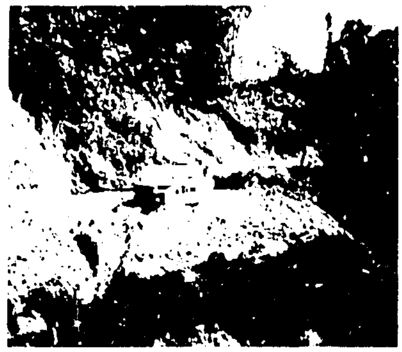
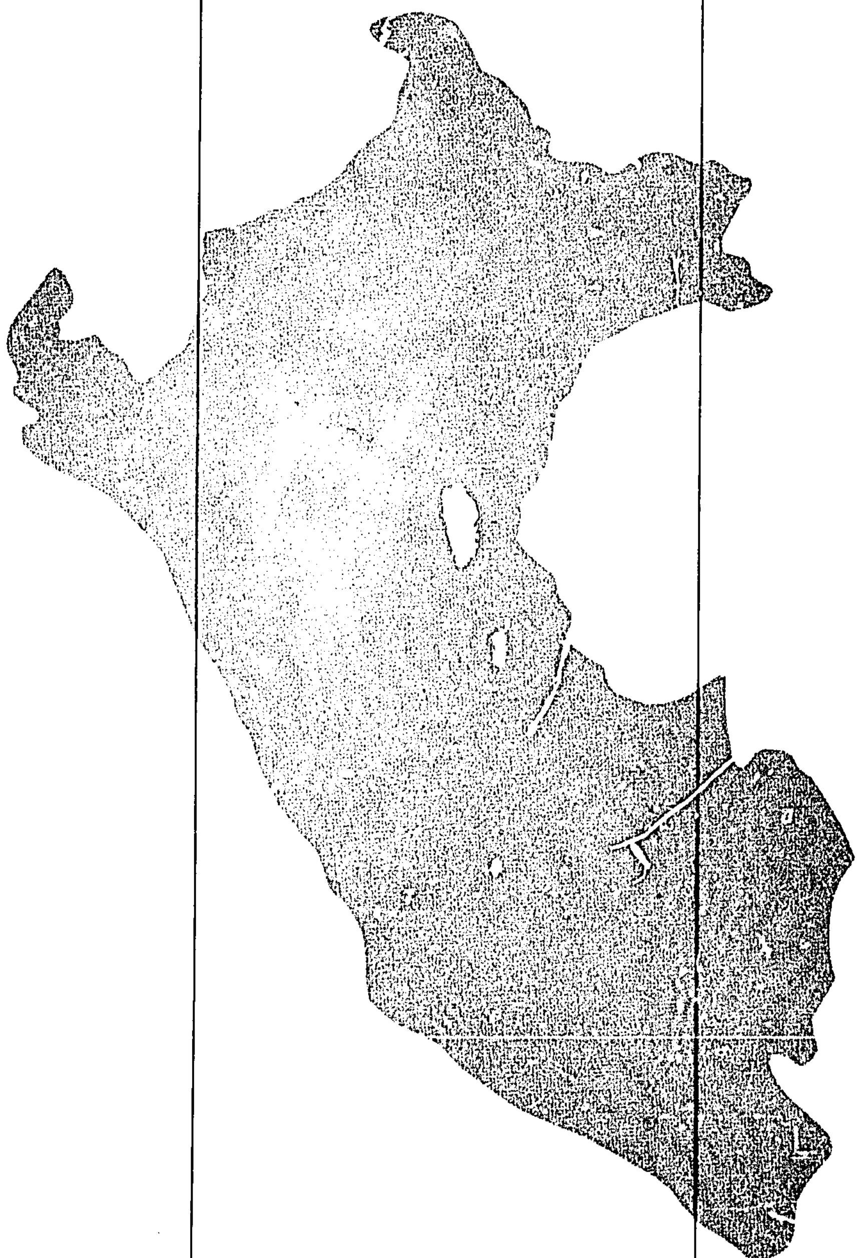
Volume II

