given three alternative yields per hectare, are given in Table VI.D-5.

Table VI.D-5. Estimated rice hectares required to meet national needs.

Year	Population millions	Annual Consp. 000 Mt	Hectares required at 4000kg/ha 000	4500kg/ha 000	5000kg/ha 000
1985	19.69	495.30	154.78	137.58	123.83
1990	22.39	563.13	175.98	156.42	140.78
1995	25.45	640.24	200.08	177.85	160.06
2000	28.94	727.92	227.47	202.20	181.98
2005	32.90	827.60	258.62	229.89	206.90
2010	37.41	940.93	294.04	261.37	235.23

Population growth rate %	2.6
Population base year	1983
Base year population	18,707 million
P.C. consumption	2.096 kg/month
Efficiency	80%
Average 83-84	4.500263
Hectare 83-84	189500

These figures, however, should be interpreted cautiously. They are merely straight-line projections. Per capita consumption could change. The impact of such a change is illustrated in Table VI.D-6, where the per capita consumption figure was increased to correspond to the statement that 1984 production nearly met national needs and published yield data.

For example, it has been shown that the demand for wheat is income elastic. That is, as incomes increase, people tend to substitute wheat for other products, including rice. Another factor which could change the above projections is a change in the price of rice relative to the other competing foodstuffs. This price has been falling during the past 14 years (see Table VI.D-7.) If this trend continues, the demand for rice could exceed the estimates given here.

Table VI.D-6. Rice hectares to meet national needs at higher levels of per capita consumption.

Year	Population millions	Annual Consp. 000 Mt	Hectares required at 4000kg/ha 000	4500kg/ha 000	5000kg/ha 000
1985	19.69	673.48	210.46	187.08	168.37
1990	22.39	765.71	239.28	212.70	191.43
1995	25.45	870.56	272.05	241.82	217.64
2000	28.94	989.77	309.30	274.94	247.44
2005	32.90	1125.31	351.66	312.59	281.33
2010	37.41	1279.41	399.81	355.39	319.85

Per capita consumption = 2.85 kg/month

Table VI.D-7. Relative prices of the principal food products in metropolitan Lima, 1970-1983.

Year	Rice	Bread	Noodles	Potatoes	Sugars	Beans	Oil
1970	100.00	99.43	111.48	46.14	64.21	150.00	174.77
1971	100.00	99.43	112.73	45.00	64.21	161.70	210.11
1972	100.00	99.43	117.27	58.07	64.21	177.39	215.11
1973	100.00	99.43	124.66	69.55	64.21	193.52	225.80
1974	100.00	118.37	140.15	51.80	53.50	185.04	189.39
1975	100.00	109.10	138.54	73.67	42.87	187.41	189.30
1976	100.00	117.14	130.93	51.76	54.91	169.63	188.07
1977	100.00	108.09	186.71	73.25	65.92	196.25	190.97
1978	100.00	133.73	176.01	50.96	77.88	294.19	258.11
1979	100.00	121.60	162.52	58.93	83.39	186.74	254.68
1980	100.00	111.21	141.21	94.47	84.48	234.18	204.95
1981	100.00	142.16	168.27	76.78	131.74	360.42	314.71
1982	100.00	122.02	136.01	82.02	108.22	249.10	285.45
1983	100.00	153.66	200.08	147.21	136.98	298.22	357.10

Source: Special Stat. Bul. of Rice Cultivation, Peru 1970-84, April 1984.

Sihce the price of rice is determined by the government, there exists no incentive for private enterprise to enter into the storage business, unless under contract to the government. Under the current system, the only possible gain a benefit a firm could derive from storing rice is the rent the government pays. If the rice price were market determined, individuals would enter into the storage business in order to capture price increases during the intervals between harvests. A possible recommendation is that if the government is going to stay in the rice buying business, the price for some of the grades of rice should be determined by the market. It is suggested that the price top-grade (export quality) rice be a market price. Any other system is either a direct export subsidy or a domestic food subsidy on the part of the government (if the price were set too high) or an export tax (if the price were set too low).

The bottom grade and non-edible grades of rice should also have a market price. This will be very low and will discourage the production of excess amounts of the poor qualities.

Also, the current price being paid to rice producers exceeds the world market price. At the start of 1984, the price of rough rice was US$265/Mt. The export of rice will not be an attractive alternative unless the domestic price is allowed to decline. However, if this occurs, it seems likely that production will also decline, and there will be no rice to export.

4. Recommendations

The rapid increase in production of rice in the Huallaga Valley brings, makes it one of the top four products in income generation. Its importance demands attention to the question of marketing efficiency and the contribution that agro-industry might make to improve incomes.

There is a pressing need for a detailed research study into the question of what will happen to production and marketing of rice in the event that national price policy is changed relative to this product. What are the advantages and disadvantages of rice production in the Huallaga Valley under different conditions? The questions of storage location, milling capacity and the rice drying function must be researched in some depth. This is particularly true if changes in the relationship between production and internal utilization balance are made. What will Peru's position be in the world rice market if it becomes an exporter? Wherein do their opportunities lie? Such questions should be addressed with in-depth research.

A major constraint in the efficient operation of the rice marketing processes at all levels is the insufficient supply of trained people to accomplish the management and marketing tasks. High priority should be given to a training program with the goal of relieving the shortage of trained marketing and management experts for utilization in both the private and public sectors.

A rice-grading system needs to be put in place immediately. This system should be directed from the primary buyer, currently the government, towards the producer. ECASA already has a rice-grading system and the authority to implement it. According to the Kansas study, the system is adequate. Some of the reasons for implementing the system are:

a. If Peru plans to enter the export market, rice grading is imperative.

b. Higher-quality production at the farm level could decrease post-harvest losses.

c. Peru is currently importing high quality rice. Without a grading system, Peru may find itself in the position of trying to export low quality rice while importing high quality rice. (In Iquitos, it was noted that high quality rice imported from Brazil was selling for three times the price of domestic rice.)

d. There is a market for high quality rice in Peru. A grading system would facilitate meeting this demand with domestic production. This would also increase the incomes of the producers capable of growing market superior rice.

e. Lower grade and non-marketable rice should be diverted to other uses - including animal feed and such activities as the production of alcohol. Again, for this to be feasible, the rice must be graded and the off-grade stuff must be marketed at a price such that it can be moved.

In addition to the above, there is need for expanded rice storage and rice drying facilities. However, further studies are needed to answer the question of whether storage should be in the production areas or in the consumer areas such as Lima. The location and size of rice dryers need to be more specifically identified with a view toward making the best use of facilities for rice, corn, soybeans, and other crops and fully utilizing their capacities.

E. YUCA - PRODUCTION AND PROCESSING

1. Production

The extensive production and consumption of yuca throughout Peru is sufficient reason for consideration of yuca in any development scenario. Average annual production in Peru was 17,190 Mt from 1965 to 1969, 24,800 Mt for the 1970-74 average, 21,195 Mt for the next five year average and 12,527 average for the period 1980 to 1982.

Yuca is a basic crop cultivated in tropical regions. Its production comprises more than 50% of all the root and tuber crops grown in tropical regions. It has been estimated that 12% of the calorie intake in Latin America is through yuca consumption. CIAT's researchers report that after rice, corn, and sugarcane, yuca is the most important carbohydrate source grown in the tropics. It has a production range similar to corn, but unlike rice and sugarcane it is rarely irrigated.

There are numerous marketing problems associated with this crop: it is bulky with a high water weight; it has a high degree of perishability; its quality is variable; and it has wide supply variations and a low per unit value. This raises the question of the impact a processing activity might have on the net returns to producer or handlers.

Yuca is highly significant in a setting of self-sufficiency farming, localized trade, and low food supplies. No one should minimize its role as the basic food item in the diets of many low-income people. But to move from that function to a more affluent society where processing increases product utility, is most likely a move to an uneconomic utilization of the product. Processed yuca has a market disadvantage and the enhancement of demand for the product is not likely. As a society increases its

income, the demand for yuca is likely to decline (this is called inferior demand in economics). Only in a setting of declining food supplies, limited alternatives, and a decreasing income would it be rational to devote funds to the processing of this product. Peru has many other food production alternatives with stronger consumer preference. Also, an outlook for improved incomes among consumers is expected for future years.

The story of yuca is one of a dramatic drop in its importance in the Huallaga area. Hectares dropped to 716 Ha from a high of 1610 average for 1970-74 in Huánuco Department and the drop was from 5504 to 2667 in 1984 in San Martin. Yields per hectare were extremely variable but ended in 1984 at a high point in Huánuco but at a low point in San Martin Department. In the Central Huallaga in 1984, the yields were only one-half of what they were during the 1970-74 period. Total production in both areas was down to 25% of what it had been on the average for the 1970-74 years. In San Martin Department, there was an unexplained upsurge in plantings in 1980 and 1981, but the increase was not sustained. (Table VI.E-1.)

Table VI.E-1. Yuca hectares harvested, yield per hectare and total production, Huánuco and San Martin Depts.--1970-84.

	Year	Harvested Hectares	Yield/Ha Metric	Total Prod. Tons
Huánuco	1970-74	1610	15.432	24869
	1975-79	1551	13.671	21198
	1980-84	1150	12.754	11860
	1984	716	19.671	10150
San Martin	1970-74	5504	19.200	105580
	1975-79	4896	14.210	69638
	1980-84	6661	11.586	81926
	1984	2658	9.924	26368

For human consumption, a major marketing problem is the perishability of yuca. It has only a 2 to 3 day storage time

and that is hardly time to get it to a distant market. If it is harvested in special ways, leaving the root as undamaged as possible, the storability goes up to 6 or 7 days which is still not enough time for a complex marketing system to assemble and distribute the product. Thus, it appears that the product market is destined to remain within a fairly close proximity to the production areas. Researchers are now experimenting with a chemical that can be added to yuca in polyethylene bags which will preserve the product for 2 to 3 weeks. This is still in the experimental stage and may not change the market much even if the research is successful.

2. Processing

There have been five yuca flour mills established in the Upper Huallaga, and five or six years ago there was a yuca promotion program to provide this product for the mills. All have ceased to function and the explanation given is that they found costs of production of the yuca flour too high and the market for the product non-existent. With the termination of purchases by these plants, producers have reduced their production significantly.

Yuca has an alternative use as livestock feed. A small-scale chipping plant to prepare tubers for livestock feed might be an investment alternative, providing that livestock numbers are large compared with available pastures and other feed sources. Presently, yuca chips do not seem essential for livestock production in the Huallaga River area because of the availability of underutilized pasture land. But if livestock numbers were to increase, in years to come yuca chips might be considered as an important source of carbohydrate, especially for swine.

CIAT researchers report that drying yuca chips for livestock feed is a critical operation and may make the difference in whether or not it is practical. If chips can be dried by the sun with minimal energy cost, then it may be an efficient feed. In cases where there has been a cost associated with the drying, the product has dropped out of the group of efficient feeds. Commercial cassava (yuca) processing for livestock has a tradition of failure and large capital losses. There is only one country with documented success -Thailand- and this is only because of a unique combination of variables make a successful project. Experience in Brazil demonstrated that supplies of raw materials to maintain profitable operations were insufficient although cassava (yuca) "grows everywhere" and its "all over the area". Feasibility studies oriented towards attracting investment failed to indicate solutions to the logistical problems.

In Venezuela, four of six cassava feed processing plants remain idle and two operate at below capacity. A planned seventh plant has not been completed. About $6 million was invested in these cassava dehydrating plants and the results bear out that governments cannot bring an agribusiness into profitable operation merely by providing money for the establishment of the processing plants. In the Venezuela case, a feasibility study was conducted which showed the I.R.R. to be only 7% and the yearly rate of return 11%. They proceeded with the project on the notion that the plant would generate better economic returns. The study contained many pages describing the machinery needs and plant layout, but only one page out of 213 pages was devoted to the problem of raw material supply. It was assumed that farmers would produce whatever was needed at whatever price. Actually prices to farmers dropped because yuca as animal feed cannot bring the price that will be paid for human food. If there are two uses and two prices, the farmers will stop producing for the lower priced market.

The fact that idle or unprofitable plants can be found in Bolivia, Argentina, and Jamaica, in addition to Brazil and Venezuela, further supports the contention that commercial scale yuca processing for livestock feed is one of the most unattractive investments that can be considered. There are perhaps $40 to $60 million worth of unused or underutilized yuca processing plants dotting the Latin American and Caribbean region.

CIAT has been conducting investigations on cassava utilization and small-scale processing during the past several years and has yet to come upon a "universal technique" that can be widely used for the conservation and storage of cassava on a commercially feasible basis. Refrigeration is effective but not cost effective. So far the most cost-effective system is to harvest the crop traditionally when the supply is needed for direct consumption. The high energy content of yuca has led researchers into feed supplement studies, and CIAT is still interested in this potential. Problems are encountered in feeding fresh yuca to livestock and swine due to the high moisture content and in its preparation for animals so they do not choke on the chunks fed to them. Dehydration before feeding seems logical. Low cost, small scale chipping and drying using passive solar energy is about the only viable alternative.

CIAT has designed and tested several types of chippers and has developed design plans for fabrication in a local metal working shop. No cost estimates are available at this time, but one might guess that they would range between $250 - $350 including material and labor. Solar drying is accomplished by using black or dark mesh screen tray-type dryers. The angle of incidence is adjusted according to the latitude. Other solar drying studies indicate that a fine mesh provides greater

reactive surface area and is recommended when relying upon natural air movement and passive drying.

Although there are simple low-cost yuca processing technologies available, caution should be exercised in promoting them. The demand for yuca feed will be greatly affected by the availability of alternative sources of carbohydrates and their quality and by the opportunity costs associated with on-farm yuca processing versus other available feed inputs.

3. Recommendations

Processing of yuca into yuca flour for demand expansion and efficient transportation from the area does not attract enthusiastic support. It is considered a low-priority project. However, processing for livestock feed may merit further study but with a minimal priority strategy.

F. PASTURES, LIVESTOCK AND MEAT MARKETING

1. Production

Statistical data for the Departments of Huánuco and San Martin show that land adapted for pasture occupies 1,110,000 ha. or 13% of the area. This is a higher percentage than any other use except forest. Cultivated pasture as well as natural pasture is without question one of the least efficiently used resources in this study area, where livestock production falls far below its economic and physical potential. For example, there is a take-off of only 17% annually for existing herds. Being able to reach a higher potential will depend heavily on technical inputs in livestock husbandry and pasture improvement and good management of both pastures and the livestock. The encroachment of native species on improved pastures must be prevented to maintain the benefits of previous investments in cultivated pastures. Animal disease, parasite control, and nutrition must receive high priorities in technical management plans.

Not with standing the contributions of new technical input, significant increases can occur under the existing technology by greater utilization of the land appropriate for pasture. Some of the cattle observed in the area are superior in quality to those in other developing countries, and well managed pastures can occasionally be seen. Diffusion of known technology can and should occur rapidly among livestock producers.

Several explanations have been offered for the major decline in recent years in cattle numbers in the project area. In the Upper Huallaga Valley, the herds have declined from 41,000 head in 1979 to 23,000 head in 1982. In the Central Huallaga, a drop to one third the number of 10 years ago has taken place. The reasons suggested for the decline include the absence of adequate economic incentives, inadequate market structure, inadequate

slaughtering facilities, insufficient cold storage, high transportation costs to the Lima market, and generally poor marketing arrangements. The current inflationary spiral and the unavailability of intermediate credit for cattle production are probably the most serious constraints. Short-term credit, one year or less, forces borrowers to seek a rapid turnover of capital and to grow crops that fill this need better than livestock which requires about three years to mature under local conditions.

The decline in carrying capacity of the pastures because of the decline in soil fertility and poor pasture management is probably one of the principal technical reasons for the decline in productivity and the decline in the economic profitability of the industry.

In the field, it was observed that some of the previously introduced forage species, such as Brachiaria decumbens, had virtually disappeared in a number of previously improved pasture areas. This grass was replaced by the native species "Torourco" which is less palatable and less productive. Consequently, there is a decline in both the production and profitability of the livestock enterprise.

Pasture management is a very important aspect of maintaining the long-term profitability of a livestock enterprise. If pastures are over grazed by over-stocking, there can be some short term gains. However, the animals will usually eat out the most palatable species and the undesirable species such as "Torourco" will dominate the sward. Consequently, both production and profitability will decline.

A preliminary reconnaissance of the Huallaga Valley indicates that the area west of Tocache might be a place where a livestock production program could be feasible. The soils appear

to be quite good, the topography fairly flat and drained. Additionally, population pressure has not yet built up, and adequate areas appear to be available for a livestock unit of an economic size.

From Juanjuí to Tarapoto, the valley is wide and on the margins of the riverbeds there are places that are highly propitious for the establishment of irrigation. This happens in Saposoa, Mayo and Sisa. When the bridge under construction in Picota is finished, the same development will probably take place in the Ponaza and Del Biavo valleys. Even though the intermediate sites between these small rivers are high and with small amount of water they are the most propitious places to plant corn. The establishment of a commercial cattle operation might also be considered. However, as the plots are too small for the latter, it probably will be necessary to group them into some type of farm organization considering the economic aspects of scale. Near Yurimaguas the situation is similar, and the same opportunities will appear when the highway is constructed there.

Dual-purpose cattle are bred throughout the valley. Producers located between Tingo Maria and La Morada are benefiting from the academic influence of the Universidad Agraria de la Selva. The dual purpose cattle are Brown Swiss crossed with Zebu. In some places the Swiss cattle are pure-bred, but the Zebu blood is usually most desirable for disease resistance.

The Government of Peru has a long history of livestock imports for the purpose of solving their inadequate supplies of meat and milk. From Brazil, Indu Brazil, Gir and Nelore strains have been imported; from the United States, Brahman, Sta. Gertrudis and Brown Swiss; from Mexico, the Beef Master breed; and from France, the Charolais. Between 1972 and 1975, over 40,000 head were imported to supplement the agrarian reform program. Livestock were allocated to the newly formed

cooperatives. Unfortunately, good stockmen were removed from the farms and were replaced by cooperative officials with less experience and less technical information about pasture management and cattle production. The result was a decline in the profitability of livestock and in their numbers.

The Alto Huallaga has certain specific characteristics that affect livestock production. The high rainfall presents a drainage problems at certain times of the year for some of the pasture land. This discourages efficient utilization of these areas. Land put into pasture in earlier years has lost much of its fertility because there were no fertilization programs to maintain productivity. Land has been parcelled into small holdings making it difficult for a livestock producer to manage sufficient hectares for efficient management. Nevertheless, there are areas where a good fertilization program and proper grass species could redeem pasture land and livestock production could be profitable. For example, it is believed that the areas between Saposoa and El Mayo, el Biavo and Sisa and in the Yurimaguas area have such potential.

It should be emphasized that land suitable for cultivated crops cannot be used for pasture purposes as profitably as it can for crops. This is true almost anywhere in the world.

Along the route from Tingo Maria to Pucallpa, there are large land areas available on both sides of the road. There are many cattle in these areas but their production is low because the pastures have not been properly managed and native brush and trees have invaded the pastures. In the case of Ganadera Amazonas where they previously pastured 18,500 head of livestock, they now can support only 6,000 head. Decline in soil fertility and pasture productivity are the basic reasons for the decline in productivity.

Along the route from Pucallpa to Tingo Maria in the town Constitución, there is an area of 700,000 hectares that is developing. INIPA and North Carolina State are participating in this project. Its first objective is to revitalize 2,000 hectares by introducing recommended grass species--Brachiaria decumbens, Brachiaria humidicola and Andropogon guianensis. There are about 3,000 head of cattle there including Nelore, Brown Swiss, Criollo and Holstein breeds.

In the same area, another project that includes 10,000 ha. is available to interested livestock people and costs are held to a minimum. In the Pachitea Valley, the natural conditions are favorable for the development of livestock and new producers are being attracted.

The Agrarian Bank in Pucallpa reported that 10% of its loans are being made for livestock production. BID funds are available for credit for livestock production. These loans extend for 12 years with the first 3 years being without amortization. The interest is 60% per year plus 2% bank commission.

Where pastures have been maintained and properly managed livestock are in good condition and production is appropriate. Phosphorous and possibly lime will be essential to bring the depleted soils back to full production. In Tarapoto, it was reported that ENCI has an adequate stock of fertilizers on hand, but that the producers did not apply it because they do not know its benefits. There is no adequate research data on the benefits of applying fertilizer on pastures or on crops that can be grown rotationally to renovate pastures. The long absence of researchers and extension agents has had a major negative impact on the technical level of livestock production.

Without good pastures, livestock production is not viable. Natural feed in abundant supply can bring profitable results if the feed is available for the total year. The integration of good pastures, good infrastructure and capable management is essential for a successful and profitable livestock enterprise.

In summary, the principal reasons cattle production is not progressing or even holding stable are believed to be the following:

a. Pastures have been degraded through overgrazing, poor management and/or decline in soil fertility, and no fertilizers or rotational systems have been used to maintain their carrying capacity.

b. The technical information about what fertilizer to use, how to use them, and what economic benefits might be gained is not generally known.

c. Livestock production under present conditions is not economically viable.

d. The official sector takes no position that encourages livestock production.

e. Under present conditions, large investments for a long period of time are not favored especially with uncertainties concerning land tenancy.

f. Guaranteed prices for rice and favorable conditions for other crops tempt producers to shift to short-term crops.

g. Poultry and pork offer strong competition to beef in filling the demand for meat.

h. Producers do not have the most productive breeds of livestock on their farms.

i. The cost of credit is high, and long term loans are relatively unavailable.

Credit is a major constraint in opening up new jungle areas for livestock. The capital investments are substantial for land clearing, pasture establishment, the purchase of cattle and initial operations until cash flow begins. As beef cattle require about three years to reach maturity there is a natural tendency to use what credit is available for short-term crops like rice which can be harvested in 110 to 120 days from planting to maturity.

2. Processing and the Market

The market for beef and animal products in the Huallaga Valley is not well developed. Surveys indicate that cattle represent about 75% of the total value of livestock on farms. However, income from selling cattle products represents only 47% of the total value. In contrast poultry are only 3.2% of the total value of livestock on farms, but produce 25% of all livestock sales. Pork represents 17% of the value of livestock on farms produces 28% of the product at the market. Livestock and poultry together provide about one-third of the total value of agricultural production.

Price comparisons are difficult under inflationary conditions, but the official government report of prices at the farm for December 1984 were: Beef - 7800 soles/kg, pork 7000 soles/kg, broilers 6000 soles/kg, eggs 3000 soles/kg and milk 1200 soles/litro.

The Ganadera Amazonas, which operates fairly large cattle ranches, also sells breeding stock and serves as a source of high-grade breeding stock to upgrade cattle herds. In February 1985 it sold 24-month old heifers for S/.2,600,000 (US$400) and 24-month old bulls for S/.3,000,000 (US$460). In comparison its 18-month old steers sold for S/.1,800,000 (US$280). They sold 400 head at this sale. In Brazil current price for a 2-year old pure Nelore breed bulls is U.S. $1,200; bulls of high cross of the same race and age sell for $1,000 each and heifers of 2 to 2 1/2 years old sell for $600 each.

In the Upper Huallaga Valley, very few slaughtering, or refrigeration facilities are available. Also, no centers of concentration for further animal distribution are available. Small slaughtering plants are needed for the local market. Slaughter may be limited to certain days and the distribution keyed to these days. Investments required would be small, and private investors will most likely step in with some encouragement. Larger efficient slaughtering plants will come in a second phase when production expansion is more certain.

In the Tarapoto area, beef production and slaughtering facilities point toward future growth. The firm EMCOPESA is one of 5 slaughtering plants, three of which have cold storage. Each has its own unique function. This firm ships all meat produced to Lima by airplane, ranging from 5 to 7 tons per day of slaughtering. The other firms sell mostly on the local market.

EMCOPESA is a combined public and private operation. The average daily kill is 23 head which may be at or near a minimal break-even point. It has a slaughtering capacity of 70 to 90 head per day. Hence, a current production figure of well below capacity is of major concern. Its cooling capacity is for 80 carcasses, and shipments out must be closely aligned with the slaughtering. Shipments by commercial airlines depend upon the

space available from day to day. The carcasses are quartered and packed in boxes and chilled. They are moved directly to the airport which is near to the packing plant and are transported without refrigeration but arrives in good condition. The meat goes directly to agents and wholesalers who merchandise to retailers, restaurants, and hotels.

An on-the-spot survey of prices in February 1985 showed the following relationships between prices of different types of meat:

Table VI.F-1. Producer and Market Prices for Meat

	Beef		Pork		Poultry	
	Producer	Market	Producer	Market	Producer	Market
Tingo Maria	5,000	13,000	10,000	14,000	9,000	12,000
Tarapoto	7,000	13,000	8,000	13,000	7,000	10,000
Pucallpa	8,000	16,000	9,000	15,000	11,000	14,000

At the end of 1984, the two largest slaughtering plants showed the following number of head slaughtered and the tonnage produced:

Table VI.F-2. Slaughter by Two Packing Houses, Tarapoto - 1984.