Appendices





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APPENDIX A

FISH RESOURCES IN THE PALCAZU VALLEY:

EFFECTS OF THE ROAD AND COLONIZATION ON CONSERVATION AND PROTEIN SUPPLY

Peter B. Bayley

CONTENTS

ABSTRACT

The aquatic environment, fish ecology and riverine reptiles, are described. The largely subsistence fishery yielding about 590 tons per year, is by comparison with other fisheries, close to tne maximum expected. Moreover, the increasing commercial fishery downstream will almost certainly affect the stocks which typically migrate large distances. The illegal use of dynamite accounts for most of the fishing effort. It is very inefficient and destructive. The effect of road construction may limit the extent of upstream migration. Colonization may affect the hydrology adversely if the forest is not protected, and will also put undue pressure on the fish stock unless animal protein alternatives are found. These alternatives and costs are discussed, including fish culture.

1. INTRODUCTION

The approach to this assessment was limited by time, and I concentrated on learning a great deal by questioning experienced Colonist and Amuesha fishermen who had twenty or more year's experience. This information was subsequently compared and contrasted with my own experience with fisheries in the foothills of the Bolivian Andes (R. Pilcamayo), the Central Amazon in Brazil and Iquitos. In addition, published material on migratory fish of the same genera in south Brazil and Argentina have been essential in understanding viable life strategies in the context of the R. Palcazu and contimuous rivers.

It was also possible to make a collection of various genera whose specific identity was uncertain. These are to be deposited in the Museo Nacional de Ciencia Natural in Lima and the Smithsonian Institute for subsequent identification. This will provide additional baseline data with which to assess long term effects of colonization on species distribution.

2. THE AQUATIC ENVIRONMENT

Since many of the important fish populations are not confined to the R. Palcazu Valley, it is necessary to describe the system as far as the confluence of the R. Pachitea with the R. Ucayali.

The hydrology of any system controls the fish productivity in ways which are not obvious to those only familiar with the vastly altered temperate river systems (Welcomme, 1979). Certain types of flooding are essential for productivity, whereas others can be prejudicial. Slow, predictable flooding such as that which characterizes the Rio Ucayali is essential for maintaining the life cycles and productivity of the majority of commercial fish species. Short term or "flash" flooding, which can occur without environmental alteration in the montainous areas produces innundation of such limited duration and low predictability as to have no direct value as access to fish for feeding or spawning purposes. In addition, flash flooding often carries a high suspended inorganic sediment load which has effects described in chapters 3 and 6. In the Rio Palcazu and its tributaries there is no prolonged flooding, but flash flooding is frequent, especially during the months of December to February. These floods typically last for less than 24 hours. Since the river and its tributaries are very close to the major zones of precipitation, and the latter always exceeds evapotranspiration and by a similar amount, river flow rates closely correspond to precipitation on a month to month basis. Minimum flow occurs during July and August, mostly the latter, and maximum flow occurs in December, January and February, typically in January. In the middle Palcazu the typical high water levels are about 1.5 m. above the lowest level, but these are still 1-2 m below the river bank height which is only occasionally exceeded, by definition, by flash floods. At low water, transparency exceeds 5 m. Most of this river consists of pools and rapids or riffles, with waterfalls above the confluence of the Rios Bocaz and Pichinaz which form the Palcazu.

The whole system as far as the lower Pachitea has well-defined river courses in which braiding is limited (except for a section of the lower Rio Pozuzo) and ox-bow lakes are so infrequent as to be inconsequential. Table 1 shows the lengths of the major rivers. Table 2 shows the catchment areas of major components.

Only the lower Rio Pachitea, which is essentially part of the Ucayali floodplain with its complex of lakes, levées and connecting channels, is clearly within the slow, predicatable flooding definition.