	No. Bulls	M. T.	No. Cows	M. T.	Cows & Bulls	M. T.
EMCOPESA	2,574	379.39	2,504	352.20	5,078	731.59
Camal Municipal	2,536	299.43	1,964	264.53	4,500	563.96
Total General	5,110	678.82	4,468	61.673	9,578	1295.55

Beef producers were receiving about 5,000 soles per kg and the consumers are paying 9,000 soles(Nov. 1984). Cost of air freight is slightly less than 1,000 soles per kilo. This leaves 3,000 soles for the intermediaries including retailers.

A typical arrangement is for intermediaries to buy direct from livestock sellers, then pay about 130 soles/kg for custom

killing and shipping to their own refrigerated houses in Lima for retail distribution. The dealer thus retains ownership throughout the market channels. Some air shipments go to Iquitos under the same basic arrangements. Air shipment costs about the same to Iquitos as Lima.

Vertical integration is found with the packing plant, feed-lot fattening and formula-feed processing all within one firm. This is a form of agro-industry with a built-in efficiency potential. EMCOPESA has two beef cattle feed lots. One had 350 animals in the fattening lots and the other a much smaller number. The animals are fed for 2 to 3 months and they gain about 3 lbs. a day which is exceptionally good. One feed lot has a capacity of 800 head, and the other three or four other private feed yards also have excess capacity.

Beef coming into the market from feed yards goes to a special trade-restaurants, and hotels. It sells for S/.13,000/kg in contrast to S/.9,000/kg for non-fattened beef. Operators of the feed yards are convinced that the yards are profitable, but complain of the inability to obtain an adequate supple of cattle, either for fattening or for slaughtering.

Various feed rations are used. Two examples are listed:

Table VI.F-3. Feed rations used in cattle feeding.

Ratio for fattening	Percent	Ration for slaughter	Percent
Fish meal	4	Fish meal	3
Cotton seed meal	4	Cotton seed meal	4
Corn	35	Corn	12
Rice millings	35	Rice millings	34
Gallinazo	4	Gallinazo	12.5
Urea	17	Coronta	18
Sugar cane	1	Sugar cane	16
Trace minerals		Urea	0.5

Only the fish meal, urea and trace minerals are imported from the coastal area. Animals consume 12 to 13 kg per day and gain 1.2 kg/day (a conversion factor of 10 to 1).

The market for beef as is that for poultry and pork is almost entirely within the producing region. With the exception of the approximately 5 tons per work day (probably less) that is shipped by air to Lima, the supplies of beef are consumed in the region. The market potential within the region is favorable because the per capita consumption of beef is low, population is growing at a rate above that of the national average and per capita incomes are projected to increase. The internal regional market gives local producers a comparative advantage over producers from other areas because of the freight differential.

Production should be increased at least to meet this local demand even though circumstances are not strongly in favor of major output expansion until the economic disadvantages and the pasture technology change in favor of cattle production.

3. Recommendations

Pasture is one of the least used resources in the entire Huallaga Valley. Beef cattle production has suffered a serious decline because of economic incentives not comparable with alternatives, and the need for quick turn over of credit. The medium-term credit which is required for livestock production is not adequate.

A longer perspective makes livestock production a meaningful activity in the region. Seldom can land with crop producing capacity be used economically for pasture. Land that is marginal for crops or land useful only for pasture should serve as the basis for livestock production.

A major thrust to expand the commercial production of livestock production like the one currently successful in selected other countries, cannot be justified at this time. The Upper and Central Huallaga areas do not lend themselves to large cattle ranching type operations. The fact that the land has been allocated in small parcels, the great variation in the quality of land for pasture in each area, and the traditional production capacities of the farmers in the areas all are variables that are not favorable to commercial cattle operations.

However, there are certain areas of the jungle that do lend themselves to commercial cattle production. The valleys of Bajo Huallaga, del Marañon, del Ucayali and the areas of Pichis Palcazú, Pachitea and others have adequate land areas where livestock have not really yet been established. Also in the Yurimaguas and further down and in the Pucallpa, Campo Verde, Turnavista and Aguaytia on the route from Tingo Maria to Pucallpa, there are good pasture areas with appropriate topography, good water and relatively fertile soils if properly managed.

Some of these areas might be selected, organized and developed into large-scale cattle production which permits economies of scale, good management and special marketing arrangements. The many other areas that have a cattle production potential but are without the size potential, might well be developed as economic incentives merit such development, but a major development thrust is not proposed as a priority project at this time.

The organization, Ganadera Amazonas, a public sponsored promotional agency, has had valuable experience in the type of cattle production suggested for the selected areas. Their experience, expertise, and funding make that agency the logical basic institution to implement cattle production expansion. The

agro-industry activities can be implemented through existing organizations in the area that are not being fully utilized under the present depressed production situation.

The idea of developing the dual purpose line of cattle for meat and milk along the more populated areas of the valley and on the small farms has some merit. The development of the meat and milk type of cattle is consistent with the projection of population and income growth as well as the changes in consumption preferences that will increase the demand for milk and milk products as well as beef.

Certain requirements are basic to livestock production in the Huallaga valley. The following list highlights some of these:

a. Clearly identify and establish a national policy favorable to livestock production.

b. Establish a stable position relative to land tenure.

c. Improve roads, both the main and tributary, in order that marketing of cattle can be more efficiently carried out.

d. Emphasize the key role played by the zebu breed and appropriate breed crosses.

e. Improve access to intermediate credit for cattle expansion at rational interest rates.

f. Provide supervision for those taking out credit until the producer has proven the ability to use credit wisely to increase his production.

g. Provide needed research and extension services to improve pastures, stimulate use of needed fertilizers and improve the management capacity of the stockmen.

4. Strategy Statement

An educational program on a continued basis is required to better take advantage of pasture and livestock technologies. The experiment station research has made a good start, but needs additional personnel and financial support for pasture research and animal nutrition studies.

The provision of medium "term credit" is essential and should be given high priority. Strategy calls for the maximum utilization of the slaughtering facilities now in place before new facilities are provided. The slaughter plant in Tarapoto is operating at only 1/3 of capacity. On a longer term strategy, the construction of a medium-sized slaughtering plant with de-boning and vacuum packing capabilities should be considered. This would reduce airline transportation costs. Such a plant could salvage the by-products and thereby improve efficiency in processing.

A strategy for beef production in the Huallaga valley should be continue and expand research and extension efforts to improve pastures and expand the adoption of animal science technologies. With the proposed availability of lime, a renewed effort should be made to determine the economic payoff relationship between lime inputs and beef output. Another requirement is more economic analysis of the integration of livestock production into a farming system of diversification and small units. Of course, the strength of large scale cattle operations should be identified. Rational capital utilization and economic use of credit is information urgently needed by all who contemplate expanding cattle operations.

A policy that provides credit for the intermediate time period will do much to stimulate production. This type of policy must be accompanied with economic analyses that demonstrate the economies and consequences of such policy.

A modest credit program is proposed to accommodate those ready to improve pastures and obtain breeding stock. The following is suggested for the areas of small farmers who might operate dual purpose cattle on small units:

Table VI.F-4. Credit Proposal for Pasture Improvement and Investment in Cattle.

	YEAR 1	2	3	4	5
1st. Group of 100 farmers with 500 ha.*	300,000	25,000	25,000		
2nd. Group of 100 farmers with 500 ha.		300,000	25,000	25,000	
3rd. Group of 100 farmers with 500 ha.			300,000	25,000	25,000
Total	300,000	325,000	350,000	50,000	25,000

Total for 5 years : $ 1,050,000

* Each farmer would invest $ 100/ha. in pasture improvement in year 1 and $ 50 for each of year 2 and 3. An average of 5 ha. per farmer. He would invest $ 500/ha. in breeding stock in year 1. Each farmer would borrow $700/ha or $3500 total with 300 farmers participating a sum of $ 1,050,000 line of credit for 5 years is required.

G. POULTRY PRODUCTION AND PROCESSING

1. Production

The available production statistics from PEAH reports that in the Upper Huallaga region, total of 300,627 birds were produced under the extensive system. In addition, 532,904 birds were produced for meat and 61,707 birds were kept for egg production under the intensive system, making a total production in their area of influence of 283 MT of eggs and 954 MT of meat produced in 1983.

In San Martin Department the number of birds in 1981 was 329,176. In 1983 there were 38 broiler producers with 831,220 birds and 16 egg producers with 627,800 birds and over 70 million eggs produced. An important observation is that poultry on farms represented only 3.2% of the value of all livestock on farms, but that small percentage accounted for 25.6% of the value of production of livestock products. One broiler producer had a combined capacity of 100,000 birds per month.

Poultry production has been expanding rapidly in the Central and Alto Huallaga. Opinions of producers in the area are that their production is about equal to the internal amount demanded for both eggs and meat birds at present prices. The Upper Huallaga requires some inshipments to meet their consumption requirements in the Tingo Maria area.

The key to a successful poultry industry is vertical integration, good management, and utilization of the best technology. Feed costs usually represent 60% or more of the cost of production, therefore, cheap corn, soybean meal and other essential ingredients are vital to the long-term success of poultry enterprises. The use of modern hybrid chicks is also a key part of most efficient and profitable poultry enterprises.

The hatching, feed processing, controlled feeding, flow of capital, slaughter and dressing, movement to market and final sales all should be integrated into a smooth flowing system that reduces frictions and lags. This vertical integration permits economies of aggregation, coordinated flows, reduction of costs, reduction or risk, maximum facility use, reduced pricing points and maximum coordination of all activities.

The poultry industry is a meaningful market outlet for corn, rice by-products and other feed ingredients produced in the area. An advantage should be obtained from using these locally-produced feeds instead of shipping products out and hauling back manufactured feeds.

Tarapoto area has all the necessary elements to permit solid growth of the poultry industry. Provided there is adequate ventilation, the climate should not be a major limiting factor. The production of corn and the anticipated production of soybeans on an efficient basis should be major positive factors for the continued profitable growth of the poultry industry as long as there is continuing improvement in the transportation system in order to expand the potential marketing area for the poultry products.

2. Market

The marketing system for chicken is relatively simple in the Huallaga area. Most of the birds are sold alive for local consumption. Small producers use a pick-up or truck to deliver a load of chicken to the busy center of the town and sell them direct to consumers from the back of the vehicle. Usually a portable scale is used to weigh the birds. Price is a function of the supply and demand interplay, but with wide differences at any one time or from place to place and from time to time. Buyers have limited opportunity to seek out the best buy.

Sellers likewise do not consider alternative outlets. The quality of the birds does not enter into the price except as it is registered in the weight differences.

The larger producers have more sophisticated marketing methods. They establish clients among the restaurants and also sell to intermediaries who merchandise to the trade. One large producer for the area with a 5,500 chicken capacity kills and dresses 400 chickens a day and sells locally. Selling birds dressed is one step further in the marketing process. A trend in the preference for dressed birds is becoming apparent. This will require an expansion in this agro-industry activity. This producer reported selling birds weighing 2 kg for 7,000 soles/kg. The feed costs were reported to be 900 soles per kg of feed. He mixes his own feed (Nov. 1984).

An other poultry man sells eggs in a relatively large volume. He has a laying-hen capacity of 24,000 birds, but was feeding only 18,000 at the time of interview. He, too, mixes his own feed. He uses soybean meal purchased from an agent who imports it from Bolivia. His fish meal comes from the coast as does the urea. Local corn is the main ingredient in his feed mixture. His market is 100% local, and he meets the consumers' requirements most of the time. At Christmas time the amount demanded exceeds his ability to supply, but at other times he has a surplus to worry about. He sells directly to wholesalers, who presently are paying 236 soles per egg. He has no refrigeration storage so he must make deliveries daily. These two producers reported that the poultry business in the Tarapoto area is a very good business, but indicated that output expansion might easily create a surplus problem requiring them to seek a market outside of the area.

3. Processing

Agro-industry opportunities related to the poultry industry includes the processing of chicken for the dressed chicken trade. About 80% of the chickens sold are live. Formula feed mixing is tied closely to the chicken industry, and the success of one should reflect on the success of the other.

Cold storage facilities are needed to permit a smoother product flow to consumers. Although 15 cold storage facilities are reported to exist in Tarapoto, the poultry producers did not seem to have access to them. In addition to the growth of the poultry industry, the development of hatcheries in the Huallaga areas, should also be pursued in order to achieve a reduction in the transport of baby chicks from outside the area.

4. Market Demand

Poultry consumption will grow as population grows and as incomes rise. The annual growth rate of poultry consumption in developing countries is more than three times the rest of the world,--7 percent compared with 2%.. Predictions have placed the growth per capita of poultry meat production at 100% in Brazil for the 1980-85 period, 37% in Mexico, 25% in Argentina and 15% in India. According to a recent report, the demand for eggs shows a similar growth prospect. From 1980 to 2000 demand for eggs will grow by 390% in the OPEC countries, 255% in Asian countries, 65% in Eastern Europe and 40% in Japan. The reason given for this growth is that chickens convert feed more efficiently than other livestock--about 2.2 kg of feed yields 1 kg of live broiler. For swine the range is 5 to 6 kg of feed per 1 kg of live weight. With beef cattle range is 8 or 9 kg of feed per kg of live weight gain. This of course varies with the age of the animals, the efficiency of the feeds, and the effectiveness of the ration being fed.

5. Cold Storage Facilities

The development of almost every sector of agriculture and agro-industry has close association with other sectors. It is difficult to find a development activity that does not affect others to some extent. The poultry sector is a good example because of the integrated associations between poultry production, the processed feed industry, hatcheries, poultry processing for the dressed trade, egg and meat markets, and cold storage facilities.

The inadequacy of cold storage facilities becomes of major importance as the trade demands dressed poultry which in turn requires a chilling facility as well as cold storage to equate the flows of supplies to the flows of demand. With variable supply volumes of eggs, and the urgency of product quality, cold storage for eggs is essential for a mature marketing structure.

Cold storage performs several functions in a mature market structure. Some of these functions are preservation of quality, matching a variable supply flow to a constant or different demand flow, storage of perishables for volume processing, serving as a basis for credit collateral and as a means for holding a stock for a price advantage. The costs of storage per unit of time must not exceed the benefits from one or more of these functions. A feasibility study must identify these costs and benefits before arriving at a recommendation.

As mentioned earlier, there reportedly are 15 different cold storage facilities in the Tarapoto area. None were identified in the Tingo Maria area. Cold storage facilities have been built for specific needs by private firms and reportedly no public facilities are available for a storage fee. The meat packing houses can hardly operate without a chilling facility if they are

to ship to Lima or Iquitos. The poultry producers indicated that they needed cold storage badly for eggs and dressed poultry. The trend toward sales of dressed poultry should be accompanied by slushed ice-type chilling facilities immediately after slaughter. Cold storage to hold the birds as well as refrigerated trucks or ice to be used during transportation to the markets are needed.

Cold storage facilities are an absolute requirement for the poultry industry. It is more efficient to store dressed birds for a day rather than it is to feed a bird one day beyond the optimum time for slaughter. It is not efficient to use cold storage as part of the daily marketing system if sold locally. A bird will not lose quality if sold within 24 hours of the time dressed, but the cold storage would be required to handle the irregular flow of the product to market. A glut or over supply needs to be smoothed out to meet the rather constant demand. If dressed poultry is to be marketed out of the immediate market then cold storage is essential. A bird can be held from 5 to 8 days and beef two weeks. The variation is related to the size of each meat portion, how thoroughly it is chilled, sanitation and other conditions.

An appropriate cold storage arrangement includes three structures (cameras), one to receive the warm meat, the freezing or chilling tunnel and third a storage facility for the chilled or frozen products. The freezing unit costs 5 times as much as just a storage space. A freezing unit costs much more for power than just a chilling unit. A 20 hp unit is capable of holding at 20° C, 200 tons/day, while a 40 hp unit is required to bring down to -30°C 8 tons/day shift.

Engineering services are available in Lima for the planning and specification of requirements to build whatever freezing or cooling functions are required. However, the refrigeration units should be imported.

On the Coast, the poultry industry does not normally use chilling facilities for their normal marketing of dressed poultry. The Lima market will absorb its supply as quickly as it is produced. However, when a glut comes on the market, and this occurs from time to time, the sellers then rent commercial storage space for freezing and storage until they can move the supply onto the market. The trade prefers non-frozen products. If birds are chilled or frozen then there must be refrigerated trucks available to move the produce to its final buyer.

Currently Peru is exporting poultry to Russia in frozen form. Brazil has made a major push with frozen poultry into the Middle East and African markets. Poultry producers who want to participate in this trade are obliged to have access to cold storage facilities.

6. Recommendations

Poultry processing facilities, cold storage, and formula feed manufacturing are the three activities most closely associated with a growing viable poultry industry in the Huallaga Valley. The growth is expected to be in a greater number of birds to keep up with population and income-instigated growth. Growth will bring a shift from the extensive to the intensive system of production. Also, a shift to the sale of dressed birds, refrigerated eggs and meat and to formula feed rations is occurring. Poultry in the area is not expected to compete effectively in the short run with the large poultry producers near the Lima market The first phase will be to meet the internal regional requirements. As the road system improves and the local industry becomes more efficient it should be able to compete in the frozen bird market.

The poultry industry is growing by means of private sector investments. It is anticipated that it will continue basically as a private sector activity and will instigate the additional components mentioned previously without direct public sector involvement.

Research work at experiment stations can contribute toward helping solve special problems of the area, and extension agents can furnish the private operators with required information about production and marketing problems. Therefore this important economic activity will be serviced by means of the research and extension capacities more than any direct public investment or promotional program.

The major constraint to the appropriate construction of cold storage facilities in the Huallaga valley is the capital for installation. Costs of operation are expected to be adequately covered by the short-term benefits as the facilities are used. Adequate source of energy has been suggested as a constraint and it may well be a real concern. However, the expansion of electric lines in the valley and the alternative sources of energy might make this constraint less important.

It is recommended that the private trade be encouraged to expand cold-storage facilities. This encouragement might be best manifest through a line of credit made available for this purpose. Subsidized credit may not be required and is not herein recommended but a medium term credit is essential in appropriate amounts to precipitate investments. Each cold storage facility will need to be adapted to the special need of the business for which it is constructed. Generalizations as to size, characteristics and costs are of little value, but specific costs and attributes associated with the needs for a particular use would be useful.

A short-term advisor with experience in construction and utilization of cold storage facilities can perform a needed service to the poultry industry as they branch out into dressed or frozen poultry processing. The advisor will be helpful in consulting with credit agencies if they are to provide credit for the purpose of constructing storage houses. A recent reference for cost budgeting is attached as Table VI.G-1.

Table VI.G-1. Costs and specifications for cold storage facilities.

Ref: Construction cold storage with compressors StanTufts:as of Jan. 1985 current cost construction in California

60 x 80 ft x 25 high room
concrete tile-up building
outside wall 6" concrete
followed by 4" insulation
followed by 3" concrete
Slabs poured on 6" slabs with Ruffer
on 18" centers on floor.

(1) If used as storage only, no capacity to pull down fruit temp. - maintaining temp. not lowering pre cooled and then placed in storage. Allied R-22 system (refrigeration type):

96,000 cu ft
60 tons refrig. using R-22
cost/cu ft $2,47 , $240,000±

If using same room to reduce fruit temp. and then store:

cost increased $ 30,000
cost/cu ft $2.80
140 tons (measure of refrigerant capacity)
refrigeration R-22 $270,000

Just room itself - $ 35.00 sq. ft - no doors

no refrigeration
cost/cu ft $1.70

Could put up metal building and spray w/insulation for $10.00 sq. ft, but insulation is costly and hard to find people to do it. Concrete is most economical.

Instead of freon ($2.00/lb) you could use ammonia (liquor) more efficient and cheaper for large installation - cost might drop - 10-15¢ cu ft.

H. FORMULA FEED PROCESSING

The development of formula-feed processing activities must be closely in conjunction with poultry, swine and dairy production. On the other hand, if attention is turned to increasing production livestock, interest in processed feeds become relevant. In developing countries additional animal protein is needed to upgrade the quality of the people's diet. Through additional quantities of meat, milk, and eggs, this can be accomplished. Formula feeds can contribute to this objective. However, there are some basic considerations regarding formula feeds which should be noted.

1. Formula Feed Considerations

a. A formula feed for animals must emphasize both proper nutrition and economics. A balanced feed must have the right combination of protein, energy, calcium, phosphorus and other minerals and vitamins, but at the least cost. By-products from food processing often becomes a source for the most economic ingredients. The following data suggests the great importance of processing by-products for selected products.

Table VI.H-1. By-product feed as percent of original crop weight.

By-products		Percentage
Cottonseed	- cottonseed meal	47
Corn	- corn bran	10
Corn	- corn germ meal	19
Rice	- rice bran	10
Soybeans	- soybean meal	78
Sugarcane	- molasses	3
Cacao beans	- cacao shell meal	11
Oil palm kernel	- palm kernel meal	22

b. Animals must be bred for high productive potential. Low-grade livestock will not respond to a balanced

ration as economically as those bred to give the best response. Marketing of the processed feed must be efficient or the skills of the nutritionist will be lost in the marketing process.

c. A significant share of the feed ingredients must be indigenous to the area of feed preparation and feeding. Trace minerals and some share of the ration might be drawn from a distant source, but for economic operations the main source of energy and protein for the feed must be nearby.

d. We propose a direct marketing system or better still, an integrated arrangement where the feed is prepared and utilized by the same management. It is possible to achieve the ideal of synchronizing supplies with need and adapting the feed to meet specific needs. A great variety of rations are possible and economies come from adjusting the ration to make best use of available raw materials with minimum marketing and handling costs.

e. Government regulations can facilitate or hinder the processed feed business. Raw material pricing by the government may help or hinder. Quality control and truth in promotion requirements are relevant.

f. The feed-processing industry lends itself naturally to an integrated system which includes, milk and egg production. Financing, buying, selling, production, and all aspects of the industry are interwoven in a way that can yield benefits to all participants, if this coordination is carefully worked out. Contracts, agreements, joint ventures, partnerships, total ownership, and market arrangements all become a part of a formula feed processing/livestock complex/that can be successful.

The Huallaga River area has a number of elements conducive to the expansion of formula feed processing. There is a good

supply of corn, rice mill by-products, some cottonseed, a potential for soybean production, and by-products are expected from the cacao processing plant. The palm oil kernel most likely will probably be processed outside the area. Urea, trace minerals, fishmeal and vitamins will be imported into the area, but these ingredients are high value per weight products.

Some imports of balanced feeds into the area, including corn that had previously been shipped out, should face direct competition from balanced feeds that are produced within the area. Not only the cost of shipping out corn, but the cost of shipping in the finished feed can be saved by internal producers of feed, providing they can operate efficiently.

An efficient system is for the feed user to process the feed at the site where it is used. This is now being done in the Tarapoto area. Most of the formula feeds are being produced by the poultry producers and cattle feeders in the area. A proposal to expand the feed processing in the area is not expected to change this relationship.

One adequate source of protein supplement is not now available. One processor was importing soybean meal from Bolivia, an arrangement that is not clearly understood. Soybean production in the area has been attempted but almost completely abandoned. One explanation was that an oil-processing facility is not available. The establishment of facilities to handle the oil may be prompted by a strong demand for the soybean meal in the area of production. It is difficult to find a source of protein for animal feed that is competitive with soybeans, as has been found in many other countries where meat production is expanding.

At the present time poultry creates the major demand for formula feeds in the Huallaga Valley. Poultry products are in

great favor among consumers, both for eggs and meat. Although the production approximates the amount consumers will buy at the present prices in Tarapoto, it is expected to grow as population grows and incomes rise. Therefore, the demand for formula feeds will probably also expand at a faster rate because there are still a lot of poultry producers who use the extensive system and do not fully utilize manufactured feeds.

In Tingo Maria a small feed mill is operating in Tingo Maria which produces three to five tons per hour of poultry feed. Many stores carry manufactured feeds shipped in from the coast. The volume handled is small. Of the 38 intensified poultry enterprises in Huallaga Central, ten report mixing their own feed. Two of these firms not only mix their own feed,, but also sell the mix on the open market. In 1984 the Banco Industrial reported financing an independent feed mill for producing animal feed in the Tarapoto area.

Pork is a favored meat in the study area and is usually priced above beef and chicken. Even though the experiment stations demonstrate the best breeds and best management, farmers have not adopted their recommendations and have not managed to increase production. Production is still widely scattered and mostly for home consumption. Formula feed production in the area may facilitate increased pork production, but this study has not gained sufficiently reliable information to support this opinion. Another opinion is that the pork industry will develop around the corn farms in a pattern similar to the Midwest in the USA. In any event, there would appear to be agribusiness opportunities for developing improved feed for swine and for greater commercialization in selling hybrid or improved breeds of swine.

Milk production will be treated in a separate chapter, but the relationship of milk production and formula feeds is close. There is a limit to the intake of grass by the animal, and the protein content of the grass is usually below the optimum thus there is a ceiling on the productive capability of the animal. To move milk production to a higher plane, there must be a higher intake of feed that is properly balanced with the correct amounts of proteins, energy, and minerals. The amount of formula feed sold to the dairy industry thus becomes an economic decision related to the price of milk, the price of the feed supplements, and the productive capacity of the animals assuming that the energy or roughage will be from improved pastures. Considering the current price of milk and the status of the dairy industry in the Huallaga Valley, it is anticipated that the use of formula feeds by the dairy industry will be limited for the near future to small amounts of high protein supplements.

2. Recommendations

The preparation of formula feeds in the valley is making notable progress. It is, and will be a major outlet for the by-products of cotton, rice, cacao processing, and corn produced in the area. This is taking place through private investment for the most part but not exclusively. It is paralleled by the growth of the poultry industry and that has been done through the private sector. It is recommended that no major input of the public sector be called for at this time other than to support the industry with research and extension efforts. The private investment sector should have all the possible encouragement to bring formula feed processing up to a more appropriate balance with poultry needs and then be prepared to make the investments required to continue a growth dictated mostly by population growth and improved incomes as impacted on the demand for meat and eggs. The increased use of formula feeds in the swine and dairy industries is expected to follow the lead established by the poultry industry.

I. SWINE

1. Production

The 1984 preliminary production statistics shows pork producing more total metric tons of meat than any other type of livestock. This was the case in both Huánuco and San Martin Departments. In both departments total production was down from the 1982 figures as shown in Table VI.I-1.

Table VI.I-1. Livestock and poultry production in Huánuco and San Martin Departments 1982 and 1984.

	Huánuco		San Martin	
	1982 (MT)	1984 (MT)	1982 (MT)	1984 (MT)
Poultry	3781	2815	2022	1943
Sheep	289	266	6	0
Pork	3192	2883	3355	2839
Cattle	2100	2290	2460	2478

Source: Oficina Sectorial de Estadística-Ministerio de Agricultura 1984 Data is preliminary.

Pork production increased at a rapid rate from 1981 to 1983 in both areas, and the 1984 decline was not typical. The production has been mostly on small farms under the extensive system of production. In the PEAH area of influence the total number of head under each system is shown in Table VI.I-2.

Table VI.I-2. PEAH area pork production under extensive and intensive systems.

Systems	Year	Number of head
Extensive system	1981	6,904
	1982	17,038
	1983	25,391
Intensive system	1981	2,852
	1982	2,762
	1983	2,194

In the PEAH area, total tons of pork produced increased from 39 TM in 1981 to 112 MT in 1983. Slaughter in Tarapoto in 1983 was 5,920 head for a total weight of 283,000 kg.

Substantial improvements can be made in the back-yard free range swine production system. Profit from pig production under these conditions is limited by (1) high mortality among young pigs, (2) poor feeding practices, (3) parasites, and (4) diseases. Research has shown a 100% increase in productivity from low capital and labor inputs. This includes reduced mortality, some improvement in feeding, and reasonable access and use of vaccines and antiparasite drugs.

Experiment station research is demonstrating high quality hog production, using the best breeds, high level technology in production, and good management. The breeds recommended include Yorkshire, Landrace, Duroc, and Hampshire. A fairly large number of experiments made with pigs at UNAS and Tulumayo (17) have shown the successful use of 10% dried cocoa pods as a source of energy, of 10% dried tropical kudzu as a source of protein, and the use of up to 100% casava meal as a replacement for corn in swine rations. In related parasitological studies, 200 pigs were examined at the time of slaughter. The incidence of internal parasites was as follows: large roundworm 16%, kidney worms 80%, nodular worms 81%, lungworms 54% and threadworms 66%.

A fairly simple swine feeding system is being recommended by the researchers. Under this system, most pigs, from young animals weighing 20 kg to adult swine, are daily fed one kg of concentrate designed to meet the protein, vitamin, and mineral requirement. The remainder of the nutritional requirements, primarily energy, are met from whatever tropical feedstuffs, by-products and forages are available. These do not have to be dried, ground or mixed. They are fed freely just as they are. For example, dried cocoa pod meal is a useful feed with its 12.6%

moisture content, 8% protein, 3.3% fat and 33.5% NFE, but does contain about 35% fiber and 7.6% ash.

Even though the experiment stations and the universities have been demonstrating modern technology in swine production, a sizable increase in commercial swine production has not occurred. Production is still based on small farms with family consumption as the main purpose. An excellent opportunity exists for innovators engaging in medium scale commercial hog production to take advantage of the surplus corn and rice by-products in the area. The continued advent of the manufactured feed business in the area should result in a better integration with the hog feeding business in the near future.

2. Market

The market for pork is mostly on the production farms. The supply of commercially slaughtered hogs is sold in the immediate area. Reports show no pork moving in or out of the Huallaga area, except for small volumes or live animals on occasions but not on a sustained basis. Peru has a strong demand for pork and the prices are often higher than beef prices. Prices to farmers in the Upper Huallaga zone average the same as beef with insignificant variations from year to year. Poultry meat prices average 25% above pork prices in the country. This did not hold true in Lima where pork prices exceeded poultry prices.

Market problems for pork are similar to those for beef. Key market constraints are: limited volumes for efficient handling, inadequate cold storage facilities, limited slaughtering facilities, no large volume retail or wholesale outlets in the production areas; and high cost transportation to the markets outside of the production areas. Statistics show insignificant quantities of pork being imported and none being exported from Peru. The population growth and hoped for improvements in

consumer incomes should bring a growing consumer demand for pork, not only in the Huallaga producing region but also in the total country.

3. Processing

Beef slaughtering plants often provide a hog killing service as well, but volumes are small. Slaughter facilities are not the main constraint to increased commercial hog production. Their capacity is greater than the demand for those services. If swine production should expand or if production were to change to the intensive system, it is likely that there would develop more on-farm small slaughter facilities. This is not a recommended step, but it is a typical development. The existing slaughtering plants might expand their services to the swine trade through more aggressive promotion of their business among hog producers. The integrated arrangement found among the cattle producers, dry lot feeding, and slaughter as well as feed mixing may be a way to prompt an increase in commercial hog feeding in the area.

4. Recommendations

The transition from extensive pork production to the specialized intensive system is expected to occur over a reasonably long time period. The factors that will speed up this economic process include a favorable supply of feed grains and high protein formula feeds, expanded distribution of the lean type hogs in the area, expanded market demand from population because of income growth, and the transportation cost reduction from improved roads.

It is premature to recommend specialized hog slaughtering facilities in the Huallaga river area until the processing facilities now in the area are using their hog killing floor capacity more efficiently. Within a few years, specialized hog

feeding under the intensive system, specialized hog slaughtering processors, and entrance into the Lima market are predicted. The opportunities for profitable private investments will increase.

J. MILK PRODUCTION AND PROCESSING

1. Production

Production and consumption of dairy products in the Huallaga Valleys are unusually low. The cause-and-effect relationship is debated with some observers claiming that the population will not consume milk because of cultural factors. Others claim that consumption is low because production is low and that if supplies were available consumption would rise to fully utilize the production.

Milk production and an elaborate processing and distribution system are characteristics of most developed countries. The nutritional merits of milk for babies and youth has resulted in high priority for milk products. It is granted however, that the absence of refrigeration and sanitary methods for handling and distributing milk has made milk an unlikely item for specialized production and trade. It is surprising that more milk from cows or goats is not produced for home consumption. However, some of the reasons for this are that tropical regions with high temperatures favor bacterial activity and spoilage rates are high, combined with the lack of refrigeration.

Economic development as well as nutritional education regarding the benefits of milk for growing children can result in expanded production of dairy cattle. Improved methods of handling milk, more refrigeration, low-cost methods of cooling milk, and prompt delivery to consumers are all feasible. Whatever can be done to encourage the dairy industry should receive the support of a significant share of the consuming public.

The first requirement for the dairy industry is to shift to a breed that will adapt to the area. The Brown Swiss-Zebu cross

has already been introduced and demonstration herds are looking good. The breeding program increases the ratio of Brown Swiss blood to Zebu to improve milk production, but still retain the Zebu disease resistance and environmental adaptability. Holstein crossing with Zebu also was observed and good results are reported. Improved pasture technology and formula feed production for daily cattle supplements are both essential to the dairy industry.

There are dairy herds in the Tarapoto area. Among these are Juan Guerra - 49 lactating cows producing 10,550 liters/month. Cunumbre area - 21 dairymen producing 9,960 liters/month. Ganadera Amazonas at Bellavista - 4,200 head of cattle (primarily dairy type) averaging over 6 liters/day. This operation produces cheese because it is too distant to market for fresh milk.

The Escuela Superior de Nor Oriental de la Selva is demonstrating a high level of technical pasture and dairy cattle management. They rotate pasture use, have high quality cattle, and produce 9 liters of milk per cow per day (the national average is 3.2 liters). They reported production costs of S/.700/liter and a consumer's sale price of S/.1000 to 1200/liter (this cost estimate may not be completely comparable because of certain inputs that are not costed out at their experiment unit). The milk produced was all consumed by the school community. The director of the school is of the opinion that milk consumption would increase greatly if it were available. He discounts the notion that people in the area will not drink milk if it is handled properly.

2. Processing and the Market

The cooperative milk processing plant under construction near Tarapoto-Lacteos Selva will be completed within a year and will have a capacity that is above the present supply of milk.

It is hoped that additional local production within two or three years will permit operations to capacity. This plant is designed to pasteurize, homogenize and package milk for fresh milk consumers. Production of cheese or other dairy products are not in its immediate plans. According to the promoters of Lacteos Selva, about 4,500 liters per day of milk are currently available for processing. The plant will have a rated capacity of 14,000 liters per 8 hour shift. By installing refrigeration facilities in two outlying areas reducing its gathering costs, Lacteos Selva hopes to reach a break-even level of processing at about 8,000 liters. Even though this plant appears to be over-built, it could greatly facilitate the marketing of fresh milk in the area and extend shelf life by pasteurization.

The processing plant is a step toward a dairy products industry, but a marketing structure must develop at the same time. A required market structure will include a system for cooling milk on the farm, a milk delivery system to provide a constant supply for the processor, and a distribution mechanism for the processed milk. On-farm milk coolers are functioning in areas not served by electricity in other countries with an investment of about $1,000 to construct bio-gas digestors that produce methane gas to power refrigeration units. It makes it possible to deliver milk to the processor once each day rather than twice. Savings in transportation costs make this an economical investment for many farmers distant from the plant. A sharing of the transportation costs by means of a jointly financed pick-up truck is an alternative frequently used.

Quality preservation during delivery to consumers is difficult when refrigeration is scarce. A trend will be established for more cooling facilities as time goes by.

Along with milk for fresh consumption, the production of cheese, yogurt, ice cream, and soft cheeses should be a realistic

parallel growth. The production of a sterilized milk product that has a long shelf life is another possibility, but more information is needed before a commercial investment can be recommended. The use of such a product in other countries is increasing and the proposed pilot project for UNAS in Tingo Maria will be helpful in evaluating its commercial potential.

3. Demand

Peru imports about one-third of the milk products it consumes. Even the processors who make evaporated milk find that it is cheaper to import dry milk and butterfat and reconstitute it for the manufacture of their product.

Leche Gloria in Arequipa has an elaborate fresh milk collection scheme that includes 7,800 farmers. But they complain of the high cost for procurement. In the Huallaga Valley it is likely that the collection costs as well as production costs would be less attractive because of the need for additional transportation infrastructure.

Cheese producers report that foreign cheese is dumped on the Peru market on a subsidized basis, making it difficult to compete. Cheese producers also complain of inadequate working capital to finance inventories, inadequate cold storage capacity, and low production. The quality of some Peru cheese is reported by some consumers to be inferior to imported cheese.

4. Recommendations

Even though the development of a viable dairy industry generally occurs as a country develops, circumstances now existing in Peru make a recommendation to expand production and to process milk is unwise. First, the availability of imports at subsidized prices well below the costs of internal production is

deterrent enough. A number of developed countries have serious surpluses of milk and milk products, and a policy to try to make Peru self-sufficient is unreal.

Furthermore, the new processing plant near completion in Tarapoto will have to struggle for some time to gain sufficient production to operate near capacity. Further processing facilities cannot be justified in the Tarapoto area at this time. Appropriate assistance from the extension service and research station and the Universidad National de la Selva in Tingo Maria should not be discouraged. The proposed UHT pilot milk processing operations at the University should be continued since their findings may be most valuable for those who look favorably toward this activity. Milk and milk products have an important nutritional role, and production of milk for home consumption as well as local communities should not be discounted.

The development of the dairy industry in the Huallaga areas should be considered a possible viable option for the future. Although consumers' preference for the fresh product is not high and although many deterrents to market modernization exist, the fact remains that the industry will eventually develop; and the sooner this occurs the better for nutritional reasons as well as economic. The fact that a new processing plant is under construction using public funding and World Bank assistance, a defensible strategy is to delay further investments in the Tarapoto area until this plant has some experience and increases in production of milk by farmers is more certain. The list of potential agribusiness investments should contain possible future support for cheese, ice cream and yogurt. Factories and UHT milk sterilization if the UNAS pilot project and market acceptance justify such additional plants.

K. FRUIT MARKETING AND PROCESSING

1. Production

The favorable tropical growing conditions in the Huallaga Valley result in a wide variety of fruit being grown in the area. However, because of the perishable nature of the fruit, high transportation costs, inadequate economic incentives, and the generally poor quality of fruit produced, the volumes grown are insufficient for the establishment of an efficient marketing system.

Bananas and citrus fruit are the only products that show significant hectares in production. In 1982, there were 5896 ha of bananas grown in the Upper Huallaga Valley and 10,782 ha in the Central Huallaga. Less than 1000 ha of other fruit was grown in the Upper area, with citrus accounting for about 60% of it. In the Central area there was an estimated 5100 ha of fruit other than bananas.

The evolution of fruit production in the Upper Huallaga is demonstrated by what has happened in the Leoncio Prado Province (location of Tingo Maria) from 1972 to 1981. During those 10 years production, oranges were down to 23% of the 1972 level, palta to 11.6%, plátano to 76%, piña to 2%, and all fruit production was only 73% of the production 10 years before. Bananas came the closest to maintaining its production.

There is little debate that more fruit could be produced if up-to-date technology were used such as improved varieties, fertilization, insect, and disease control, careful management and careful harvesting. But the economic incentive has been lacking and production has shifted to more profitable alternatives.

Bananas are second to potatoes, grown only in the highland areas, in total value of production in the Huánuco Department (excluding coca). In 1984, potatoes had a gross value of over 51 million soles, bananas over 9 million and coffee 6.7 million soles. Harvested hectares in the Upper Huallaga was about the same in 1984 as during the first five years of the 1970's, and the same holds true for the Central Huallaga. Yields per hectare dropped drastically in 1984 in both departments, resulting in total production of only 41% in the Upper Huallaga and 45% in the Central Huallaga compared with the first five-year average of the 1970's. (Table VI.K-1.)

Table VI.K-1. Banana, harvested hectares, yield, and production, Huánuco and San Martin Departments, 1970 to 1984.

	Year	Harvested hectares	Yield per ha	Total production
Huánuco	1970-74 av	5657	12.247 Mt	69190
	1975-79	6020	11.289	67967
	1980-84	5559	13.577	75183
	1984	5562	5.153	28663
San Martin	1970-74 av	11900	14.520	172573
	1975-79	13133	12.633	165800
	1980-84	10215	10.066	124272
	1984	11146	6.903	76943

Source: Ministerio de Agricultura, Departamento de Estadisticas.

2. Market

The marketing of fruit, including bananas, is done in a rather primitive manner. There is little control of quality, no market news service and limited grading. Nothing resembles a modern marketing system, even for bananas where the volume is large enough to make it the principal gross income producer in Huánuco Department next to potatoes (excluding coca), and among the top three sources of income in San Martin Department.

Production depends heavily on small producers who have a limited system for central collection, grading, storing, or packaging. Producers bring small quantities to the roadside, where truckers pass by with funds to buy on their own account or most usually on the account of intermediaries who pay truckers for the trucking services. It is reported by observers that bananas pass through several intermediaries before final consumer purchases.

Bananas trucked to Lima are moved directly to the wholesale markets where brokers or the intermediary owning the bananas sell to retailers or direct to consumers. An alternative route of much of the supply is to storage houses where an intermediary buyer cuts the hands of bananas off the stock, does some selection to eliminate the spoiled fruit, and stacks the green fruit in the warehouse for ripening.

Country sellers receive from 85 to 100 soles per banana and the final consumer pays 200 soles so the margin is not wide considering the cost of transportation, handling and merchandising. There does not seem to be a great deal of margin available for very many intermediaries to participate.

3. Market margins

A study of the margins on fresh fruits produced in the high selva appear to be fairly constant in absolute magnitude (see Table VI.K-2.) The percentage margins vary because of the different base value of the commodity. This magnitude appears to be consistent with the channel all these products must follow. The services provided by the distribution system is more or less the same for all of the products. The exception is bananas, which are picked and shipped green, and then the wholesaler cuts the hands from the stalk, does some minor sorting, and then

stores the bananas until ripe before distributing them to the retailers.

Table VI.K-2. Prices and margins - selected fruits 1984 (Prices in US cents).

	Prod. Price	Whsle Price	Retail Price	Margins Prod.-Whole %	Margins Whsle-Retail %
Oranges					
Valencia SP	11	15	23	36	53
Valencia P	16	23	35	44	52
Mandarin					
Dancy	6	15	16	150	7
Tangerine	15	20	23	33	15
Tangelo	23	38	44	65	16
Keen Lemon	11	15	29	36	93
Banana					
Isla	23	28	59*	22	na
Manzana	12	18	44*	50	na
Palillo	19	22	53*	16	na
Seda	10	15	29*	50	na
Papaya	24	29	44	21	52
Pineapple	13	23	35	77	52
Passion Fruit	15	19	23	27	21
Cocona	12	19	23	58	21
Averages				49	37

*Banana retail price is for a hand (5 units).
Source: PIP study, Nakasone and Bolton.

As can be seen, the size of the margins is not unreasonable for the services provided. However, the margins can be reduced by providing alternative market channels for the producers. The most obvious one is for producers or groups of producers to sell direct to retailers or even direct to consumers. Even if this never becomes a major channel, the threat of such a channel coming into importance could be enough to force wholesalers to be

more competitive in pricing their services. In economic terms, the market will then become contestable. That is, because the entry and exit costs are low, the threat of entry prevents the existing firms, even if they have an effective monopoly, from charging monopoly prices.

In at least some of the markets, the farmers are reputedly not allowed to sell their produce. Based on observation, however, is appears quite possible for small farmers to sell their wares "on the street" in the immediate vicinity of the State operated market place. The larger producers usually consign their fruit to a commission seller or broker.

4. Local and regional markets

These are small wholesale and retail market places located in the rural town. Sometimes the retail and wholesale function are separated as in Tingo Maria, but usually, both activities are carried out in the same locale, as in Tarapoto. The Tarapoto market opens early, about 2:00 am, for wholesale activity, and opens for retail activity at 5:00 am.

Markets such as these are the traditional way for prices to be made and produce distributed in most of the world. So far, a better model has yet to be found. That is not to claim, however, that these markets are without problems. One of the major problems in central wholesale markets everywhere is that there appears to arise, almost without exception, an extra-legal or quasi-legal organization that controls the activities of the participants and exacts monopoly rents. Typically, the control takes the form of assigning certain suppliers and customers to specific members of the wholesale market, much like the behavior expected of a cartel.

Most of the fruit produced in the Huallaga area, with the exception of bananas, is sold at community market centers such as described above, in the producing areas. These markets are the most primitive imaginable with no facilities for product display, preservation of quality, sanitation, storage, facilities for loading or unloading or control of business transactions. The building of community markets with needed facilities and appropriate controls would be a benefit to consumers who would have access to better fruit under more sanitary conditions. Producers would suffer less quality loss, save their marketing time, and it is hoped, capture some of the benefits from better prices. Intermediary handlers likewise might benefit from more efficient handling, less product loss and improved services to their clients.

It is true that the benefits from a more modern wholesale and retail market in the Huallaga communities would not produce large sums of income for anyone in particular and might even result in a net cost to the community, but the social benefits as well as economic benefits to the many consumers and the many small producers is important to the development of an area.

Private capital is not likely to be attracted to a market modernization project. Public funds will have to be expended, and the community is the most likely participant in the construction of the facilities. Much of the costs can be recovered from space rental and charges for services, but that takes time which means there is a capital cost that is difficult for the municipality to cover since it has limited or no opportunity to collect taxes for such a purpose.

5. Market in Lima

Approximately 25 percent of Peru's population resides in

Lima. This is obviously the major market for agricultural products destined for human consumption.

Table VI.K-3. Per capita consumption of the 16 most important food items in Lima.

Item	Kg/month	Item	Kg/month
Potato	4.0	Noodles	1.0
Fresh milk	3.0	Bananas	1.0
Rice	2.8	Tomato	0.8
Bread	2.2	Chicken	0.8
White Sugar	1.7	Oranges	0.8
Evap. Milk	1.5	Oils	0.6
Fruit*	1.2	Squash	0.6
Onions	1.2	Other	12.7
Beef	1.1		

*Not including bananas and oranges.

Fruits and vegetables consumed in Lima will most likely be produced in the regions nearest to Lima, an exception perhaps being specialty crops with a comparative production advantage elsewhere.

6. Export markets

World trade is highly competitive, and it takes considerable expertise to survive in world export markets. In the context of Peru and other developing nations, one of the requirements for success in the international arena is the ability consistently to supply a product of the desired quality. Buyers are quite willing to go elsewhere if they cannot get the quantity and quality they require, and once a market is lost, it may become extremely difficult to recapture.

Tropical fruits, with the notable exception of pineapple, have not gained wide acceptance in the North American markets. The consumption of fruits such as papaya and mangos is primarily by persons belonging to cultural groups with a preference for these fruits or by individuals who were exposed to these fruits

while traveling. Europeans, on the other hand, appear to be much more willing to try out new consumption items.

For many tropical fruits, the market will have to be developed before any real potential for exporting the crop can be expected. This can be an expensive proposition. It usually involves advertising, promotion with potential industrial users, going to trade meeting, and perhaps the formation of an export or marketing commission. These activities are difficult to organize and hard to justify before production commences. On the other hand, it is risky to start production before a market exists.

And the question that should always be asked is "who is the market being developed for?" There are very few if any crops that can be produced in only one country. The pineapple market in the US was developed by Hawaii producers, but most pineapple now comes from the Philippines and Asia. The State of Hawaii actively promoted antheriums and the production has now shifted to Mexico.

The banana market in Lima reportedly considers Huallaga Valley bananas to be inferior to bananas from other sources. Part of the problem may be agronomic. But part of the problem is definitely in the post-harvest handling of product. Also, because of the distance of the producing regions from Lima, the returns to the producers are lowered by an amount at least equal to the transportation costs, which have been estimated to be about US$ 70 per ton (some estimates are considerably higher).

7. Fruit Processing

Processing of fruit has been a proposal given considerable recognition in development projects for the area. Many developing countries have turned to fruit juice production for their local market and for exports. Large volumes of

concentrated citrus juices move into the world market. The problems and constraints associated with the promotion of fruit processing include the following items.

The volume of citrus production is not sufficient for economical processing. One juice plant can process 24 TM in an 8 hr. day. Making pasteurized orange juice is not a complex process and there would be a ready market for it in Lima if it were packaged in plastic type containers of one/half to one liter size. The juice processing can make orange juice available at a price less than the cost of the same quantity of juice in oranges delivered to the consumers. But this assumes that the volume would be sufficient for a minimum of 8-hour shift operation, and this volume is not available in areas for efficient collection. This system assumes that about 10% of the fruit can be graded high and moved to consumers fresh and that the remaining fruit of lower quality would have its best use as juice.

Other fruit commonly used for juice likewise is not in adequate supply. In the Province of Saposoa, citrus production shows some positive gain. There, a development company has been formed and with a credit program from Holland they propose to produce essential oils from lemon and oranges and to extract orange juice and make marmalades.

Banana processing has been suggested by promoters of processing in the study area. Experiences in other countries and the literature does not give much encouragement to banana processing. The best practice is to market bananas fresh. Much can be done to improve handling methods, reduce bruising, grade out low quality fruit before transporting, and develop collection centers to minimize collection costs. A proposal that needs further consideration is to remove the banana hands from the stock, pack them in the containers in the country prior to movement to the market. This would cut down on bulk for

transport and reduce handling bruises. Special market outlet development is feasible with such a marketing service.

8. Recommendations

Under the particular constraints of this study with its income objective of producing income, it is not recommended that investment funds be advanced for the building of community markets. Extending loan funds to communities for this purpose can be rationally justified, but when considering other alternative uses for funds and with capital rationing constraints this possible avenue for improving the efficiency of the market for fruit will have to be given a low priority.

The construction of new facilities is not recommended for the following reasons:

a. It will neither significantly increase incomes in the region nor stimulate agribusiness; and

b. It would tend to perpetuate the existing problems with the market structure. Historically, the most successful way of overcoming the cartel power of a wholesale sector has been the development of alternative market channels that by-passed this segment of the marketing chain. In the case of fresh fruit and vegetables, large retailers started to buy directly from farmers, and large farmers and farmer organizations started to market their products direct. The construction of new facilities could actually impede the development of new market channels by strengthening the existing market system.

Improvements in the system of grading and distribution of market information remains important components to a modernized

marketing system. The absence of adequate grades is more obvious for fruit than for other products, but improvements require a public sector input that can be supported only with a strong resolve to make the improvements required. Single investment inputs will not solve the problem. A system needs to be developed and an implementation technique as well. Some grading is done by wholesalers and retailers, but it is neither uniform nor extensive.

A low priority for fruit processing in the project area is suggested because of low volumes. The local valley market is growing and much can be done to more adequately satisfy this market. Improved quality of fruit is essential for the local market much as it is in the central market of Lima.

The formation of farmer cooperatives to help solve fruit marketing problems is recommended. Groups of farmers can do much more to fill their individual needs by working together where common problems can best be solved jointly. Cooperatives can provide needed services, provide concentration centers, establish farmers' markets, grade, store, sell, and even process the fruit. However, the attitudinal environment in Peru forces one to propose cooperatives with great caution.

The concept of farmer cooperatives is basically sound, and it is rational to expect a cooperative to accomplish one or more of the following three things:

a. Provide a needed service not now being provided.
b. Perform a needed service better than it is now being done.
c. Capture excess profits taken by others if they exist.

If a cooperative cannot realize one or more of the above it should not start operations. Successful cooperatives need:

a. Well-trained and capable management.

b. A modern system of accounting.

c. A strict and regular auditing system by an outside firm.

It is recommended that support be given to the educational process to bring an appropriate attitude toward the utility and function of farmer cooperatives to solve marketing problems. The Agrarian Cooperative Naranjillo and the Centro de Cooperativas in the Upper Huallaga (CECOAH) have worthy and ambitious projects including, rice processing, machinery pools, rice culture, livestock organizations, corn marketing, banana marketing, truck pools, credit programs, cacao processing and coffee marketing.

The pilot marmalade plant at UNAS should be continued and expanded to include the feasibility of fruit juices packaged in plastic bags and paper cartons.

Both research and extension technicians need to be alert to the needs for quality improvement of fruit produced in the Huallaga Valley, They may make an important contribution if they can develop ways to do a better job of marketing these perishable products to consumers within the valley population.

In summary, investments in fruit processing in the Huallaga Valley are not recommended at this time for the following reasons:

a. Production volumes are not sufficient to warrant processing, and the pull through power is judged to be weak.

b. Internal regional demand may grow as fast as production for fresh products.

c. Medium term credit pay off is estimated to be higher for alternative uses in the area.

d. Quality is generally poor for fruit produced in the area.

5. Canning of fruit in tin cans is not economical because of the high cost of tin plate, low fruit quality and low volumes.

The possibility of establishing a regional banana-packing center in the Alto Huallaga should be investigated. The bananas could be assembled, dehanded, and packed in containers for shipping. To be economical, the increase in price (due to increase in quality and services provided) must be sufficient to pay for the cost of the service.

Such a system could have several advantages, including: not having to pay to ship the stems and culls to Lima; production of a higher-quality product; and provision of an alternative market channel to the producers. Historically, one of the most successful methods of overcoming excessive market power in the wholesale segment of a specific market channel is to develop an alternative channel. It might even be feasible for such a packing plant to deal directly with large retailers. On the negative side, packing material may be expensive; and it may turn out that fewer bananas can be carried on a truck. The costs and benefits of such a plant should be easy to evaluate, and someone familiar with bananas should be able to evaluate this proposal.

Another possibility that might affect the feasibility of such a proposal would be to locate the packing shed adjacent to one of the proposed cacao fermenting and drying installations. It may be feasible to use joint management, joint loading facilities, scales, security forces, etc. The creation of joint

facilities with time may develop into regional assembly points, where market information can be traded and disbursed.

L. COFFEE PROCESSING

1. Production

Although coffee from the Huallaga Valley accounts for no more than 5 percent of the nation's coffee production, it ranked third in gross value among crops in the Upper Huallaga in 1984 and seventh for the Central Huallaga. During the recent four years coffee production has declined. Production in the PEAH area declined from 2379 Mt in 1981 to 1486 Mt in 1983. The same thing happened in the Central Huallaga.

Harvested hectares dropped to one third of the 1970-74 average by 1984 in Huánuco Department and was only 62% in San Martin Department. Yields per hectare increased in both areas over the last 14 years and were at its high point in the Upper Huallaga area in 1984. Total production in 1984 was 59% of the 1970-74 average. Improved yields offset, in part, the severe drop in harvested hectares. In the San Martin Department total production was three-fourths the 1970-74 average by 1984. (Table VI.L-1)

Even though coffee has been one of the main products in the area over the years, its downward drop is highly significant for any agribusiness proposals relating to coffee in the Huallaga Valley.

Table VI.L-1. Harvested hectares, average yields, and total production of coffee in Huánuco and San Martin Departments, 1970-84.

		Harvested hectares	Yield per ha	Total production
Huánuco	1970-74	7857	.447 Mt	3514 Mt
	1975-79	5340	.587	2885
	1980-84	2376	.587	1393
	1984	2650	.784	2077
San Martin	1970-74	5562	.500	2866
	1975-79	3378	.586	1980
	1980-84	2934	.618	1614
	1984	3450	.611	2109

Source: Oficina Sectorial de Estadística-Ministerio de Agricultura

Coffee production is agronomically appropriate for the Huallaga Valley. The soil, rainfall, elevation, and growing conditions are favorable. It has been grown in the area from the beginning of the colonization period. Only recently it has fallen behind in surface harvested and in yield. A 20% reduction in harvested hectares are accompanied by a 25% decline in yield from 1981 to 1983.

The decline in production is a function of competition from other crops (including coca) which showed a better economic benefit. This, in turn, prompted the producers to use less fertilizer and less care in handling the trees, and in harvesting. Under the assumption that the loss in production is not a permanent trend, the resources expended to help improve the economic payout for coffee should not be neglected.

Coffee production fits into the farming system in the area of small producers with diversified crops and family labor available. The producers, unfortunately, seem to lag in the adoption of fertilizers and other technologies that would expand their output. It is not likely that the study area will greatly

increase its proportional share of the nation's coffee production. But it should be prepared to keep abreast of improvement opportunities and to share in the national growth related to population and income increments.

2. Market

Coffee is grown in small quantities by many producers (about one-fourth of the farmers), setting the stage for an inefficient marketing system. First, the harvest season is extended over a long period of time which may be convenient for using family labor for harvesting, but it makes the deliveries to the market small. Second, fermenting, washing, and drying are done by producers who lack proper quality control. Partial hulls and foreign material are left with the bean, fermenting is less than exact, washing is not complete, and sun drying often results in moldy and off-flavor beans, especially if rain occurs during the drying process.

An opportunity exists for group action to provide a motorized huller, controlled fermenting, washing and quick and complete drying. Clusters of producers with sufficient volume when combining their harvest can gain special efficiencies in handling their coffee. Small producers could custom hire these facilities or own them jointly. Unfortunately, the social environment for such collaboration is unfavorable at this time, and coffee buyers continue to receive small lots of low quality product.

In the Central Huallaga area the Cooperativa Cafetalera de Servicios de Lamas is the major buyer of coffee. The Naranjillo Cooperative located in the Upper Huallaga handles the majority of the production from this area. Also, in the Upper Huallaga is the Cooperativa Te-Cafe which handles the coffee produced by its members. All of these cooperatives sell the green coffee to

Central de Cooperativas Cafetaleras del Peru in Lima. This buyer classifies, removes the pergamino, and bags the coffee for export. This firm handles about 30% of the country's coffee exports.

Because of improper picking, fermenting, and drying, the coffee from the Huallaga Valley is discounted 10 to 15% in price because of inferior quality.

Cooperativa Cafetalera de Servicios de Lamas operate purchasing stations at La Libertad and Pomascho as well as at Lamas. Cooperativa Naranjillo purchases coffee only at Tingo Maria. This firm has a dryer, but it operates only two months of the year. Because coffee must be dehulled, fermented, washed, and dried immediately after picking, a central location for performing these functions is not practical. Smaller units located at assembly areas for a cluster of local producers are the most practical solution to the problems associated with the practice of each farmer processing his own fruit.

The Cooperativa de Lamas provided the following information in June 1984 about margins and costs:

Table VI.L-2. Coffee production costs and margins, June 1984.

	Soles/kg	US$/ton
Producer price	S/. 3000	$ 900.00
Cleaning charge paid by producer	50	15.00
Storage in Tarapoto	3	0.90
Bagging	14	4.10
Transport (Lamas-Lima)	340	102.00
Interest cost to Banco Agrario	1046	313.60
Service charges to CAFE-PERU		
Selection and classification	70	21.00
Storage	35	10.50
Bagging	60	18.00
Freight to port of Callao	30	9.00
Export taxes, custom fees	620	185.90
Total cost	5168	1,549.60
Export price FOB (US$1.06/lb)	7750	2,323.80
Net profit to the Coop and its members	2582	774.20

3. Market Demand

The coffee market is dominated by the world coffee market, which is a function of an International Coffee Agreement that directly affects prices and distribution. Eighty percent of world coffee sales fall under their organization's direct influence. The remaining 20% is sold in countries that are not members of the association. Internally the Junta de Cafe Nacional closely supervises this country's involvement in the markets. The world coffee markets traditionally fluctuate widely in supplies and prices and on subject to climate variations. Producing countries vigorously compete with each other. Entrance into the market by new producers or those with a low-quality product can only produce greater difficulties.

During the last four years Peru exported 44.7% of its coffee production. The percentage ranged from 41% to 47% from year to year as may be noted in Table VI.L-3. below.

Table VI.L-3. Production and exports of coffee.

	Peru coffee production Mt	Coffee exports Mt
1980	94,941	43,204
1981	99,351	40,651
1982	89,950	42,165
1983	90,845	41,325
1984	91,000	

The export market for coffee is characterized by rigid quotas, intense competition for a quality demanding market, and a growing number of countries exerting their influence to get in on the market with increasing supplies.

There is currently a surplus of coffee in Peru. The International Coffee Agreement (ICO) limits Peru's exports to member countries. This has encouraged exports to countries outside the ICO. This trade has been expanding, and this expansion can be attributed to private traders who took over exporting coffee from ENCI in early 1983.

4. Recommendations

Coffee production expansion in the study area is not proposed other than to recapture some of the past volume of production in order to participate in a normal growth pattern comparable to the population growth and income improvement of consumers. Holding this position may not occur if producers do not keep up with recommended fertilizer practices, replacement of nonproducing coffee bushes, improve cultural practices, and improve quality. It is recommended that the experiment stations and extension service provide the research and educational input as needed.

Clearly, coffee from the Huallaga area must struggle to market a quality product because the export market, which takes

45% of the nations coffee, demands quality. The point of quality loss most obvious is at the farm level where dehulling, fermenting, washing and drying occur. This process can be improved and quality retained.

It is recommended that a more detailed study be made of the feasibility of collecting coffee from clusters of farmers in localized areas. One alternative is to collect the coffee at fixed assembly points where depulping, fermentation, and drying would occur. A second alternative might be to have mobile units pick up the red cherries and truck them to the Cooperative's central units for processing and drying. It is suggested that the feasibility study might take about four man months of consulting time. If the plan is socially and economically feasible, a second step could be a pilot project where a fixed assembly point was established or a pilot mobile unit established to collect the cherries by truck and take them back to a central processing center at the cooperative headquarters.

The estimated cost would be about $60,000 for the initial feasibility study. If the results and local interest warranted further action the pilot phase with consulting services, construction costs, transportation, and other expenses might be about $250,000. If the pilot operations were successful, expansion into full scale commercial operation could be about $2,000,000 depending upon the number of units, locations and other variables.

M. SPICES AND ESSENTIAL OILS

Spices grow in a natural state in the study area, but the extensiveness of production is difficult to estimate. No plantations of significant size are now in production. Small farmers have limited production on their farms. Technology of production is limited, but the experiment station at Tulumayo is working on a number of crops such as cinnamon and vanilla. These studies should be encouraged and expanded.

1. Production

Detailed production costs, collection methods, processing, and merchandising procedures, and other basic information are not generally known for the study area. Consequently, spices and essential oils were not considered a high priority development prospect at this time.

2. World Markets

None the less, spices and essential oils are high value crops and transportation costs are of minor importance in the marketing process. World supplies are limited in relationship to the quantities demanded hence prices are high. For this reason a number of developing countries look to these products as potential exports. The world demand requires high quality products. Some countries have been in the spice trade for centuries and have a good grasp of quality variables. Consequently, the question arises as to how effective a new entrant into the market can compete with the traditional sources. The demand for spices is inelastic which means that increases in the quantity supplied would be associated with a proportionally greater reduction in prices. A justified fear is that a new entrant into the market might not be able to survive

the wide price variations that accompany products with an inelastic market.

Table VI.M-1 indicates a surprising variety of spices from Peru in the export market, relatively small dollar volumes, wide variations from year to year in export value and what appears to be a downward trend in the value of exports from Peru of spice and colorants.

Table VI.M-1. Peru exports of spices and colorants - 1979 to 1984

	Thousand US Dollars					
Spice	1979	1980	1981	1982	1983	1984
Garlic	2385	921	889	2067	996	
Anise	151	353	170	396	50	
Turmeric	512	323	273	300	289	
Ginger					5	
Marjoram	1075	493	809	183	168	
Annato	1947	1526	1334	1240	467	
Chile P.	16	91	1			
Other Spices	1	828	20		770	

Note: 4th quarter of 1983 not included
Source: FOPEX

The following crops have been identified as either having potential in the study area or being worthy of further investigation.

a. Annatto (achiote). Annatto is a natural carotenoid pigment obtained from the surface of the seed of the annatto tree. As annatto is not carcinogenic, it is preferred over synthetic colorants for some uses. As the concern for cancer increases, it is possible that the demand for annatto may increase significantly in the future.

Given the current technology, manufactures prefer to import the seed. The extract, bixine, is highly unstable and

deteriorates rapidly. In 1981, the fob price was US$15.60 per gallon. Currently the major importer of annatto from Peru is the US. Annatto grows wild everywhere in the Peruvian jungle. The principal collection zones are the departments of Cuzco and Ayacucho.

b. Turmeric (palillo). Turmeric is used both as a spice and a colorant. World demand has been relatively stable (see following table).

Table VI.M-2. World demand for turmeric (tons)

	1978	1979	1980	1981
Imports by country				
Singapore		1223	1033	979
U. K.	1961	2410	1306	1763
W. Ger.	616	822	577	524
Netherlands	316	379	312	396
Iran	2569			
Japan	1789	2429	2564	2560
Saudi Arabia	386	925	382	506
USA	1839	1540	1549	1863
Total	9476	9728	7723	8591

India is the worlds largest producer of turmeric. However, less than 5 percent of their total production is exported. Other major producers are Pakistan, Haiti, Jamaica, China, and Peru. It is estimated (see above table) that annual imports of turmeric into the major markets averages 9,000 to 10,000 tons annually with a value of US$8 to 10 million.

The most important use of turmeric in the international market is as an essential ingredient in the preparation of curry powder. It is also used as a condiment in many pickle and relish formula, and to give flavor and color in prepared mustard.

The increase in popularity of curry powder and other spice blends, which appears to be taking place in Asia, Europe, and

North America, have boosted the demand for turmeric. The increase in demand is particularly evident in curry manufacturing countries such as the United Kingdom.

The suppliers of turmeric, however, are already responding to the increased demand. In particular, India, has responded by increasing its exports of blended spices. The increased demand for turmeric as a colorant following the ban of synthetic colorants in processed food is another factor which will strengthen the demand for turmeric. Currently, Peruvian exports are priced considerably above the world market. In 1980, the average export price was US$1.19/kg and the average CIF price in the US was 0.81/kg. Therefore, further exports of this product from Peru are probably limited to neighboring Latin American countries.

c. Black Pepper. There is a substantial world market for this product. The quantities imported by the five major importing countries are listed below.

Table VI.M-3. Imports of black pepper (tons)

	1978	1979	1980	1981
Singapore	31543	33826	24277	21970
France	7094	7302	7246	8246
West Ger.	9653	11661	10847	11432
USSR	10885	11604	11572	14126
USA	28552	27248	32849	31???

This is a very labor-intensive crop, and there are well established producing regions in Southeast Asia, particularly in Indonesia and Malaysia. Many of the producing regions have established agencies or marketing boards that actively promote and market their product.

d. Camucamu. This a potential crop for the region. It is a good source of Vitamin C. As the market for vitamin C,

particulary from natural sources in increasing, there exists a potential market for this product.

e. Cardamom. This is another potential crop for Peru. Currently, there is no commercial production of Cardamom in Peru. India is the principal world producer of Cardamom, followed by Guatemala, Sri Lanka and the United Republic of Tanzania. Smaller quantities of Cardamom from Costa Rica (markets through Guatemala) and Papua New Guinea are also sold on the world market. Apparently, some production has either been proposed or is underway in Honduras.

Planned expansions in the principal producing countries suggest that by the end of 1985, world supplies will be between 11,000 and 12,000 tons. Cardamom is a highly valued spice. In 1981, London c.i.f. prices for Indian Alleppey AGS 1 Cardamom ranged between 4,500 to 8,000 pounds per ton.

The major users of Cardamom are the Arabic and Nordic countries. The Arabs use green Cardamom to flavor coffee. Cardamom is a popular flavoring in Nordic countries, and most of the spice is used for home and industrial baking. In other western markets Cardamom is used mainly in spice blends and only a small amount is sold at retail levels. Oil may also be extracted from Cardamom. The current world demand for Cardamom oil is about 10 tons per annum. Most Cardamom oil is used in the cosmetic and perfume industries.

In Honduras, it was estimated that it requires about US$ 9,000/Ha to establish Cardamom, with about $3,500 required the first year, and the remainder spread over the next three years. The market is sensitive to quality. In 1982 the following f.o.b. prices were quoted for Honduras: US$ 500/qt. for first class, $300/qt for second class, $195/qt. for sun dried, and $150/qt. for loose seeds.

The overall prospects for continued growth in world Cardamom demand are uncertain. This hinges on the fact that the major share of the world consumption is concentrated in a few Arab countries with small indigenous populations accustomed to the extensive use of Cardamom. Increases in demand will depend upon continued economic prosperity in these countries.

Until recently, most spice marketing in importing companies was carried out by individual merchants. Spices were typically purchased from dealers, either directly or through brokers or agents. Recently, however, direct contacts between importers and industrial users and suppliers in the producing regions have become more prevalent. This has resulted in a decline in the number of brokers and agents operating in the major spice trading centers. This change in the structure of spice trading has also resulted in the combining of several functions that were previously separated into the activities of a single firm. (vertical integration). Several brokers trade on their own account while continuing to act as brokers, some importers also grind and wholesale, and some grinders have also branched out into food processing.

There has also been a tendency for the major retail chains, such as Safeway in the US and EDEKA in the Federal Republic of Germany to do their own importing, grinding, and packaging. These activities were previously contracted out. Several spice exporting countries have developed marketing boards to promote marketing of commodities such as spices. Examples are the Spices Export Promotion Council (India), Bureau de Commercialisation et de Stabilisation des Prix du Poivre (Madagascar), the Pepper Marketing Board (Malaysia), and the Central Indonesian Trading Company located in New York. The last three boards are only concerned with Pepper.

One of the problems of assuring long-range security of supplies of spices is the small volume of demand. The intensive research effort required to produce superior plants cannot be supported by the small quantities involved. Moreover artificial flavoring have some formidable competitive advantages: uniformity and reliability of quality and price.

McCormick and Co., Inc. of Baltimore, Maryland is the world's largest distributor of food flavors and seasonings, sending 75 or more spices and 200 other flavoring products to 84 countries. Net sales in 1980 was $547 million.

Agents in New York buy much of the supply for McCormick but they send buyers to 54 countries for supplies.

There are several reasons that the spice trade offers only limited opportunities for new producers according to this buyer:

a. Quality. No measurable standards, but subjective factor.
b. Familiarity with the specific preferences of buyers. Almost a personal preference of each buyer that cannot be explained. The trade learns this through years of experience. Matching flavor to consumer preference is difficult.
c. Much spice is harvested from wild plants. Cultivation may change quality.
d. Volume is the main problem. Twenty to 25 ha would be sufficient to produce enough tarragon for the entire U.S. demand.
e. Spice processors must diversify their sources because the total supply could be stopped by a political or climatic event.
f. Efforts to develop synthetic substitutes such as for vanilla will continue.

McCormick and Co. will provide technical help and will issue a procurement contract stipulation price, quantity and quality. They may also specify management techniques. The company demands that the government will agree not to interfere in the transactions. At present this company reports that there are more prospective sources of supply of most spices than the company can develop. Their policy at present is to try to improve production from present suppliers. They agree that world demand will continue to increase.

As a point of interest a few prices are presented to show the extremely high prices for some spices, but the rather modest prices for others. PEAH reported prices to producers in the Tingo Maria area. These prices appear to be very unattractive.

Table VI.M-4. World market for specialty crops - 1983

		$/MT
Turmeric	C&F New York	800 (dry)
Ginger	" "	2100 (dry)
Pepper	" "	1800 (dry)
Vanilla	" "	27000
Black pepper	" "	2180
Cinnamon	" "	1300

Table VI.M-5. Prices of specialty crops reported in Tingo Maria - 1984

	$/Kg	$/MT
Achiote dried seed	.36	360
Ginger	.12	120
Turmeric	.21	210

6. Recommendations:

The economics of production in the Huallaga Valley is not known because of the production pattern of small producers with spice plants growing in an uncultivated manner.

Minor products with restricted output and special markets are hazardous to promote because of too many unknowns and vulnerable market situations. Nevertheless, some opportunities exist for spices such as annatto, pepper, cinnamon, vanilla, and ginger. To the extent that supplies are sufficient for efficient handling, the potential can be realized.

Research into the production and processing of spices, colorants, and other specialty crops should be strongly encouraged. However, this does not mean that large scale production should be encouraged at this time. For production of these types of crops to be successful, the entire market channel must be in place, from production through processing, and distribution.

A model which has proved successful in this type of situation is to encourage joint ventures with firms which already have the technology to produce a particular product and which are already in the market. Although many products of this class are widely used, the market structure is typically highly concentrated. It is not easy for a new firm to break in. Also, it is possible that some of the technology may be proprietary.

Basically a firm that has market channels and positions in place, and possesses the technical know-how, becomes a partner with a local firm interested in producing (and processing, if required) a product. The foreign firms' contribution to the partnership can be just the marketing and the technical knowledge.

A loan program should be designed that recognizes and encourages joint ventures. Another possibility is that if the foreign firm will be making substantial investments, USAID or some other agency could insure the investment against activities of terrorists and from government expropriation.

7. Strategy statement

Medium priority is given for this production and processing activity. However, in a secondary development thrust after more information is available some supportive effort may be worthwhile. Probably no more than $250,000 investment in technical assistance and laboratories for the processing of specific spices or colorants would be required. A pilot plant to process spices may have a good pay off within a few years provided production can be expanded. Public funds will probably be required through the research and extension service to move this industry to the next stage of development.

Because of the great uncertainties that are associated with new and exotic products, the expansion of production and accompanied processing must proceed slowly so that adjustments can be coped with without major losses. At the present time, new investments should be coordinated with further research and development efforts.

N. GRADES, STANDARDS, MARKET NEWS

As the economy of the Huallaga Valley becomes more sophisticated the use of market news and established grades will become of increasing importance. Some short term consultants are recommended to initiate work on these important areas.

1. General Background

Grades and standards play an important role in the market process. One, they facilitate communication between participants. Each purchase does not have to be physically inspected to determine quality. Two, when different qualities have different uses and/or different prices, grades allow the price signals to be passed through the marketing system. This permits the producer to make the management decision of what grade of the product will be most advantageous for him to produce.

Historically, grades and standards have served two distinct roles, besides the basic informational role. One, standards have been imposed by buyers in order to get the product they require or desire. These often are set in terms of maturity, moisture content, size, and color, and degree of damage (insect, sun, etc.), and variety. Sometimes different qualities are just priced differently. Often, however, the buyer (processor, miller, grinder, etc.) will set the standard required or expected and penalize the producer to the degree his product does not meet the standard. (i.e., more than x percent but less than y percent off-quality results in a stated reduction in price). Supply also enters into the picture. Processors will not set standards such that they cannot obtain the quantities they desire.

The second use of grades has been to control market supply. This is typical of the grades and standards sponsored by producer

associations in the US and enforced by either the USDA or state departments of agriculture. These regulations essentially state that only products meeting a specified set of standards can be sold. The impact of these regulations is to effectively limit the market supply, raising prices to the producers in the short-run.

However, there is an additional use of grades and standards in the market place. This takes place when the product is destined for export markets. In this situation, quality control becomes imperative. There is a tendency to associate products with the region where they are produced. Once a country obtains a reputation for marketing low or inconsistent quality products, the market is likely to automatically discount or even avoid purchasing that product in the future.

2. Grades in the Context of the Project area

It is anticipated that the Central Huallaga area will continue to evolve into a grain, fiber, and oil seed producing area, with the accompanying development of the ancillary activities such as milling, processing, and by-product use such as poultry and swine feeding. In the Alto Huallaga, cacao and bananas (besides coca) will be the major crops in the immediate short run, followed by slower development into some of the same crops expected in the central region and the possible development of spices and essential oils if sufficient research and development effort is put into these crops. In this context, the discussion that follows will focus on the expected near-term cropping patterns in the project region.

Detailed discussion of grades and the quality situation for several of the crops are given in the sections pertaining to the specific crop. Some general observations on the problems of grades and standards are outlined in the following paragraphs.

Grades are a must, and every effort should be made to implement a system of grades and standards. The focus of these grades and standards should be to drive the producer (by rewarding him for performance) to supply the product required by the processors. In order for quality cacao products to be produced, both the agronomic culture of the beans and the post-harvest handling must meet quality standards. In the case of bananas, the use of appropriate cultivars and appropriate post-harvest handling could yield increased returns to the producers. A simple sorting procedure where the producer is paid for the amount of marketable fruit could push the use of the appropriate cultivars and correct post-harvest handling procedures.

The grading system for grains must be designed to reward the farmer who produces the quality required by the processing, storage and distribution, and end user sectors. Grain which mills, grinds, crushes, and/or stores better should receive a higher price. If the end-user will pay more for quality, this premium must be passed back to the producer if the quality product is to become available. For example, in the case of rice, at least two qualities can be observed on the market place, a high quality imported rice and domestic rice. If rice were graded and sorted then sorted by delivered grade at the mill, local producers of the higher quality rice could enter the market for high quality rice and be rewarded for their agronomic and management skills. Also, as most rice is currently mixed "familiar" and sold at a uniform price, the use of grades and sorting should make it possible to sell the lower quality rice at a relative price lower than the current uniform price, which would tend to increase overall consumption of rice and benefit low income consumers.

3. Market News

The provision of timely market information is essential both to producers and to processors, both in finding the price and in planning future activities. The value of such information is clearly illustrated by the demand for such information - from both private and public sources - and by the rents that brokers and middlemen are able to extract. Remember that middlemen's primary stock in trade is really just information - they have to know what supplies are available where at what cost and where the potential buyers are and what they are willing to pay. Middlemen may perform other functions as well, such as processing, breakbulk, delivery, etc.

Within the Ministry of Agriculture, the (DGAIC) Dirección General de Agroindustria y Comercialización supervises the price reporting and market information services are accomplished by the Sistema Nacional de Información de Mercado Agropecuario (SIMAP). This agency assembles information weekly, monthly, and annually concerning prices at wholesale for a wide assortment of agricultural products arriving at Lima markets. Volumes, and origin are reported. Volumes, prices, and a note on the supply situation are reported for the seven major cities of the country (but not the Huallaga Valley). Prices at retail for the first quality is also reported weekly. International prices for the main export products in six different world markets are reported. Thirteen product prices are reported for five Latin American neighboring countries.

The monthly reports give monthly volume totals and price averages. Monthly variation percentages for volumes and price averages are added to this report. Monthly price averages at the farm are reported for fewer than 12 farm products produced in Lima Department. Some special reports are released for major market areas.

The informational reports are released to the newspaper "El Comercio" and to Channel 5 TV station, and to five radio stations. These news outlets are provided daily price quotations for the six major areas of the city of Lima. A total of 34 different products, including different cuts of meat, eggs, and processed food items are included in these price reports. Included in the monthly and annual summary reports is a page of comments about aspects of the prices and volumes being reported.

The introduction to the annual summary report explained that the report was a result of a contract between the Dirección General de Agroindustria y Comercialización, El Proyecto Especial Programa Sectorial Agropecuario y el Banco Inter-Americano de Desarrollo. Volumes of movements are obtained at the entrance posts for the major markets as reported by the Department of Transportation. Surveys are conducted regularly at the wholesale and retail markets to obtain the price data.

Constraints that limit the usefulness of the present system of market information include:

- Practically no information is funneled back to the producers in the Huallaga Valley.
- Reports about the prices and volumes in the markets in Huallaga are not included.
- Prices for different qualities are not reported.
- Virtually no analysis of what is reported is made.
- No research into price or volume movements or significance is available.
- Minimum or no explanation of what variables are impacting on prices except for the limited one page commentary at the introduction of the monthly report.
- Line charts for the major product prices are useful for recognizing the seasonal price movements.

- Price and volume market reports are essential and useful but their full usefulness is not appreciated until analyses are added.

4. Recommendations

Market news services in Peru should be of a national nature and the benefits provided to as many producers and segments of the marketing system as possible. For crops such as platains or bananas, the information should be provided to producers through the local radio stations and newspapers.

a. Fruits and Vegetables. With regards to fruits and vegetables, the market in Lima clearly dominates the national scene, and this is where prices are made. Regional prices can be expected to differ, being lower when the region is a net supplier to the Lima market and higher when the region is a net buyer from the Lima market.

Information on the current source of major products, by variety, perhaps size, and the quantity currently entering the principal markets, should be collected and distributed on a 5- or 6-day per week basis. This is currently being done, but the future of the program is in doubt. Data on the high, low, and some sort of an average or typical price should also be compiled and distributed.

These data should then be distributed via radio, the press, and perhaps by telex directly to regional markets where the news could be posted in a central place. It appears that the notices that are currently appearing in the daily newspapers are directed more towards consumers than towards producers and other entities in the distribution system.

b. Grains; Fiber, and Oilseed Crops. Data on quantities delivered, in storage, and sold as well as the corresponding prices by grade and variety should be collected. Movement in the international market (imports and exports, and perhaps world movements) should also be compiled. Price data should be compiled by type and grade at the central trading points--the ports, Lima, and the principal trading points.

These data should then be published and broadcast. Also, the data should be posted at the central trading points. Perhaps it could be updated via telex. Some of the data of immediate importance such as large sales, purchases or imports could be posted on a daily basis. Much of the information on movements and prices, however, could be compiled on a weekly basis and disseminated weekly.

Initially, it is recommended that the news service for the Huallaga Valley concentrate on plátanos, corn, and rice, and perhaps cotton. The service could expand into other crops as they become more important. The recommendation for rice is conditioned on the premise that the government gets out of the rice buying business. If not, there will be no point in adding anything to the existing rice information network. However, it is considered worthwhile to establish a news system for plátanos and corn.

One possibility is to use some of the personnel of ECASA and ENCI to staff the news service as the role of these agencies in the purchase and distribution of rice and corn declines (as is currently proposed).

c. Product Grading. Grading standards or systems for most farm products exist in Peru either as official or trade grades. Consequently, it is not recommended that a new grading system be developed. However, there is justification to take

action to improve those grades and standards that may or may not be in actual use, and to take necessary action to make them more useful.

The first step is to clarify the responsibility among official agencies for extending the appropriate use of grades and standards and if a new assignment to an existing agency is necessary then such should not be delayed. A recommendation for adjusting the official duties can best be made after a more complete review of present duties. An over-all national policy dealing with grades and standards will most likely be essential, but the execution of appropriate procedures will be product oriented.

The most difficult task will be to bring into practice a system of price differentiation related to quality which in turn is the basic component of the grades. Each commodity group will require a certain amount of instruction on how to use the grades and how they can serve to improve marketing efficiency. Grading products should not be made mandatory but the open market should bring distinct advantages to those who grade and prove to have superior grades. Producers who elect not to have their products graded will be obliged to accept lower prices or seek buyers who have no grade preferences. Identification of products in terms of their utility is the only way that price reports can be meaningful, therefore, a system of market information must be paralleled with a good grading system. Grading permits transactions without the physical presence of the product and this permits a market efficiency through minimal product handling. A buyer who can order by grade over the phone reduces his procurement costs substantially.

An upgraded market information service is needed and it needs to be national in scope. This must be the function of the public sector because the benefits are widely distributed to all.

But obviously costs are associated with getting an improved system started and continuing the service. In the absence of adequate public funding internally then external sources must be explored. From the standpoint of activities designed to help development in the Huallaga area the only alternative would be to make sure that upgraded news services would include specifically reporting of and to the Tarapoto and Tingo Maria areas as an initial step.

5. Strategy Statement

A short-term consultant who is knowledgeable about grades and standards in other developed countries should be assigned to evaluate the Peru system of grading for the major products produced in the Huallaga Valley. He will be assigned to identify the problems, constraints, and recommend feasible and pragmatic improvements. He will have the additional duty to recommend a system that would facilitate the utilization of official grades at each market place and demonstrate their usefulness in passing on to producers the incentives to produce improved qualities.

A second short-term consultant who is knowledgeable about the market news services in other countries should be assigned to evaluate the market news services in Peru and propose needed improvement and upgrading. He will be expected to propose methods for distribution and utilization of this information by producers as a means to facilitating better marketing decisions by producers.

O. AQUACULTURE

There is a substantial amount of land in the high jungle that is suitable for warm water aquaculture. According to a recent survey by the Ministerio de Pesqueria, there are about 200,000 hectares. These are lands not currently in agricultural or urban use, with slopes greater than 2 percent and less than 10 percent, and with a constant supply of water of suitable quality (temperature, pH, etc.) for warm water aquaculture. The four principal species being considered for the high jungle are Talapia (Sarotherodon nilotica), Carp (Mural), giant freshwater malaysian prawns (Macrobrachium rosenbergi), and Gamitana (Colossoma macropomum), a native species.

1. Aquaculture in Peru

In the north of Peru in the region of Tumbes, there are extensive commercial operations producing salt water shrimp, that total about 50,000 ha. In the adjacent area of Ecuador there are reportedly even larger commercial salt water shrimp production, utilizing an area in the 100,000 ha range. Also, in the higher regions of the Andes, generally above the 3,000 meter level, there is commercial trout production.

The Ministerio de Pesqueria is largely concerned with the development aspects of aquaculture and has about 6 fishery specialists in the ministry and about 3 specialists in the regions. Aquaculture research and training is presently being carried out at La Molina. Currently, about 80 percent of the research is dedicated to cold water species. The water in the coastal regions is generally too cold (under 20 degrees centigrade) for tropical species. Additionally, the water in the coastal regions is expensive and the quality of the water and the soil are not suitable for tropical species.

2. Aquaculture in the Project Region

There is one commercial operation (Alemar) underway in the Tarapoto area. This company currently has two 2,000 M^2 ponds and are producing talapia and prawns. A 7,000 M^2 pond is either being constructed or planned for the immediate future. Their production is currently about 50 percent talapia and 50 percent prawns. To date all their products have been sold locally. Prawns receive a price of about S./40,000/kg (US$6/kg) and talapia a price ranging from S./5,000 to S./9,000/kg (US$0.75 to US$1.36/kg) depending on the season.

Twenty hectares of ponds for prawn production have just been completed in the Uchiza area, and 20 more hectares are under construction. Apparently, one of the investors is involved in road construction in the region and was able to use the same equipment for pond construction.

In Ahuashiyacu, near Tarapoto, the Ministerio de Pesquería has a station to produce carp and talapia fingerlings. There are plans to contract an expert to increase the production in the near future.

3. The Species

a. Talapia. This is a species that is being recommended by several development agencies worldwide. It is an extremely broad genus, with over 200 known varieties. Some are much more palatable than others. The variety currently being produced, Sarotherodon nilotica, is reported to be readily accepted in the local market. Current production is 30,000 fingerlings per year. According to one estimate, the facilities (at Ahuashiyacu) are capable of producing ten times this amount if managed correctly. Current demand for fingerlings was estimated by the Ministerio de Pesqueria to be about 150,000 fingerlings per year.

Talapia is a species that poses a very real danger to the environment. It reproduces readily and has few natural predators. The escape of Talapia into the Amazon basin could have disastrous effects on the ecology of the basin. In order to minimize this risk, only male fingerlings are being distributed. Apparently, it is possible to cross male S. hornorum with female S. nilotica and obtain a hybrid that is only male.

Production of talapia is entirely for the local market. Currently, whole fresh talapia sell for about S./5,000 a kilo during the winter when other sources of fish are readily available and for as much as S.9,000 a kilo during the summer when fish are scarce. This price appears to be quite reasonable. The fish are usually sold at a size of 150-200 grams. In Hawaii, the wholesale price of red talapia is about US$1/lb, a price at which most producers find it more profitable to dig a hole and bury it rather than try to sell it. (Talapia is often produced in conjunction with other aquaculture activities.) However, there appears to be a ready demand for talapia in the jungle. This statement, however, must be qualified, as current levels of production have yet to place large amounts on the market.

Talapia is currently fed in one of two ways, either the water is fertilized and the fish feed off the natural growth of plant and animal matter in the water, or they are fed agricultural waste materials such as manure, rice hulls, and stocks and stems.

Research is currently underway to determine the feasibility of culturing talapia in rice ponds.

b. Carp. Carp is widely produced for food in China and south-east asia and in other countries such as Israel. There are several different species produced commercially

throughout the world. The Ministerio is considering the variety known as Mural for the jungle. If it can gain market acceptance, this species has potential for the jungle, particularly as it does not pose nearly the environmental danger that talapia does. Carp can be marketed at about 500 grams.

c. Prawns (Macrobrachium rosenbergi). This species is produced commercially in many parts of the world, particularly in Southeast Asia. There are also commercial operations in the US, primarily in Hawaii and Florida, and also in some other states. There is even one operation in Nevada. Major research into the production is currently being carried out at the University of Hawaii, the University of Florida, and at other universities.

Current production in Tarapoto is being marketed locally as whole live fish. This is how most of the production in the US is also marketed. The current price in Tarapoto, US$6/kg, is about half the price the same product brings on the US market. Alemar plans to eventually market its production on the world market as individually frozen tails. The prawns would have to be processed in the Tarapoto region and shipped to export points. This will involve air freight from Tarapoto to the export point and then air freight to the final market.

Processed and semi-processed fresh water prawn tails are currently available on the world market, usually originating in asia. In the US, they usually sell for about a dollar to a dollar and a half less than the comparable form and size of shrimp.

Surveys of the potential buyers of prawns in the US indicated that the primary market for live Malaysian prawns are restaurants which treat them as specialty items. The processed or semi-processed Malaysian prawns were typically purchased by oriental restaurants that used them as a substitute for shrimp.

Basically, the US and Japanese markets treat malaysian prawns as an inferior product to shrimp. It is not uncommon to have waiters recommend that you order the salt water prawns instead of the fresh water prawns. The general comment is that they lack both the flavor and texture of shrimp.

Another problem in marketing Malaysian prawns is the large percentage of head weight to total body weight. Also, the prawns must either be sold live or be processed immediately after harvesting. If not, the flesh becomes soft and unacceptable to most users. Alemar is feeding the prawns a balanced ration. Basically this is chicken feed. This is the same product that is being fed in commercial operations in the US. Research into the most cost effective feed for prawns is being carried out at La Molina, and at several universities in the US.

Prawn larvae (PL's) are available from La Molina at a cost of US$30/1000 PL. This compares with a price of US$18/1000 PL at private hatcheries in the US. The technology for producing PL's is known, and readily available from either private of public sources. The application of the technology, however, does requires a fair degree of sophistication in applied biological techniques and technicians must be trained.

d. Gamitana (Colossoma macropomum). This is a native species. The fish feeds on fruit. Currently the station at Ahuashiyacu is working on reproducing this species in captivity. So far they have obtained about 20,000 fingerlings. This species also has a good potential for the region as there is no risk of environmental damage.

4. Recommendation

Aquaculture requires a fairly substantial capital investment. Dikes have to be constructed, pumps, pipes, and

aerators must be purchased. (An hour of machine time currently costs about S.200,000.) Aquaculture also requires some highly sophisticated management skills. Unlike livestock production, where problems are obvious (i.e. have recognizable physical symptoms that can be visually observed), most of the problems that occur in aquaculture are literally out of sight and their detection depends on taking physical and chemical measurements, as well as regular samples of the product.

There exists a market for fish in the project region, and this is the market that should initially be addressed. In fact, the only species that is sufficiently valuable to have any export potential are the fresh water prawns, and this should be carefully researched. It is not obvious that fresh water prawns can "pay the freight."

All four fish species discussed above should be produced either for autoconsumption or for the regional market. However, because of the potential environmental damage, the production of talapia should proceed very cautiously. Ideally, native species would be produced, however, we do not yet know how to reproduce in captivity many of the species currently consumed and production would have to depend on capturing fry in the wild. Also, spawning tends to be seasonal.

Aquaculture can be expected to grow with agriculture in the region. Many of the products and by-products of agricultural activities can be utilized by aquaculture. It is recommended that support be provided for research and credit for some pond construction. Overall, aquaculture is given no higher than a medium priority. Markets have yet to be tested and actual production techniques are far from being perfected (not only in Peru). The provision of limited support to a few trial operations and to research, however, could have future payoffs.

F. FORESTRY AND WOOD PRODUCTS

The forests and jungles of the Huallaga drainage basins makes the lumber industry a logical opportunity for income generation. There has been and still is an active timber harvesting activity. The future must retain this industry as an important component of the developing scene. However, several factors have contributed to disappointing results of past activities.

1. Forestry Products

Most problems can be listed under the main heading of poor management. Short-term planning that did not allow for changes in the costs of maintaining supplies of timber. No allowances for replanting and sustaining production. Inability to adjust lumber product production to a changing market demand. Lack of quality control and inability for cost containment. These are a few of the problems identified that seem to be management related. A long-term management plan would allow for the retreating sources of timber supply. The great variety of trees in a virgin forest makes quality control difficult if only one or a few wood products are produced.

Modern forestry industries operate under a long-term plan where replanting takes place and the forests are of a single species, with harvest times synchronized with the lumber mill needs.

A disappointing impression results from a visit to the Wood Products Cooperative MAPRESA in the Upper Huallaga area. This mill was started by private capital about 17 years ago but was sold to a limited membership cooperative in 1976. The mill produced compressed board from chips. Among the problems that led to its termination of operations was the ever increasing cost

of transporting raw material to the stationary mill, variety of tree species being delivered, the inability to maintain a given quality product, high cost of adhesive, and the variability in the effectiveness of adhesives with different kinds of wood chips. The extremely high investment demanded a constant and high level production but the plant was unable to sustain the cost efficient level. The market for the final product was not the problem except for the quality variability.

Today the mill is idle. The equipment, motors, the building, and costly machines are still serviceable and the owners plead for funding that would permit them to again operate. Perhaps the right management team could make it economic but until such a team is apparent there seems little chance of redeeming the mill.

A number of small saw mills are operating. They provide lumber mostly for the local market. These small mills have certain economic advantages over larger mills even though they do not pick up the economies of size. They can adjust to the type of logs available. They can adjust to the local demands. Their labor costs can be closely aligned with their output. They can actually move their entire sawmill to a new virgin area if timber sources become too distant.

Although the small sawmills are important to the economic utilization of their forest resources and should be continued, there should be a long-term plan for forest resource development that includes an extensive operation with a reforestation program that maintains a constant supply over a long term. This will not likely evolve from the existing sawmills, but will require either large public funding or large investors from other areas. Forest land tenure would be a critical problem that only the public sector could arrange.

Caresa Wood Mill near Aucayacu is privately owned and has been operating for 15 years. The owner reports a strong demand for his products in the local area. He is faced with the problem of higher transportation costs as he must reach out further for timber. Forty people are employed by this operator, showing its importance to the local community.

The retreating source of timber results in a rising cost of operation for wood mills when forest replanting is not practiced. A non reforesting system as found in the Huallaga area may not be bad if the cleared land has a higher economic use. The basic problem is non-movable sawmills and increasing costs for transportation. Idle mills and unused capacity seems to be a waste when the forests seem to be plentiful and demand for lumber is strong.

2. Recommendations

A low priority for further investment in wood mills because of the spotty history of wood processing in the area. Nevertheless, the lumber business should be promoted on a basis of small sawmills that are capable of moving to new locations as supplies recede to greater distances.

A high priority should be placed on the establishment of a long-term permanent logging and milling industry wherein forests are managed in large blocks and a systematic reforesting program followed. The strategy would be to put together thousands of hectares of forest land for this purpose. It most likely would be publicly owned forests but nothing should stop a private firm from operating it and gaining ownership. The source of funds should come from large firms of an international nature who can manage such resources over an extended time period. The products produced may be pulp wood or dimension lumber of specialty products.

A large holding lumber industry need not eliminate the small lumber mills who have comparative advantages by reason of location or local market. It is not anticipated that reforestation or the lumber industry would be a major part of this agro-industry program.

Support should be given to reforestation programs. However, considering the long lead time of 10 to 15 years to harvest income it has a low priority recommendation at this time.

Q. ENERGY AND APPROPRIATE FARM TECHNOLOGIES

1. Introduction

Energy and power is a critical component for agricultural production and processing. As production per hectare increases, there is usually a corollary increase in the amount of energy required to increase the output for plowing, irrigation, harvesting, transportation and other farm uses. Moreover, improvements in agricultural processing such as drying, storage, milling, canning, transportation and efficient marketing often are constrained by the high cost of energy, or the dependence upon inefficient and low quality sources of energy such as "muscle power", animal traction, wood, crop residues or animal wastes.

Appropriate technologies that provide improved tools, small machines or equipment which can reduce the amount of human labor required, or make the labor input more efficient, are needed by the small-scale farmer. Thus, the small-scale farmer can improve his competitive position as a producer and improve his ability to generate more income. Furthermore, in order to improve a product's value by industrial processing and to maintain the quality of raw materials, appropriate processing facilities are required. This includes harvesting, drying, storage, and delivery of commodities to the appropriate market place.

The use of small-scale appropriate technologies and renewable sources of energy offers a viable complement to the traditional inputs required for improved productivity and increased efficiency in small-scale farming operations. For the purpose of this report, appropriate technologies are defined as technologies that: (1) Use locally available resources; (2) Are labor-intensive (U.S. capital intensive); (3) Are endogenously

developed; and (4) Are low in cost (and therefore are affordable to low-income groups).

2. Energy

Data and statistics have demonstrated that there is an extremely close correlation between energy utilization and economic productivity. Economic development requires cost-effective sources of energy to meet production demands. Agricultural production has significant demand functions for énergy and is consumed in fertilizer and agro-input production, mechanization, irrigation, transportation, and in the processing of raw materials. Agroindustry is particularly dependent upon reliable sources of energy. Fuels are required to run machinery, to generate heat and steam, and for refrigeration and storage areas. The forms of energy that are required include both non-renewable and renewable forms. Non-renewable sources of energy are gasoline, diesel, kerosene, and liquid petroleum (LP); while renewable fuels are solar, wind, hydro, and bio-mass.

Currently, the majority of the Huallaga Valley lacks reliable sources of energy. Electrical energy is generated by diesel powered generators and service is available only in the major urban areas such as Tarapoto and Tingo Maria. Costs for diesel generated electricity are much higher than hydroelectric power, and diesel generators are less reliable. Diesel fuel is indexed to a dollar value and is currently selling for approximately $1.00/gallon (gasoline is selling for $1.25/gallon retail). Moreover, diesel generated electrical costs are also higher due to high maintenance costs and periodic generator overhaul.

a. Electricity. Electricity in the urban areas is provided by either ELECTROPERU, private electrical companies or, on a smaller scale, "compañias familiares." The demand for

electricity throughout the watershed remains unsatisfied, particularly in those areas served by public utilities alone.

It has been estimated that there is approximately 150,000MW of hydroelectric potential (58,000 megavolts) in Peru and 85% of the installable capacity is in the selva area. Currently there are plans to install a rural electric system from Cerro de Pasco to Huánuco and through to Tingo Maria, Aucayacu, and Tocache. The plans have been approved by ELECTROPERU and the majority of the project will be financed by the Canadian Government (GOC) through the Canadian International Development Agency (CIDA).

The project provides for the construction of 138 KV high tension line which is supplied by the Mantaro Hydroelectric dam. Sub-stations at Tingó Maria, Aucayacu and Tocache Nuevo will transform the 138 KV electricity to usable forms (220 volts) to service those urban centers as well as a surrounding 40 km radius. Gaps in rural electrical supply will be filled by employing a new and unique system which taps high tension lines using an electrostatic coupling system. This system avoids the high capital costs required to construct the traditional type of transformer substation unit. A substation unit costs US$2.5 million to install, and is justified only when it services a minimum of 40,000 users. The electrostatic coupling system costs US$1500 per KW to install and can generate up to 100 KW's. Each station can distribute 100 KW energy in a 40 Km radius and deliver electricity to approximately 3000 users. Two to three of these systems will be installed between Aucayacu and Tocache Nuevo. The final logistical details are yet to be finalized at the time of this report.

In addition, CIDA is planning to finance the construction of a new hydroelectric facility at Sauce that will provide electric service to Tarapoto, on through to Juanjuí, and finally connecting at Tocache Nuevo. These project activities will

electrify the entire Huallaga watershed which in turn will change dramatically the socio-economic character of the area.

The importance of rural electrification cannot be overstated. From the point of view of industry a more attractive investment climate will be created for agro-industrialists and venture capitalists. A whole range of small to large-scale industries can start-up without having to base itself in an urban center as a result of a guaranteed and reliable supply of energy. For the producer, electricity can pump water, power small motors; and be used to dry crops, improve storage, and preserve perishable foodstuffs. Electricity is also important to dairy and beef livestock operations. Finally, electricity improves the overall social character of family life by providing good lighting for reading, quality energy for cooking and food preservation, and links remote areas through communication. It is difficult to quantify the future impact of rural electrification, but through historical hindsight a qualitative perspective to the issue is provided by noting the impact upon rural United States and Canada.

The rural electrification program should not create an attitude that energy conservation strategies are no longer warranted. Electrical service still will have a cost to end-users, and electricity does not meet all energy needs. Strong arguments can be made for developing small-scale energy technologies that can supplant the use of diesel or gasoline, and also complement the use of electricity. Their applications should be tailored to the prevailing socio-environmental conditions and the technological needs.

b. <u>Small-scale energy development</u>. In Peru, it is estimated that an individual living in a rural area consumes an energy equivalent of 6 bbl of oil per year which is equal to 3.67 $\times 10^{10}$ joules per year per person. The majority of this energy is

derived from non-commercial sources--firewood, agricultural residues, and animal wastes. Conservative estimates indicate that about 60% of the energy consumed is from these sources. It is felt that a greater emphasis on appropriate technologies for energy generation becomes more imperative as the cost of non-renewable fuels increases. Also, renewable energies reduce fixed operating costs for agroindustries which makes the market product more competitive.

Table VI.0-1. Agricultural operations requiring energy.

Basic family needs:	Cooking, lighting, water delivery
Agricultural production:	Land clearing, plowing, planting, lime and fertilizer incorporation, weeding irrigation, harvesting
Agricultural processing:	Drying, ventilation for storage, pasteurization, sterilization, refrigeration, food processing

There are various forms of renewable alternative energy and appropriate technologies (AT) which can support the above mentioned operations and in some cases supplant commercial or conventional energy sources. Commercial fuels are becoming increasingly more costly and at times have limited availability due to difficulties of transportation and distribution in the Huallaga Valley.

The following table provides an outline of the renewable energy technologies which can be applied to agriculture and that may be viable options to consider.

Table VI.0-2. Renewable energy technologies and potential applications.

Animal draft: plowing, input incorporation, seeding, harvesting, threshing, transportation.

Solar:

(1) Passive drying, dehydration, refrigeration, distillation, space heating, cooking, water heating

(2) Photovoltaic pumping, drying, electric generation, grinding, mechanical shaft power

Bio-mass:

(1) Anaerobic digestion for:
biogas-mechanical shaft, power, heating, cooking, lighting, combustion, motor

(2) Fermentation alcohol, ethanol, methanol production for liquid fuels

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Until commercial viability is clearly demonstrated it is felt that at the current stages of renewable energy technology development activities should remain within the providence of research. Until research demonstrates the cost/benefits of renewable energy technologies the private sector will remain hesitant to invest any sort of capital. Furthermore, it is felt that the most promising types of technology for the Huallaga watershed are simple solar technologies which generate low-grade heat, and basic bio-mass conversion technologies.

i. Bio-mass conversion. Bio-mass conversion is the process whereby organic materials such as wood, crop residue and animal waste are converted to combustible fuels. By far the most important energy source for rural families is firewood. Data has revealed that over 70% of the firewood is used for cooking purposes. A serious problem currently exists where there is a disproportionate imbalance between firewood supplies and population densities. The Sierra region has only 0.2% of the national wood supply, supports 24% of the population and accounts

for 85% of the estimated 5.3 million cu.m. annual firewood consumed. The selva region, which is still thinly populated, holds 96% of the national forest reserves. Informal interview indicated that "...there are no shortages of firewood in the area." Based on empirical evidence and data it is felt that there are excellent opportunities to develop bio-mass energy sources for Sierra and Coastal market areas, as well as for use in local small-scale cottage industries.

ii. Sawmill residue. Sawmills are an excellent example of an agroindustry which could benefit greatly from the exploitation of wood residues. Currently, sawdust and wood residues from sawmill operations remain unused. The easiest conversion technique would be to make briquettes which have a higher thermal efficiency equal to bulk wood (in the order of 1.5 x 10^{10} joules per ton). Briquet making technologies are very simple and easy to manufacture. They can be manufactured locally, using metal and hydraulics. Units can be built that cost between US$50 and $250 depending upon sophistication and desired output. Briquettes can supplant firewood and provide a cleaner smoke. The market potential for briquettes appears to be good since its heating value is competitive with wood and charcoal and the costs to produce it would be less. The other alternative is to gasify the wood residues and use the combustible fuel for machinery. This technology is already established and available from Brazil. The payback for investing in a unit is estimated to be approximately 5 years but may be less now due to the indexed price increases in diesel and gasoline prices.

iii. Charcoal production. Charcoal production located near forest harvesting operations appears to be another possibility for cottage industry development. In an unconverted form, each ton of wood has a heat value of between 13 and 18 x 10^{9} joules while a ton of charcoal has a heat value of 2.8 x 10^{10}

joules. Currently there is a severe shortage of charcoal and wood for fuel in the Coastal and Sierra regions. Charcoal is being brought into Lima from as far away as Lambayeque and Loreto. Charcoal was observed being sold in a local super-mercado for 6300 soles/kg which equals 6.3 million soles/tonne (at 20-02-85 exchange rates that equals US$900/tonne). Figures quoted from a 1982 World Bank study indicate that charcoal is sold at between US$28 and $65.80 per tonne on a wholesale basis close to the source of production. Retail prices ranged from US$140.60 to $187.40/tonne in Huancayo. It is difficult to obtain current reliable data on costs, because of the informal nature of the industry. One must assume that this is an economically viable effort since charcoal can bear the transportation costs from Loreto.

Either stationary or mobile pyrolitic convertors (kilns) are used to make charcoal. Although they operate at fairly low efficiency (15-20%) the cost to make one is relatively low since they are typically constructed from clay soils. A traditional kiln can produce approximately one tonne/day. Output can be increased easily by improving the kiln design and construction materials, so that up to 3 tons per day can be produced. There are several AT designs which are available, but earthen kilns may be most appropriate since the current materials used at the present time for construction bear very little cost. Charcoal can serve as a primary energy source for small cottage industries such as brickmaking, lime calcination, etc.

iv. Bagasse. Bagasse is another source of bio-mass energy that should be considered. It was reported that in 1976 bagasse was used extensively as a boiler fuel, and served part of the process steam and electricity requirements of the sugar industry. It has been estimated that bagasse provided approximately 9×10^{15} joules of primary energy input to steam electric power generation for the sugar industry.

It is reported that a small-scale sugar cane processing facility is being planned in the Alto Huallaga project area. This would be an excellent opportunity to incorporate bagasse conversion technologies in order to replace diesel fuel as the primary energy source. Bagasse as a primary energy source, will reduce fixed operating costs which will improve the competitive price structure of their product.

v. Bio-gas. Methane bio-gas production is considered to be one of the more promising energy technologies for on-farm use. Briefly, the process which produces bio-gas or methane gas is the anaerobic fermentation of animal wastes and crop residues. The anaerobic process conserves more efficiently the nitrogen contained in waste matter. After conversion into bio-gas the remaining slurry is suitable for use as fertilizer. The gas can be used directly for cooking and lighting; and when impurities and moisture are removed can be used to power small engines. Also, engines can be modified to support the lower quality methane for direct internal combustion. A typical plant can support the cooking and lighting needs for a family of five persons with only 5 cows. The cost is approximately US$800-$1000 depending upon the size and materials used. Little maintenance or replacement of parts is ever required. The payback period is approximately 5 years.

Table VI.Q-3. Bio-gas consumption for different purposes.

Use	Units of consumption
Cooking (per person/day)	0.35 cu.m.
Gas lamps	1.1/mantle/hour
Gas engines	0.45/HP/hr
Electrical generation	0.6/KWH
To replace petroleum based fuels	approx 1.7/liter of fuel

There are some bio-gas generators in the Project Area, most notably at UNAS and on the farm of a local dairy farmer. The system at UNAS is functionable but the gas is not being used well. The system observed at the dairy farm was working very well, and the gas was being used to heat milk in order to produce cheese, and to heat hypodermic needles. In addition, the gas was being used for simple lighting purposes. Unfortunately the system was undersized and produced enough gas for only 4 hours/day of use. The tank size could have been larger in order to accommodate the waste matter produced from 100 head of cattle.

Methane gas can contribute greatly to the unsatisfied energy demands of rural farm families when sufficient animal and/or human waste materials are available. In addition to meeting cooking and lighting needs methane can be used for crop drying purposes. The scenario envisaged has low grade thermal heat being generated by solar energy, and the ventilation unit powered by a methane generated fan. The methane gas also can be used for direct combustion when there is no sun. Further back-up auxillary service can be provided by the projected electrical service. The cost analysis of such a unit cannot be quantified since there are none known to be in service at this time. Tulumayo Research Station together with UNAS should make a strong effort to develop such a system and to conduct an analysis of its technical performance and of its economic viability.

Methane biodigestors and solar flat plate collectors have proven to be viable industries as cottage industries only. Before commercialization the university and research system must demonstrate its technical viability and the economic pay-off. As indicated earlier, the incentive systems have to exist before adoption and/or commercialization will occur.

c. Solar energy. Peru receives a high degree of solar radiation, (except on the Coastal areas) which makes it an almost ideal environment for the application of solar energy technologies. In the Huallaga Valley watershed there are primarily two distinct seasons, summer and winter. These seasons actually correspond with wet and dry seasons. The Alto Huallaga area is more problematic in that it rains frequently all year, nonetheless it rains more during November through March and begins to taper off during April. The Huallaga Central area has a more distinct wet-dry pattern; the wet season is November through March and the other months are normally dry.

During the rainy season solar insolation is greatly reduced due to frequent cloud cover. This should not impede the development of solar energy application because the peak demands for low-grade heat applications generally comes during periods when solar insolation also is at high levels.

The first step for solar energy development is the improvement of the data base in order to quantify accurately the incoming incidence for proper analysis and to qualify its potentials. Currently, in the Alto Huallaga project area individuals only make assumptions rather than comment from conclusive data e.g. it rains a lot so it won't work. Solar insolation is a function both of the amount of sunlight hours and the intensity of the radiation. Since there is no quantified data of the intensity one can only speculate. Based upon the very limited data available it is felt that there is both

sufficient sunlight and that solar radiation intensity is high enough for low-grade thermal applications.

The data for the Tingo Maria area reveals that there are between 5 to 6 1/2 hours of full sunlight during the day. Full sunlight is defined generally as clear, unobstructed sun. Also, there is an approximate 1:1 correlation between full sunlight hours and kilowatt hours of solar radiation. Therefore, anywhere from 4 to 6 KWH's are available for thermal energy. Converted to joules this amounts to between 1.32×10^7 joules and 2.15×10^7 joules of thermal energy per day. It was calculated that 3.2 KWH's or 1.1×10^7 joules of thermal energy is available during the rainiest month of the year (this average was calculated for a six year period during the month of January). Moreover, to indicate the contribution that solar energy can make in the Alto Huallaga area a five year average was computed for March and April which are rice harvest months, and for September and October which are the periods when corn is harvested. It was calculated that approximately 5 KWH's/day (1.65×10^7 joules) of solar energy is available during March and April, and that similar amounts are available during September and October. The limited data supports the contention that there is sufficient solar energy available for low-grade thermal processes e.g. crop drying. Similar figures were calculated for El Porvenir in the San Martin province.

Finally, to place these rough calculations into a comparative perspective, the Philippines, Thailand, and India experience similar seasonal differences and full sunlight hours per day. These countries commonly use solar energy for low-grade thermal applications, e.g. crop drying, food preservation, cooking, etc.

3. Appropriate Technology and Mechanization

Field surveying and observations in the field indicated that there is tremendous potential for the design, development. Adoption of a wide array of farm machinery and technologies that will greatly improve the land-labor-output equation leading to greater efficiency and higher profit margins. The scope and magnitude of what may be considered appropriate ranges from the very low-cost rudimentary technologies to fairly sophisticated up-to-date ones.

Prior to recommending types of technologies, it is important to consider what the prevailing incentives are that will stimulate capital investment and the adoption of technological innovations in the area. Market pricing structures, increases in income, and a decrease in human labor inputs are considered to be the three basic incentives that will motivate a farmer to incorporate a machine, tool or technology into his everyday farming practices. Diffusion and adoption research has verified that in developing country scenarios the technological adoption process by small-scale farmers is not a smooth line process, but rather a series of discreet and dichotomous cognitive evaluation processes. At each juncture of the process an evaluation is made, however rudimentary the process is, whether it is in the best interest of the farm operations, and if there is a measure of benefit related to the cost associated with the new technology.

This dichotomous, cognitive process continues through acceptance/rejection stages until a final decision is made whether to invest in the product or not. Therefore, the farmer will invest capital and time only when he has realized that the use of a technology will significantly improve his income base as a result of his investment because either he will (a) receive a better price for his product because of an improvement in

quality, (b) reduce the amount of human energy input required with improved results, or (c) realize greater profits due to increased output. Currently, in the PEAH project area there is a dearth of technologies that have been developed and adapted historically due to the absence of many of the basic incentive motivators.

Current pricing and income incentives do not favor greatly initial large capital investments in on-farm equipment such as dryers and storage facilities. A convincing argument can be made though for labor saving technologies and for those technologies that will aid in the expansion of cultivated land and improve current farm practices. Increasing land area and improving efficiency of operations most often results in additional generation of income.

4. Mechanization

A key problem in the Alto Huallaga zone is the dearth of machinery capable of performing farm work in an efficient and expedient manner. Rapid regrowth into heavy brush and secondary jungle makes land clearing using human, animal or light machinery (less than 55 HP rated) very difficult. Once the area is cleared then the area can be maintained properly if the appropriate technologies are available.

The heart of mechanization was and always will be the tractor. Although highly supportive of small and intermediate scale technologies, a critical juncture is almost always reached where a tractor of some form is required if gross incomes are to be increased. This is because the amount of land that can be cultivated using human or animal labor always will be highly limited due to biochemical and physical limitations. Recent studies have indicated that only 6-7 has. are in production while

the average farm size is between 18 and 25 ha. This is directly attributable to the lack of machinery to maintain clear land.

A comparison of the person-hours required and associated costs to prepare the land and seed for one rice crop illustrates the advantage that tractor power has over human or animal power. It is estimated that 110 person-hours per hectare are required for land preparation and seeding using traditional methods (machete, hoe, and tacarpo) in upland rice. Using a team of oxen in irrigated rice, plowing and puddling can be accomplished within 64 person-hours per hectare. Transplanting of rice requires another 20 hours. (This system is not used in the Alto Huallaga area but is used for descriptive purposes.) A 25-HP tractor can prepare approximately 2 hectare per 8 person hours; and in conjunction with a cyclone seeder, the hectare can be seeded in 1.8 to 2 person-hours.

Mechanization and tractor use in the Alto Huallaga becomes particularly germane because of the acute labor shortage in the area. The current average daily wage rate for agricultural work ranges from $1.85 to $3.00. It is understood that the daily wage scale for work pertaining to coca production is approximately $7.70 plus free room and board. Apparently the wage rate for coca workers is spiraling upwards due to recent increases in demand for Upper Huallaga coca paste.

The salient issue is--how can mechanization be incorporated into agricultural activities in the area? Surveys and interviews revealed that there are several key constraints impeding the flow of machinery into the area. The problems enumerated are:

a. The inability to justify the high capital costs to purchase a tractor due to the small economy of scale of current farming operations;

b. The extreme difficulty in obtaining credit due to institutional constraints;
c. What appears to the farmer as high interest rates;
d. The lack of equity capital to purchase tractors; and
e. A high sales tax which is 32% of the total sales cost.

Additional problems associated with a shortage of larger scale agricultural machinery include a lack of spare parts, an absence of trained service personnel, and a shortage of skills required for farm machinery usage and maintenance.

5. Animal Draft Power

The potential for the introduction, diffusion, and adoption of animal draft in the Alta Huallaga area for on-farm work is highly circumspect from a sociological, technical, and economic view point. Technically, the use of animals still restricts highly the amount of hectares that can be cultivated. Data from India indicates that a pair of oxen using improved technology can manage 4-6 hectares depending upon the health and nutritional status of the bullock. This information was supported in the Tarapoto and Bajo Mayo region where the maximum hectares cultivated to rice with a team of oxen was 6 has. In India much has been done to improve the implements and technologies adapted for animal draft, yet reports still indicate that their fabrication, diffusion, and adoption remains limited. This is in a country where there are 70 million draft animals. Implement improvement has been ongoing for over three decades, and rudimentary data has shown that some 390 improved implements have been developed, yet only 40 are being manufactured. Furthermore, the iron plow--which is essential for working heavy clay soils--has been adopted on only one-sixth of the holdings that use draft animals. If the rate of technology adoption has been so abysmal in a country where it is the predominant source of

draft power, one could hardly expect better performance in a country lacking the same strong traditional background.

Poor economic response can be expected also. It goes back to the incentive issue--what will be the incentive to develop improved technologies here in Peru? Currently the use of oxen is limited both regionally and in their application. Moreover, their use is often by those farmers who have escalated from complete manual operations to a semi-mechanized operation but still lack the capital for complete mechanization. The questions that need to be addressed are: (a) What is the market size for improved draft animal technologies?; and (2) What are the margins that can be made given the limited equity capital of small-scale farmers? One can speculate with a fair degree of accuracy that the market size is very limited and that the margins on sales and profits will be very low in order to market the product to limited income farmers. In light of the absence of motivational incentives it is doubtful that the private sector would quickly intervene to fabricate animal draft technologies.

Further drawbacks include:

a. The absence of husbandry technologies;

b. A general decline in energy inputs for animals because of a shortage of crop residues during peak load periods;

c. The historical absence of any type of draft animals in the area; and

d. The high rainfall which leads to hoof rot, viruses, enzootic parasites, etc.

The one area which may hold promise for animal draft is the use of pack animals for on-farm and short transportation usage.

6. The Development and Promotion of Appropriate Technologies

Almost any type of tool-implement-or machine will have an impact in an area like the Alto Huallaga area where there is a scarcity of endogenous types of technologies. There are a multitude of designs, and models, that have been tested and verified as to their use, output and general performance. Often the only work required is the local adaptations and modifications to improve their performance. AT's are available for pre-production (land preparation, seeding, fertilizer and other input applications), production (weeding) and for post-harvest usage (harvesting, drying, storage). The greatest promise for AT application is in the pre-and post-production areas.

Strategies for development in order to test, disseminate, and fabricate AT's a coordinated effort is required between research, extension, and the private sector.

a. The role of research. Research is responsible basically for responding to salient field problems for crops that are being grown and which require research support services to farmers. The information generated by research is disseminated through the extension service. Research and development of technologies for land preparation, seeding, and post harvest handling is urgently needed if production output is to improve.

b. Land Preparation. It is critical that tools and small-scale machinery are available to farmers so that once secondary jungle and heavy brush is cleared the land can be managed for extended production cycles. It has been estimated that a minimum of 0.2HP/acre or 0.4/HA are required to obtain adequate crop yields. Animal draft is only capable of generating 0.05HP/acre or 0.095KW/HA. As discussed earlier, there is a true dearth of machinery capable of providing this energy. Also,

tillage implements are required to incorporate agricultural inputs such as lime and fertilizers in order to obtain the best results and simultaneously reduce their loss.

The salient issue is the economy-of-scale of the farming operation. A farm that has 14 hectares and above of arable land can support the investment of a 17-45 HP tractor with the associated implements. Some of the implements recommended include: disc plough, (2-3 furrows) and/or mold board plough for soil preparation and input incorporation; tiller (9 and 11 tires) with seed hopper attachment; cultivators; and mowers. Alternative types of farm machinery have to be considered when the farm size is less than 15 hectares of arable land. For farms of this size 7-10HP two-wheel walking tractors or power rotary tillers should be considered for introduction. Attachments such as mold board plows, rotary cultivators, tined cultivators, mowers, seeders, etc., are available. Specific manufacturers that produce these size tractors include Kubota, Landmaster Ltd., Honda, and Holden Maschunenfabrik. There are many others, but few have been developed by U.S. companies that are cost competitive. Research should conduct tests to determine the most efficacious and cost effective machines to recommend to farmers.

c. Planting. It is commonly known that farmers still plant with a "tacarpo" the most traditional and rudimentary method for planting. This restricts greatly the amount of hectares that can be sown. More important, seeding is still done using a Tacarpo at the Tulumayo Experiment Station. Research can move quickly to improve seeding methods so that once more hectares are cleared for production they can be planted quickly and efficiently. Simple types of manual powered seeders that increase the amount of hectares seeded during a work day are recommended initially. Improved seeders also decrease production costs by eliminating guesswork to planting distances and seed

densities. Proper plant densities increase output and responses to other technological recommendations e.g. fertilizer applications.

Some of the seeder models recommended to obtain are: the cyclone seeder currently manufactured in Tarapoto; the SENAMCO metered knocker seeder; the knocker seeder combined fertilizer hopper constructed under the ITDG/GRZ project in Magoye, Zambia, and the Mini Nibex variable seeder/coulter which is fabricated in Marka, Sweden. This listing is very abbreviated, but does illustrate the types of seeders that are available for use. All of them can seed at least one hectare per 8 hours. Traditional seed hoppers that can attach to small tractors (17-36HP) and sow between 3-6 rows at a time are recommended also. To reemphasize--these technologies exist. Research should obtain several prototypes for testing and demonstration purposes. Once they are obtained they can be modified; and due to their relative simplicity they are easy to build and therefore can be fabricated locally. Testing should not occupy more than two production cycles. Research has to begin setting examples.

d. Post harvest improvements. The observed methods for handling grain during and after harvest are extremely rudimentary with little care being exercised. Drying of grain is the same as the method used with the advent of domesticated agriculture millenniums ago--laying the grain out on the ground to dry by natural sun and air movement. Under current pricing and incentive systems there is little motivation to improve post-harvest handling improvements--pay premium price for high quality grain and a discount penalty for poor quality. Otherwise it is difficult to justify capital investment in improved technologies. Currently, only discounting for high moisture content occurs.

There are two rationales available to justify small expenditures for improved grain drying--reducing labor input and avoiding discount pricing. Due to the frequent precipitation in the Upper Huallaga area a farmer often has to scurry to collect the unprotected drying grain, and then repeat the process when the sun returns. Dryers which accelerate the drying process, protect the grain from precipitation, and which operate using renewable sources of energy in a more efficient manner appear to be the most viable option on the short-term, given all other independent variables remain static (e.g. pricing, grading). Until stronger incentives are created to improve post-harvest handling it is unlikely that much private sector interest will be generated to fabricate drying technologies and storage facilities.

The strategy suggested is that research and extension should bear the major responsibility for developing: (a) Improved passive solar dryers; and (b) Hybrid solar drying systems which combine bio-gas (methane) for combustible fuel to power a fan and/or provide an alternative heat source when sunlight is unavailable. Since these systems are very low in cost and relatively easy to construct they can be fabricated at UNAS and Tulumayo. Moreover, an excellent opportunity exists to strengthen linkages between UNAS & Tulumayo through the joint design, fabrication and testing of different drying systems. Every effort should be made to actualize the recommendation proposed in the consulting report by Dr. Ed Pytlik, IRI consultant to PEAH, which suggests that UNAS incorporate into its ag engineering curriculum a course entailing student projects that require the design, construction, and evaluation of AT's. Students should conduct work at the Tulumayo Center when appropriate since there is adequate space and materials for drying.

e. The role of extension. The role of extension is pivotal and crucial to the diffusion and promotion of AT's. As previously mentioned, one of extension's functions is to inform research of the salient and acute farm field problems. The other key function is to "extend" the information that research has generated. Within the context of extending or diffusing newly generated information extension can apply various methodologies to get the message to its constituency. Extension has to demonstrate to farmers that many more hectares of rice can be planted during an eight-hour work-day using a US$40 cyclone seeder; and that there are several advantages to investing in the seeder that significantly outweigh the traditional Tacarpo planting method.

Methodologies to consider for diffusing At information may include, but are not limited to the following:

(i) Field days at the experiment station

(ii) Field days in farmers' fields

(iii) One-to-one demonstrations with individual farmers

(iv) Audio visuals - videotaping and broadcasting over television

Training of extensionists in AT construction techniques also should be a priority. Once skilled to construct AT's, extensionists can work with a farmer to assemble the materials and assist in the construction. Collaborative work to improve on-farm operations is a pivotal methodology to confidence building and continued efforts between extension and producers.

f. The role of the private sector. In every community around the world there exist individuals who are mechanically and

entrepreneurial oriented. They are not that difficult to identify because they emerge to the forefront as soon as a new, different or good idea is demonstrated. When the individual does emerge he should be incorporated into the development process immediately. This process involves testing and making the appropriate modifications to improve performance; and fabricating the tool/technology for wider distribution.

Within the general mandate of research & extension there is no covenant, nor should there be, to fabricate and distribute equipment. That is why it is crucial that the private sector be brought into the R&D process. Otherwise extension will generate a demand but will lose credibility quickly when a void for the available technology occurs. Conversely, credibility of the research and extension system is enhanced when the demand is generated and the technology is available on a timely basis.

By virtue of their definition AT's can be fabricated locally, using locally available materials and resources. The process described has already occurred in the Tarapoto region where a facilitator establishes the linkages between research and extension activities, and an entrepreneurial minded individual filled the role of the private sector. There have been obstacles to development which are commonly enumerated: Lack of medium - term credit; High interest rates; and general lack of institutional support.

It is suggested that USAID provide a medium-term small-business loan to the enterprise in Tarapoto. Adequate funds are required to procure parts and components in order to fabricate a sufficient quantity of the IRRI 1.0 rice cutter, IRRI TH7 thresher, and cyclone seeders. The present manufacturing mode consists of selling 10 or 20 cyclone seeders and using the receipts to purchase parts to assemble a thresher--selling a thresher and uses those receipts to procure

parts for the harvester. As long as this enterprise continues to fabricate tools and machines on a piecemeal basis their costs of production will remain high. A suitable production system that permits a certain volume output reduces per unit costs, which improves their competitive position in the market place. Providing a medium-term loan for manufacturing will assist this fledgling enterprise greatly.

Another method of support is to purchase outright 3 or 4 TH7 threshers with fan blowers (approximate cost is US$3000), 1 or 2 rice harvesters (US$3000), and 10 to 20 cyclone seeders (US$40). Procurement would be through the auspices of PEAH so that the equipment will be available for testing and demonstration under the PEAH promoted rice improvement program. Moreover, by procuring this machinery linkages will be established between zones and AT's will begin to diffuse and flow from both the lower and upper valley.

7. Recommendations

It has been suggested that a machinery pool be established at strategic locations within the PEAH project area. Servicio Nacional de Maquinaria Agrícola (SENAMA) is the government agency responsible for providing agricultural and road machinery. The shortage of equipment that SENAMA maintains for the area indicates that this agency will not be able to provide the proper service required to meet farmers' needs in the near future.

In general, government machinery pools have been found to be an "inappropriate" system for providing machinery service. Very high capital costs are required to start-up and maintain the facility--capital that most often does not exist. Furthermore, it has been found that government controlled agencies incur high administrative costs at the expense of good client service. Therefore it is not recommended that a government controlled

machinery pool be capitalized and established in the project area.

Similarly, it is difficult to rationalize or justify the establishment of a privately held machinery pool. Estimated calculations revealed that at the "incentive" interest rate of 62% plus 3 points, a privately owned machinery pool rental service would have to have its machinery operating for over 2000 hours/year, not allowing for breakdown, repair, and service time. At that level of effort the company would just reach the break even point. The interest rate would have to be at least half the current rate to attract an individual or group to consider capitalizing such a venture.

The recommendation for introducing tractors involves a fairly slow but effective process. The most successful process can be described using the following paradigm:

There is <u>always</u> one or two farmers in an area who are "adopters" (not necessarily innovators) of improved farm practices. Yield increases can be anticipated as they incorporate improved on-farm practices. With more product to market the farmer begins to realize greater income, and will seek to continue expanding production as his per hectare yields increase. Soon, sufficient capital becomes available and a tractor is purchased to expand the amount of hectares under production, and also to continue to maximize his per hectare yields.

All during this process the adopter's neighbors watch and monitor his progress. Neighboring farmers generally will incorporate similar practices within one or two production cycles once they witness a demonstrated rise in general prosperity.

Since tractors are never fully utilized, the adopter will offer to provide tractor service to his neighbors at the prevailing market rate. This process has been documented and is occurring in the Alto Huallaga project area - albeit slowly. Moreover this process has occurred with frequency in the Huallaga Central area and many individual farmers currently own or rent their own tractors. This is supported by the existence of numerous tractor dealerships in Tarapoto. Private enterprise goes where the business is.

As row crops gain greater recognition, a greater demand for tractors will be generated. Kubota--the only tractor dealer between Tocache and Tingo Maria--did not sell any tractors in the preceding eighteen months; since December 1984 six were sold for the Tocache area. Moreover the administrator of the Kubota dealership indicated that farmers are coming in almost on a daily basis inquiring about tractors. He cited many of the previously mentioned reasons for the slow sales. The GOP can stimulate tractor sales through the following:

- Exonerate the zone from all import tariffs on all tractors.

- Reduce significantly or eliminate the sales tax from tractor purchases as well as its ancillary equipment; and

- Stimulated local tractor equipment manufacturing through the maintenance of a moderate import tariff on ancillary tillage implements while simultaneously creating tax incentives for their fabrication locally.

Finally, the role of extension can have a tremendous impact upon the use of tractors as well as on the use of small-scale and intermediate farm technologies. By copying the methodology

employed by the CIAT Rice Specialist, as well as other extension methods, an immediate impact can be effected. Rice harvesting using the IRRI 1.0 meter cutter, and the threshing component using the IRRI TH6 thresher was videotaped and shown on television with further support by a field day. It was indicated that "the next morning fifteen farmers were in the office--cash in hand--wanting to buy the equipment." Research and extension, working in close coordination can thus stimulate significantly the demand for proven farm technologies.

Additional select technologies that were identified in the IRI consultant report of Pytlik and Avruch (Sept 1984) that provides greater description and a more comprehensive listing of tillers, weeders , seeders and dryers which merit testing and evaluation. Many of the tools identified can be manufactured locally once a prototype has been evaluated. It is recommended that procurement of prototypes immediately commences.

Moreover, it is understood that USAID/Lima will be contracting an IRI specialist in machinery maintenance and operation on a medium-term basis. Much time has been spent in consultation regarding the design and fabrication of AT's. Certain proven technologies can be constructed during a day's work, e.g. a hydraulic ram. A major limiting factor that is impeding progress in technology development is the absence of the appropriate tools and a proper degree of financial support. It is strongly urged that a percentage of the consultant's time be devoted to developing, fabricating, and testing AT's; and that contracts be initiated with private sector individuals interested in collaborating and manufacturing commercially promising technologies. It is strongly recommended that the tools and equipment elaborated in the reports of Cook, and Pytlik and Avruch (1984) be procured and the workshops be developed immediately.

Furthermore, it is recommended that the consultant be provided with a semi-autonomous seed fund to purchase the necessary supplies and equipment in a timely and expeditious fashion. Another limiting factor to producing tangible results has been a shortage of the necessary funds made available on a timely basis. Timely appropriations of resources has constrained the completion of other technology/machinery related activities. A seed fund managed directly by the IRI consultant would avoid future logistical problems and expedite technology development.

Finally, during the field survey individuals were encountered who indicated their willingness to collaborate and cooperate with the project's activities and help design and fabricate AT's, as well as lend equipment for field demonstration purposes. Two clear strategies then unfold:

a. Improve the capital resource base and market channels for those technologies already developed and in the process of being developed; and

b. Coordinate the forces of UNAS, INIFA Research and Extension Service, and the private sector so that promising technologies are tested, developed, and fabricated locally. A budget allocation of $500,000 is recommended to implement the appropriate technology development program. The budget would support the procurement of the prototypes recommended in this report and others; and for the purchase of materials and supplies needed to fabricate prototype models, e.g., solar dryers, seeders, cultivators, accessory tools, etc. The budget also would support the salaries of two full-time researchers from UNAS and Tulumayo and two technicians. Also considered necessary is one extension specialist. In addition, continued short-term consulting in AT design, development, and fabrication is recommended. Support is needed also in solar research procedures, data compilation, and analysis. Other requirements

that would be supported by the budget include: In-country training programs, Publications, and Demonstration programs.

Finally it is recommended that advance degree training in mechanical engineering and agricultural engineering be provided to individuals from UNAS and Tulumayo. The curriculum should be broad enough to meet the diverse needs of the Alto Huallaga zone. In particular, the Macdonald College of McGill University is recommended for agricultural engineering. The Brace Research Institute is located on this campus, which was the first appropriate technology research institute established. Course work can be integrated with the activities that provide complimentary activities to the program. Brace Research Institute is an acknowledged leader in Appropriate Technology and Renewable Energy Research. Other institutes recommended are Texas A&M, Michigan State University, University of Wisconsin-Madison, University of California-Davis, and University of Colorado. These universities have been working on energy utilization, appropriate technologies and farm mechanization for over two decades. It is felt that they would offer the appropriate types of curriculum for future work in the Alto Huallaga area.

>VII. APPENDIX

BACKGROUND INFORMATION ON HUALLAGA VALLEY

A. THE SETTING

Peru has a unique set of natural resources and a notable variation in the distribution of these resources within its borders. Rainfall varies from practically zero to 3,000 mm. The soils range from deep to shallow and highly acid to alkaline. The topography for agriculture varies from the fertile irrigated valleys near sea level to steep mountains at 3,900 m elevation and to the hot humid agriculture of the selva. Nearly a third of the population is located in the Lima area yet there are vast areas of undeveloped land in the selva. Distribution of income varies greatly, access to public institutions is not uniform, political and social influence is distorted. In short, Peru is a unique challenge requiring the best efforts of many groups to approach the goals of adequate income, and improved quality of life for the citizens.

Notwithstanding the problems, Peru has special advantages that bear upon a realistic solution to the difficulties. The variety of agricultural products that result from the variety of natural resources is a major asset. Most of the food needs can be provided from within. Access to world markets is facilitated by seaports which is an asset not available to all countries. The moderate climate and abundant rivers flowing from the mountains have permitted intensive and specialized agriculture in some areas. The sea has produced a major source of fishery income, the forests are extensive, mineral deposits abundant, and the resourcefulness of the people are positive elements. The rich cultural heritage and long historical progress of Peru makes current activities within the country exciting and highly relevant in the quest for growth and human betterment.

B. THE HUALLAGA VALLEY

Within this setting it becomes rational to focus attention upon those areas of the country still in their development infancy. The Huallaga Valley has been in the growth pattern for a relatively short period. Colonization thrusts only have been within the last one-half century with the opening of roads into the area. Considering the brief time the population growth, production expansion and infrastructure installations are noteworthy. However, development has not occurred without disruption and in recent years disturbing readjustments in resource uses have demanded renewed efforts to reestablish the favorable growth rates in production, yields and income from food and fiber.

Fortunately, the science of agriculture production in the tropics has made major strides in recent years and much of this information is applicable to the Huallaga Valley. Additionally, the improved marketing of agricultural products and the use of modern agribusiness techniques will accelerate the development process. Capable observers agree that the potential for the area lies well beyond the current status. They also agree that no significant advancement will be attained without several key inputs such as modern production technology. This must be paralleled with the investment in human resources to assist in the distribution of the new technology. Additionally, there is a need for improved infrastructure in the area. Specifically transportation, communication, market facilities and public services need to be improved and strengthened.

An appropriate market structure is essential to handle commodities produced and the inputs used by agriculture if the functions of a modern marketing system are to be realized. Competitive price determination, effective vertical coordination resulting from widespread market information, timely flow of

payments, adequate financing, efficient processing, rapid product flow in the market, maintenance of quality, and equitable distribution of the proceeds to the participants are all essential components of a modern marketing system.

The benefits from technical inputs in production can be lost in a moment in the market if the market fails to accomplish its functions effectively. From this premise the special study of marketing and agro-industry originated. This study does not in any way detract from the urgency of accepting technology in agricultural production in the study area but to emphasize the interrelationship between market improvements, processing and agricultural production as critical to expanded income in the area.

Processing of agricultural products increases value by changing its form. Efficiencies in transportation, packaging, handling and storability result from the form change. The importance of processing near production is amplified in the Huallaga valleys because the marketing problems are amplified. Great distances to outside markets, inclement weather disrupting product flow, perishability of commodities produced, inadequate storage facilities and unfavorable bulk/value ratios are part of the processing issue. Processing helps generate new jobs and more income for the area, and spin-off economic activities have a favorable result.

C. BASIC DATA

The project study area of the Huallaga Valley is located in the Departments of Huánuco and San Martin and is recognized as the drainage basins of the Huallaga River. This is a portion of the head waters of the Amazon River. Total land area of the two departments include 3,456,357 ha in Huánuco and 5,230,920 ha in

San Martin. The land has been evaluated to have the following potential uses:

Table VII.C-1. Evaluation of land for potential use.

Potential use	Huánuco (ha)	San Martin (ha)
Appropriate for cultivation	345,000	355,000
Appropriate for pasture	775,000	335,000
Appropriate for forestry	645,000	1,870,000
Other	1,691,357	2,670,000

Land actually in cultivation in Huánuco Department is reported to be 105,400 ha or 30% of the land appropriate for cultivation. In San Martin Department there is 170,000 ha reported in cultivation which is 48% of the land classified as appropriate for cultivation.

This area has been the focal point for development for many years and colonization has been progressing for 50 years in limited areas. Currently there are two special development projects that are extensive and energetic in scope. The two special development projects include only a portion of these two departments but these special areas are the focal point of this marketing and agro-industry project. Statistical data for the special projects is more complete than for the total departments and have been utilized extensively to identify economic conditions in the area.

Total land area in the Upper Huallaga Special Project (PEAH) includes 292,360 ha. Table VII.C-2 reports the classification of the land.

Table VII.C-2. Distribution of land according to its appropriate use. PEAH area.

Land Distribution	Hectares
Cultivated crop land and fallow land	90,662
Perennial crop land	45,831
Cultivated pastures	15,267
Native pastures	23,328
Forest land	103,919
Other land	13,353

Total land in the Central Huallaga Special Project includes 864,000 ha classified as shown in Table VII.C-3.

Table VII.C-3. Distribution of land according to its appropriate use, Central Huallaga Special Project.

Appropriate Use of Land	Hectares
Cultivated crop land and fallow land	138,700
Perennial crop land	40,200
Pasture - both cultivated and native	19,100
Forest land	241,700
Other land	424,300

Land actually in use in the Upper Huallaga area in 1983 was only 60% of the land classified as appropriate for these purposes. (See Table VII.C-4.) In the Central Huallaga area the percentage was 41.4%.

Table VII.C-4. Actual use of land in the special project areas - 1983.

Area	Actual Use	ha	Avail. Land %
Upper Huallaga	Cultivated crops	34,612	38
	Perennial crops	42,296	92
	Cultivated pasture	15,267	100*
Central Huallaga	Cultivated crops	23,000	17
	Perennial crops	9,000	22
	Pasture (cult. & native)	50,000	261

*40% of all pasture

Pasture land was not reported in the same way in both areas so comparisons are not precise. It is interesting to note that in the Central Huallaga area much land classified as appropriate for cultivated and perennial crops were used as pasture which explains why the actual use far exceeded the land classified as appropriate for pastures.

Much of the land not in cultivation at a given time is land in fallow under the system or rotating one year of a crop with two years of fallow. If farming methods were changed making it unnecessary to fallow the soil to regain fertility the available land for expansion would be greatly increased.

The national agency INADIR has prepared a resource saturation index. They estimate that the saturation of agricultural land appropriate for agriculture is only 27% for San Martin Department and 20% for Huánuco Department. They also stated that in their judgement the cost of expanding the agricultural frontier in the Huallaga Valley to be less than one-third of that in the coastal areas. This number leaves much unexplained such as the high costs of building infrastructure in the jungle. Most likely the comparison hinged heavily on the irrigation costs required on the coast but not in the jungle.

Rainfall ranges from about 1000 mm in the Central Huallaga on up to 3000 mm in parts of the Upper Huallaga. Rainfall occurs in a bi-modal pattern and variations in the average from year to year are not great. Temperature averages from year to year also show very little variation. Month to month averages do not vary greatly. (See Table VII.C-5.)

Table VII.C-5. Climatic data for selected Huallaga stations.

Site	Average Annual Rainfall (mm)	Average Annual Temp (°C)	Elevation meters
Tingo Maria	3411	24.30	685
Tulumayo	3900	24.35	510
Tocache	1800	24.40	490
Tarapoto	1158	26.50	426
Yurimaguas	2135	26.40	182
Pucallpa	1708	26.90	148

Source: PEAH

Population of the country continues to expand at an annual rate of 2.8% in the 1980's, the rate declining only 0.1% from that between 1970 and 1980. Population in the Huánuco and San Martin Departments grew from 1970 to 1982 as follows:

Table VII.C-6. Population growth in Huánuco and San Martin Departments.

Department	Thousands 1970	Thousands 1983	Total Increase	Annual Rate
Huánuco	418.7	537.2	118.5	2.15
San Martin	222.0	325.9	103.9	3.67
Peru-total	13,447.3	19,314.8	5,867.5	2.91

Population growth has been faster than the national rates and it is projected that by the year 2000 the population in four Huallaga Departments will reach 8.9% of the nations total population up from 6.3% in 1981. The market area comprising the Huallaga Valley and regions accessible from it (Pucallpa and Aguaytia in Ucayali Department; Yurimaguas and downriver ports such as Iquitos in Loreto Department) today comprises 1.5 million persons. This population is expected to rise to over 2.5 million by the year 2000.

The region accounts for a small share of Peru's GNP. On a per capita basis their income is only about one-half of the

national average because of the small opportunity for incomes coming from industry, commerce and government services.

The regions of Upper and Central Huallaga are relatively distant from principal markets. (Distance is best conceived of in the context of the cost required to move goods to market rather than just air or road miles.) Based on cropping patterns throughout the world, the expected class of agricultural activities for this region will be crops that can be either cheaply stored and transported or require extensive land areas such as livestock grazing.

Thus crops such as the hard grains, oil seeds, and fibers can be expected to become the dominant activities in this region. Crops which can be produced and processed in the region are possibilities also. Examples of such crops include cacao, oil palm, and fruits destined to be marketed in processed form. The more land intensive and high valued perishable crops such as vegetables destined for the fresh market are typically grown on lands closer to the markets.

The exception to the above is when a region has a special agronomic condition that provides it with an advantage over other regions. These are usually high valued crops that can be produced more economically in distant regions such as exotic spices. Another example may be bananas. Worldwide, bananas are shipped long distances to markets.

The Upper Huallaga is distinctly different from the Central Huallaga in several ways. Not only is the climate dryer in the Central Huallaga, the land more level, and a bit warmer, but there is a difference in attitude about development, new processing activities and in general a more progressive attitude about the future. This cannot be discounted as an important aspect of development.

The data in Table VII.C-7 is presented to better explain the characteristics of the area but care should be taken to generalize only partially about the Central Huallaga area.

Table VII.C-7. Size of farm distribution in the Upper Huallaga.

Size of farms* (ha)	Percentage of farmers
1 to 10	12.5
10 to 30	58.8
30 to 85	26.1
Over 85	2.6

*Average size of farm - 27 hectares. Average hectares in crops and cultivated pasture - 10.3 hectares

Farmers are greatly diversified in the study areas with each farmer producing a variety of crops, some of which are for his own family consumption. Specialized farms are not common in the area (Table VII.C-8).

Table VII.C-8. Percentage of farms that grow each crop - Upper Huallaga.

Crop	Percentage
Corn	67
Bananas	65
Yuca	61
Rice	47
Cacao	46
Coca	35
Coffee	26
Citrus	17
Beans	10

The main income producers in Huánuco Department for 1984 (excluding coca) were potatoes, bananas, corn, coffee and cacao in that order. Potatoes are grown outside of the special project area of Upper Huallaga at the higher altitudes. Palm oil with its large plantations coming into production recently places that crop at the top of the list of income sources for San Martin

Department. However, due to the somewhat arbitrary division between the special projects, the location of the plantations in Tocache places it in the Upper Huallaga project area rather than in the Central Huallaga special project area. Rice has risen to the top next to palm oil rather quickly during recent years. Corn and bananas are also major income sources but the next crops on the list, frijol, coffee, and yuca fall to one-third or less gross income below bananas. (Table VII.C-9.)

Table VII.C-9. Statistical data by major crops in Huánuco and San Martin Departments, 1984.

Crop	Harvested ha	Yield/ha Mt	Production Mt	Gross Value Soles x 10^6
Huánuco:				
Potatoes	21.1	.9	19.0	51.6
Bananas	5.6	5.2	28.7	9.39
Corn	10.4	1.5	16.0	8.8
Coffee	2.6	.78	2.1	6.69
Cacao	2.2	.40	.88	4.4
Yuca	.7	19.7	10.1	2.1
Rice	.7	1.9	1.4	.84
Frijol	1.2	.95	1.2	.82
San Martin:				
Palm oil	4.0	10.5	41.9	67.0
Rice	35.1	2.66	93.6	48.78
Corn	65.2	2.0	129.6	39.25
Banana	11.1	6.9	76.9	27.72
Frijol	5.0	1.0	5.1	7.35
Yuca	2.7	9.9	26.4	6.78
Coffee	3.4	.6	2.1	5.59
Cacao	.6	.67	.4	2.0
Cotton	3.5	.8	2.8	n.a.

Source: Oficina Sectorial de Estadistica, Ministerio de Agricultura

The land reform program of more than a decade ago in Peru wherein land was shifted from private ownership to cooperative management did not have the same impact in the Huallaga Valley as in the coastal areas. This may have resulted from the fact that the jungle area was, in effect, a type of land reform when the region was being colonized. The land was not being divided into

large holdings but rather small units and there also was an interest in not disturbing the ownership structure because of its frontier character. (See Table VII.C-10.)

Table VII.C-10. Legal land tenure status of farm operators - Upper Huallaga.

Land Status of Operators	Percent
Recognized legal right to land	50
Hold a certificate of possession	22
Do not hold certificate but operating	21
Rent land	1
Unknown	6

The area is characterized by a relatively low quality of life. Literacy rates are low, access to basic sanitation, medical care, education, electricity in homes are also low compared to selected areas in Peru.

D. MARKETS

The overall Huallaga area is a net importer of such staples as rice, corn, soybeans, sugar, some fruit and vegetables, dry beans, and poultry products. It exports some of these products also, such as corn, rice, fruits and vegetables, meat, animal skins and live animals. Its regular exports in significant values include: cacao, coffee, tea, palm oil, bananas, meat, and cotton. The strange flow of products both in and out of the area can be partially explained by seasonal differences in supplies, normal behavior of the private sector seeking profits and also some irrational movements that cannot be explained from the data available.

Three different and somewhat distinct markets must be reckoned with for products of the study area. First, the internal regional market with its one and one-half million people of which almost one-half are urban residents. The growth in this

market is expanding with population growth and improved incomes. The second market is the Lima urban market and third, the international market. The internal regional market has certain advantages. The high transportation costs to Lima market represents the equivalent of a protective tariff against imported products. However, those same costs represent a major constraint for products attempting to enter the Lima market.

A number of active development projects in the Huallaga Valley are administered by official government agencies and with foreign donor participation. Foremost among these agencies are PEAH and the Central Huallaga Special Project which were created by the Peruvian Government specifically to plan and execute a variety of development projects with financial support from foreign sources as well as the GOP. A representative list, but not complete, of projects being studied is as follows:

Upper Huallaga	Central Huallaga
1. Fruit Processing	1. Roads - Penetration
2. Milk Processing	2. Roads - Maintenance
3. Soybean extraction	3. Agricultural credit
4. Balanced feed	4. Machinery pools
5. Vegetable processing	5. Market collection centers
6. Lime extraction	6. Topography and land titles
7. Extension services	7. Extension services
8. Research	8. Evaluation of natural resources

From a major over-all point of view there are three major development programs involving the area: Agricultural Development, Livestock Development and Forest Development. The agro-industry promotion activities should relate closely to these major efforts.

The Law of Promotion and Development of Agriculture in Peru charged the Minister of Agriculture with the responsibility of coordinating the studies and financing those carried out by

official government agencies. Special tax concessions were made to agriculture and processors of agricultural products.

E. CONSTRAINTS

Processing of agricultural products in the study area is mostly rudimentary and involves only the first steps of changing the product form. The final steps are accomplished in the industrial center of Lima. Even though processing in the valley is not advanced there has been a significant number of attempts at instigating agro-industry plants. In fact a surprising observation is the remnants of failed processing plants and unused production capacities of a number of presently operating processors. The approximate 93 industrial plants in the Upper Huallaga area are operating at an average of 45% of capacity. About 20 of these are agro-industry firms. Observers report that insufficient volume of raw materials resulting from inadequate economic incentive to expand production is the principle causal factor.

However, other conditions have had an impact on the retarded success of processing firms. Technology has been slow to realize its full potential in the area. Research and extension services were interrupted for a decade and still is not at an appropriate level. No country in the world has advanced its agriculture without first investing in their human capital. Peru will not make potential advancement until it instigates a much more energetic and continuous educational program. This is more notable in the study area which trained people tend to avoid.

Not surprising, credit scarcity and high cost must be listed high among the constraints. Credit is scarce for annual crops but almost nonexistent for livestock, pasture improvement, perennial crops and other uses that require a 3-year period or more before products are ready for the market. The rapid rate of

inflation (about 125% annual at the time of this study) aggravate the situation and makes credit available only at subsidized rates by the official agencies such as the Agrarian Bank.

The abnormal weather and general economic recession of the early 1980's were felt in the valley the same as in all parts of Peru. Another constraint is the high cost of energy in the area where petroleum is the energy source. In addition, the rapid expansion of coca production disrupted the traditional production patterns and this in turn impacted badly on food processors and markets.

The importance of adequate management training for the successful operation of business firms can not be over emphasized. Poor planning, incomplete coordination of raw materials, plant capacity and market demand has led to unused capacity and low returns on capital investments. The most limited resource in most underdeveloped situations is the human capacity to manage. This resource is not an endowment of nature on the nation, but the acquired skill gained from formal training and successful experiences. No agro-industry development project should be instigated without the essential ingredient of management training.

Additional constraints include the high cost of marketing Huallaga Valley products in both raw and processed form. The distance to the Lima market which is the basic price setting location for virtually all products produced in the country, ranges from 650 kilometers to 1200 kilometers. However, the distance is not the only criteria for transportation costs. The time to market varies greatly due to road mud slides and general poor road conditions. Loss in time is compounded by loss of quality and failure to meet buyer's time schedules.

Soil acidity and generally low soil fertility is a general problem in the area. Some crops require acid soils but most crops would benefit from a reduced pH and liming is considered an essential ingredient for continued development. High ambient temperatures, high rainfall, and humidity are conducive to diseases and insects and product spoilage.

The Huallaga Valley is not without comparative advantages. The abundant precipitation falling in a bi-modal pattern and the warm climate are favorable for double cropping of some crops and favorable for the production of tropical fruits, coffee, cacao, oil palm, tea, spices, and livestock pastures. The growing population in the area creates a regional market that has economic advantages for products produced within the area.

People in the area, particularly the Tarapoto area, have an optimistic attitude about the growth potential and innovators are coming forward with new ventures and investments.

The U.S. Presidential Agricultural Mission to Peru recently identified marketing of agricultural products as a constraint to economic development. They suggested a variety of chronic problems in the marketing system. Poor and inadequate storage, high product losses in the marketing chain, limited information about processing, production, supply, demand, and prices, few and unused grades and standards, absence of marketing credit, inadequate wholesale market facilities and lack of trained manpower qualified to do marketing policy analysis and to manage private and public activities in the market structure.

F. MARKET DEMAND

For demand to be a force in development, the demand has to somehow be transmitted to the producer. This applies equally whether the demand is local, national, or international.

Producers will respond to the possibility of increased income, but the system must be structured such that (1) the producer is aware of the possibilities; and (2) that the producer will benefit by the change. Often this is not the case. For example, there may be a demand for quality rice, corn, or cacao, but given the current institutional practice of uniform pricing, there is absolutely no incentive for the farmer to produce a quality product. He will receive no benefit from such an activity and will likely incur increased costs.

The concept that farmers react to market pressures seems to be a difficult concept for some people to grasp, particularly in the context of third world or developing countries. However, it is true. Granted, often there are structural problems in the market that do not permit the farmer to either perceive the demand or permit them to benefit from it. This appears to be specifically true in capital markets where typically the price of capital quoted in the "market" considerably understates the costs of capital as perceived by the small farmer.

However, the Upper Huallaga offers a clear example of a situation where small farmers in a developing nation context are reacting directly to market forces, by adopting the technology necessary to capture the benefits of the increased demand and making capital investments. The example is, of course, coca.

An abundant number of donor agencies with grant and loan funds seem to be investigating the same potential projects and this has a positive impact on the area's economic health. Although some efforts may be ill advised and the benefit-cost ratio less than desirable, nevertheless the impact is having a multiplier effect on spin-off activities.

6. HISTORICAL INFORMATION ON THE MOST IMPORTANT CROPS

SUPERFICIE COSECHADA--HUANUCO -- 1970-84

HECTAREAS

AÑOS	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
TOTAL	69753	81291	75909	74710	74445	66005	67750	60638	58316	57961	54003	45192	42044	44898	48608
TOTAL PROGR.	57875	68970	62785	61290	60380	51955	53655	46856	44841	45180	41613	32902	34684	37350	40035
TOTAL CON. HUM.	44490	54900	48120	46850	45810	40110	41605	37692	36485	36820	35838	28803	29751	31250	32659
ARROZ CASC.	1670	2110	2000	1890	1770	900	1220	750	630	600	1562	1187	876	542	705
MAIZ AMIL.*	11000	11400	12300	11100	10650	10500	10600	7982	7328	8000	7607	6373	4291	6017	5671
FRIJOL GRA.	2540	2120	2480	2510	2490	2460	2400	2430	2517	2640	3084	1747	228	559	1220
PAPA	24450	34300	25200	26600	26400	22500	23705	23880	23850	22900	19006	15381	21626	19909	21073
TRIGO	4830	4970	5140	4750	4500	3750	3680	2650	2160	2680	4579	4115	2730	4223	3990
TOTAL CON. IND.	13385	14070	14665	14440	14570	11845	12050	9164	8356	8360	5775	4099	4933	6100	7376
ALGODON	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0
CANA DE AZ.	180	100	150	180	170	200	200	0	0	0	0	0	40	4	0
SOYA	0	65	50	60	100	95	250	64	56	60	91	117	40	4	0
SORGO GRA.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAIZ AMR.*	6300	5800	6370	6100	6200	3450	3500	5600	4800	4800	3664	1927	2343	3491	4726
CAFE	6895	8095	8095	8100	8100	8100	8100	3500	3500	3500	2020	2055	2550	2605	2650
OTRO CULTI.	11878	12321	13124	13420	14065	14050	14095	13782	13475	12761	12390	12290	7360	7548	8573
CEBADA	3440	5085	5690	6020	6550	6250	6200	5920	5620	4920	4950	4800	625	860	2300
PLATANO	6235	5210	5510	5615	5715	6025	6020	6020	6020	6020	5500	5500	5887	5348	5562
YUCA	1770	1665	1600	1510	1505	1490	1550	1562	1550	1601	1640	1685	602	1108	716
QUINUA	290	200	150	100	120	110	150	205	210	165	225	230	171	157	120
LIMON	120	141	169	170	170	170	170	70	70	70	70	70	70	70	70
MANZANO	8	5	5	5	5	5	5	5	5	5	5	5	5	5	5
VID	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0
*MAIZ GRA.	17300	17200	18670	17200	18850	13950	14100	13582	12128	12800	11271	8300	6634	9508	10397

Fuente: Oficina Sectorial de Estadistica, Ministerio de Agricultura
Elaborado por: Guillermo Arce Sensebe

SUPERFICIE COSECHADA--SAN MARTIN -- 1970-84

HECTAREAS

ANOS	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
TOTAL	58100	63040	51430	47147	44540	49729	50580	51804	65668	81604	83527	92808	96830	104609	126431
TOTAL PROGR.	48885	44200	34210	29815	27000	31790	32520	34505	46402	62736	58768	65315	79598	92149	112280
TOTAL CON. HUM.	15550	19200	12055	10270	8980	13840	12540	12482	15841	17274	16210	16701	26087	34521	40112
ARROZ CASC.	11000	11600	8705	6570	4365	8340	7240	7201	11762	12574	12157	12646	19434	30854	35118
MAIZ AMIL.*	0	0	0	0	0	0	0	200	200	200	0	0	0	0	0
FRIJOL GRA.	4550	7600	3350	3700	4615	5500	5300	5031	3879	4500	4053	4055	6653	3667	4994
PAPA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRIGO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL CON. IND.	25335	25000	22155	19545	18020	17950	19980	22023	30561	45462	42558	48614	53511	57628	72168
ALGODON	2200	2790	2605	2000	1940	1325	2000	680	2280	3409	9770	10398	7542	2528	3500
CANA DE AZ.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOYA	35	10	50	45	70	45	80	118	248	289	288	981	146	18	0
SORGO GRA.	0	0	0	0	0	240	400	672	127	174	30	27	48	2	0
MAIZ AMR.*	15100	14700	14500	13000	13200	13150	14000	17153	24506	38190	29774	34330	42422	52788	65218
CAFE	8000	7500	5000	4500	2810	3190	3500	3400	3400	3400	2696	2878	3353	2292	3450
OTRO CULTI.	17215	18840	17220	17332	17540	17939	18060	17299	19266	18868	24759	27495	17232	12460	14151
CEBADA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLATANO	10800	12500	12000	12000	12200	12500	12500	12665	13500	14500	15500	14000	10782	9675	11146
YUCA	6200	6120	5000	5100	5100	5180	5300	4394	5511	4093	8934	13163	6115	2437	2657
QUINUA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIMON	150	150	150	162	170	175	170	175	185	200	235	240	245	258	258
MANZANO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VID	65	70	70	70	70	84	90	65	70	75	90	90	90	90	90
*MAIZ GRA.	15100	14700	14500	13000	13200	13150	14000	17353	24706	38390	29774	34330	42422	52788	65218

Fuente: Oficina Sectorial de Estadistica, Ministerio de Agricultura
Elaborado por: Guillermo Arce Sensebe

RENDIMIENTOS DE LOS CULTIVOS--HUANUCO -- 1970-84

TM/HA

AÑOS	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
CULT. PROGRAM.															
CULT. CONS. HUM.															
ARROZ CASC.	1.600	1.900	1.950	1.780	1.890	1.830	2.100	1.897	2.000	2.000	1.907	1.855	1.847	1.913	1.932
MAIZ AMIL.*	1.091	1.097	1.135	1.135	1.055	1.071	1.261	1.338	1.394	1.309	1.311	1.160	1.163	1.170	1.157
FRIJOL GRA.	1.078	1.094	1.055	1.124	1.072	1.088	1.021	1.049	1.064	0.996	1.020	1.101	0.829	0.857	0.955
PAPA	6.396	6.543	6.369	4.371	6.393	6.427	6.604	6.600	6.799	7.250	7.406	6.486	6.952	8.420	9.002
TRIGO	0.890	0.875	0.904	0.948	0.925	0.956	0.964	1.106	1.115	1.113	1.378	1.096	0.962	1.205	0.956
CONSUMO INDUS.															
ALGODON	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CANA DE AZ.	160.000	160.000	160.000	160.000	160.000	150.000	150.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SOYA	0.000	2.000	1.800	1.800	2.000	2.000	1.500	1.500	1.500	1.500	1.901	1.197	0.900	2.000	0.000
SORGO GRA.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MAIZ AMR.*	1.800	1.600	2.107	1.930	1.940	1.900	2.000	1.929	2.000	1.875	2.019	2.032	1.980	1.820	1.990
CAFE	0.441	0.401	0.461	0.466	0.466	0.461	0.441	0.650	0.670	0.714	0.670	0.531	0.473	0.475	0.780
OTRO CULTIVOS															
CEBADA	0.887	1.042	0.999	0.938	0.982	0.998	0.977	1.002	1.104	0.907	1.100	1.200	1.326	2.265	1.250
PLATANO	11.984	12.988	11.991	12.186	12.086	9.988	9.990	12.487	11.988	11.990	24.100	24.110	8.224	6.298	5.150
YUCA	15.774	15.617	15.421	15.162	15.187	13.564	13.769	13.611	13.763	13.646	7.050	7.100	14.940	15.007	19.670
QUINUA	0.741	0.550	0.540	0.510	0.558	0.600	0.600	0.600	0.600	0.600	0.649	0.700	0.702	0.701	0.700
LIMON	14.075	11.312	11.533	9.353	10.094	10.253	10.088	7.357	7.357	7.357	10.000	10.000	9.000	9.286	8.571
MANZANO	9.750	5.600	6.200	6.600	7.000	7.000	6.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000
VID	3.000	3.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
*MAIZ GRA.	1.349	1.267	1.467	1.417	1.381	1.276	1.445	1.581	1.634	1.521	1.541	1.363	1.452	1.409	1.539

Fuente: Oficina Sectorial de Estadistica, Ministerio de Agricultura
Elaborado por: Guillermo Arce Sensebe

RENDIMIENTOS DE LOS CULTIVOS--SAN MARTIN -- 1970-84

TM/HA

ANOS	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
CULT. PROGRAM.															
CULT. CONS. HUM.															
ARROZ CASC.	1.900	1.700	1.564	1.524	1.545	1.582	1.566	1.993	2.158	2.376	2.832	2.760	3.141	3.053	2.664
MAIZ AMIL.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.200	1.200	1.200	0.000	0.000	0.000	0.000	0.000
FRIJOL GRA.	0.700	0.700	0.679	0.758	0.735	0.750	0.800	0.804	0.805	0.804	0.736	0.782	0.796	0.705	1.022
PAPA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TRIGO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CONSUMO INDUS.															
ALGODON	0.725	0.720	0.890	0.740	0.760	0.775	0.750	0.779	0.800	0.950	0.821	0.905	0.800	0.812	0.798
CANA DE AZ.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SOYA	0.771	0.800	0.840	0.956	1.300	1.111	1.262	1.347	1.202	1.401	1.253	1.600	1.185	1.000	0.000
SORGO GRA.	0.000	0.000	0.000	0.000	0.000	2.000	2.000	1.644	1.701	1.592	1.667	1.741	1.875	1.000	0.000
MAIZ AMR.*	1.800	1.900	1.630	1.640	1.635	1.635	1.800	1.870	1.900	1.902	1.902	1.977	1.995	1.974	1.988
CAFE	0.590	0.520	0.460	0.470	0.460	0.460	0.440	0.650	0.620	0.758	0.750	0.750	0.501	0.480	0.611
OTRO CULTIVOS															
CEBADA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PLATANO	16.000	16.400	13.460	13.420	13.320	13.000	13.000	11.983	12.580	12.600	11.000	11.000	11.102	10.327	6.903
YUCA	18.000	20.000	19.000	19.000	20.000	14.550	14.500	14.000	14.000	14.000	13.000	13.000	11.520	10.486	9.924
QUINUA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LIMON	13.000	12.500	10.253	10.031	10.129	10.103	10.000	10.000	10.000	10.000	8.000	8.000	8.000	8.000	7.752
MANZANO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VID	4.154	4.471	4.671	4.686	4.814	4.929	5.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
*MAIZ GRA.	1.800	1.900	1.630	1.640	1.635	1.740	1.800	1.862	1.894	1.898	1.902	1.977	1.995	1.974	1.988

Fuente: Oficina Sectorial de Estadistica, Ministerio de Agricultura
Elaborado por: Guillermo Arce Sensebe

PRODUCCION DE LOS CULTIVOS--HUANUCO -- 1970-84

TM

ANOS	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
CULT. PROGRAM.															
CULT. CONS. HUM.															
ARROZ CASC.	2672	4009	3900	3364	3345	1647	2562	1423	1260	1200	2979	2202	1618	1037	1362
MAIZ AMIL.*	12004	12504	13965	12595	11138	11250	13370	10677	10218	10470	9970	7395	4991	7042	6562
FRIJOL GRA.	2738	2319	2616	2820	2669	2676	2450	2550	2679	2630	3145	1924	189	479	1165
PAPA	156375	224420	166860	116271	168776	144600	156556	157608	162159	166034	140765	99757	150336	167626	19000
TRIGO	4299	4347	4649	4505	4162	3585	3549	2930	2408	2984	6309	4510	2625	5089	3814
CONSUMO INDUS.															
ALGODON	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0
CANA DE AZ.	28880	16000	24000	28800	27200	30000	30000	0	0	0	0	0	0	0	0
SOYA	0	130	90	108	200	190	375	96	84	90	173	140	36	8	0
SORGO GRA.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAIZ AMR.*	11340	9280	13422	11772	12028	6555	7000	10800	9600	9000	7398	3915	4640	6353	9442
CAFE	3038	3249	3733	3775	3775	3733	3573	2275	2345	2499	1353	1091	1206	1237	2077
OTRO CULTIVOS															
CEBADA	3052	5297	5683	5647	6434	6240	6060	5932	6206	4464	5445	5760	829	1948	2888
PLATANO	74720	67665	66069	68423	69074	60175	60140	75170	72170	72180	132550	132605	48417	33680	28663
YUCA	27920	26002	24673	22895	22857	20210	21342	21260	21333	21847	11562	11964	8994	16628	10150
QUINUA	215	110	81	51	67	66	90	123	126	99	146	161	120	110	84
LIMON	1689	1595	1949	1590	1716	1743	1715	515	515	515	700	700	630	650	600
MANZANO	78	28	31	33	35	35	30	25	25	25	25	25	25	25	25
VID	45	45	0	0	0	0	0	0	0	0	0	0	0	0	0
*MAIZ GRA.	23344	21784	27387	24367	23266	17805	20370	21477	19818	19470	17368	11310	9631	13395	16004

Fuente: Oficina Sectorial de Estadistica, Ministerio de Agricultura
Elaborado por: Guillermo Arce Sensebe

PRODUCCION DE LOS CULTIVOS--SAN MARTIN -- 1970-84

TM

ANOS	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
CULT. PROGRAM.															
CULT. CONS. HUM.															
ARROZ CASC.	20900	19720	13618	10013	6742	13190	11340	14355	25384	29873	34429	34898	61036	94211	93568
MAIZ AMIL.*	0	0	0	0	0	0	0	240	240	240	0	0	0	0	0
FRIJOL GRA.	3185	5320	2275	2805	3392	4125	4240	4085	3123	3620	2985	3172	5296	2587	5104
PAPA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRIGO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CONSUMO INDUS.															
ALGODON	1595	2009	2318	1480	1474	1027	1500	530	1824	3239	8019	9412	6033	2052	2793
CANA DE AZ.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOYA	27	8	42	43	91	50	101	159	298	405	361	1570	173	18	0
SORGO GRA.	0	0	0	0	0	480	800	1105	216	277	50	47	90	2	0
MAIZ AMR.*	27180	27930	23635	21320	21582	22881	25200	32076	46561	72637	56642	67875	84611	104199	129671
CAFE	4720	3900	2300	2115	1293	1467	1540	2210	2108	2577	2022	2159	1681	1100	2109
OTRO CULTIVOS															
CEBADA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLATANO	172800	205000	161520	161040	162504	162504	162500	151765	169830	182700	170500	154000	119707	99912	76943
YUCA	111600	122400	95000	96900	102000	75369	76850	61516	77154	57302	116142	171119	70447	25554	26368
QUINUA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIMON	1950	1875	1538	1625	1722	1768	1700	1750	1850	2000	1880	1920	1960	2064	2000
MANZANO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VID	270	313	327	328	337	414	450	390	420	450	540	540	540	540	540
*MAIZ GRA.	27180	27930	23635	21320	21582	22881	25200	32316	46801	72877	56642	67875	84611	104199	129671

Fuente: Oficina Sectorial de Estadistica, Ministerio de Agricultura
Elaborado por: Guillermo Arce Sensebe

VALOR BRUTO DE PRODUCCION DE LOS CULTIVOS--HUANUCO -- 1970-84

VALOR BRUTO DE PRODUCCION

AÑOS	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
CULT. PROGRAM.															
CULT. CONS. HUM.															
ARROZ CASC.	12959	21849	20865	19849	19905	13176	21777	21683	39236	67200	249193	289387	319102	327578	845373
MAIZ GRANO	60811	63233	86342	87637	89002	165663	191000	412478	613643	805360	1352941	1250621	141600	2843884	1171680
MAIZ AMIL.*	36430	42353	49077	48876	46904	49163	138500	208958	337643	456360	1015444	934876	781441	1737191	5029760
FRIJOL GRA.	11570	10172	12026	18103	19333	42812	39550	61650	109830	174150	347522	227186	78543	325696	817860
PAPA	306519	422772	374742	444214	651029	739150	803898	1438272	2637294	6689100	845859	5748996	14348067	39480951	51621088
TRIGO	17476	18127	19657	19344	19125	37976	37265	59140	65016	149200	594118	539802	522979	1313827	8445872
CONSUMO INDUS.															
ALGODON	50	57	0	0	0	0	0	0	0	0	0	0	0	0	0
CANA DE AZ.	2880	4800	7200	8640	8160	21000	30000	0	0	0	0	0	0	0	0
SOYA	0	910	729	950	1900	2280	4500	1536	1848	4050	16954	26390	10800	2400	0
SORGO GRA.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAIZ DURO	24381	20880	37265	38851	42098	116500	52500	203520	276000	349000	337497	315745	634566	1106693	2562329
CAFE	62682	47215	62707	67939	76134	93325	107296	341250	586250	814674	783861	508962	651903	1424876	6687040
OTRO CULTIVOS															
CEBADA	7863	13821	15959	18235	24533	52446	51510	107040	136844	156960	490050	748800	248700	581536	1346848
PLATANO	127062	81250	95845	136861	165756	162613	210560	826770	1299200	1588830	6627500	19890750	3497345	8349272	9388636
YUCA	41880	26131	44093	45583	54315	62201	127407	170594	215180	333375	578100	933192	1079460	3411067	2127549
QUINUA	1331	616	470	332	504	950	1305	3690	5292	5940	11680	32200	31614	29812	0
LIMON	3716	2882	4472	4865	6968	14897	14963	11435	16100	19950	35000	63000	58740	64953	65741
MANZANO	264	69	79	95	109	291	255	200	875	1250	1500	2000	1314	2108	25614
VID	450	450	--	--	--	--	--	--	--	--	--	--	--	--	--

Fuente: Oficina Sectorial de Estadistica, Ministerio de Agricultura
Elaborado por: Guillermo Arce Sensebe

VALOR BRUTO DE PRODUCCION DE LOS CULTIVOS--SAN MARTIN -- 1970-84

VALOR BRUTO DE PRODUCCION

AÑOS	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
CULT. PROGRAM.															
CULT. CONS. HUM.															
ARROZ CASC.	83600	74936	56000	53962	44446	108158	102060	193796	594576	1194932	1221736	2384528	5876200	1747316	4878069
MAIZ GRANO	51642	53067	54361	53300	65825	160167	226800	260209	681140	2045847	2107649	5565750	84661100	18080610	3925126
MAIZ AMIL.*	0	0	0	0	0	0	0	3600	6000	12000	0	0	0	0	0
FRIJOL GRA.	28665	45752	20358	35899	47828	68063	69960	164392	188392	2906600	383871	730290	1588800	2290374	734825
PAPA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRIGO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CONSUMO INDUS.															
ALGODON	7178	10044	9737	7622	8330	16943	30000	10608	72960	275277	787466	1946496	1766945	1674535	41890
CANA DE AZ.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOYA	199	64	70	135	660	450	975	3186	14880	28322	32288	186830	32870	4644	0
SORGO GRA.	0	0	0	0	0	3504	6000	8838	3131	7751	1891	3690	9317	220	0
MAIZ DURO	51642	53067	54361	53300	65825	160167	226800	256609	675140	2033847	2107649	556570	84661100	18080610	392510
CAFE	65136	44850	32200	32148	21069	30815	40040	265200	379440	902020	973734	997631	491911	1049411	55880
OTRO CULTIVOS															
CEBADA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLATANO	172800	246000	177672	185196	276257	495625	487500	758823	1273725	1827000	2557500	2310000	9576560	8134835	27720
YUCA	106020	116286	95000	101745	193800	226107	268975	184548	617232	687624	2322840	8555950	7044700	7666700	67790
QUINUA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIMON	2340	3188	2614	2194	2411	5921	5950	14000	18500	24000	188000	192000	294000	412900	4260
MANZANO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VID	2700	2817	3434	4055	4754	5837	6750	5850	8400	11250	324000	432000	540000	540000	610000

Fuente: Oficina Sectorial de Estadistica, Ministerio de Agricultura
Elaborado por: Guillermo Arce Sensebe

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