3. FISH ECOLOGY

A checklist of the major species, including non-commercial ones, is given in Appendix 2. By far the most important species in terms of biomass and the fishery is the bocachico (Prochilodus cf nigricans) whose life cycle is described below. Other common migratory characoids including the sábalo (Bryon sp), corvina (not to be confused with another fresh-water "Corvina" in the Ucayali), (Salminus affinis), paco (Colossoma cf brachypomum. and lisa (Schizodon fasciatum) have very similar life cycles.

Prochilodus species typically undergo long migrations (de Godoy, 1950; Bonetto et al, 1964 & 1971; Bayley, 1973) and the information received in the Rio Palcazu supports this. There, the bocachico arrives from downstream in August and September and sometimes in July in the upper Palcazu. Typically they arrive in July, occasionally in June or August at San Pedro de Longin in the lower Palcazu. There are also resident subpopulations which had not previously migrated downstream. The newly arrived fish neither have large fat reserves (in contrast to the Rio Pilcomayo, Bolivia and Rio Mogi Guassy, Brazil nor mature gonads. Fat reserves are built up during subsequent feeding on organically-rich mud and detritus, in particular in the affluent streams. Ripe gonads are found from September to November. Females who have recently spawned are found in November and December.

Also, by analogy with what is known from the Rio Pilcomayo and Rio Mogi Guassu, there is little doubt that the bocachico spawns in the main river upstream. But being an open-water spawner with semi-pelagic eggs, there are no specific spawning sites such as with Salmonids. Since most spawning occurs on the first major flood, which would normally be in November in the Rio Palcazu, the eggs are carried downstream. Some early development may take place in the mouths of affluents, but no small bocachico (or sábalo, corvina or zungaro) were found or reported in the Rio Palcazu or its tributaries, despite the fact that specimens down to 2 cm. long are exact replicas of their respective adults. The smallest bocachico reported are 12 cm. long, but most of the immature migrants have a model length of 17-18 cm which would represent fish born the year before.

The reported minimum size of sábalo and corvina is 18 cm, that of paco 30 cm, and of zungaro 50 cm.

Adults or immature fish stay upstream during the high water period but some (I think the major part) go downstream with the flood water. Some fishermen report the capture of bocachico at successive downstream locations on the main river, typically after the first flood when most adults probably spawn. But some adults and immature fish remain upstream, especially in the affluent streams, which are enlarged during the high water period.

Nursery grounds are known to occur in flood-plain habitats (Bonetto et al, 1969; personal observation in Central Amazon) and the nearest place where these occur is in the lowest part of the Pachitea. The implication that annual migrations cover 500 Km of river are not absurd, since marking experiments of Prochilodus and Salminus (Bonetto et.al. 1964, 1971 de Godoy, 1959) have demonstrated annual migrations covering at least 600 Km of river. Indeed it is possible that the life cycles include part of the R. Ucayali.

It is not clear why there are migrations of immature bocachico, sábalo and corvina in the Palcazu as indeed occurs in equivalent ecological settings in S. America and Africa. In the Palcazu, younger fish tend to spread themselves throughout the basin whereas the adults tend to move further upstream, more or less as a unit in September to October.

Large paco (up to 20 Kg.) and zungaro (up to 80 Kg) appear to stay upstream in the large pools, the former eating fruits, flowers and leaves; the latter eating fish, in particular bocachico. The relationship between flooding and food supply can be complex. For example, the annual flooding regime is essential for the high biological production of many species, including bocachico. In the floodplain, detritus resulting from the alternate aquatic and terrestral macrophyte production and decay provides direct food for bocachico and indirectly supports most commercial fish species. However, flash floods in the upper reaches of systems such as the Rio Palcazu carry inorganic sediment and the bocachico stop feeding due to the temporary coating of the bottom with a film of undigestible material. On the contrary the piscivorous zungaro is able to feed during floods due to the poorer visibility of the water. Even on clear nights prey can escape the zungaro when the water is very clear.

Non-migrating fish species are of little importance except for the many carachama (armoured catfish) species of the Loricariidae family which apparently do not migrate.

The most common non-migrating species of the other families are the piraña, uasacu, añahua, bujurqui and small Tetragonopterinae. The first two are of some importance as food.

"Migration" is used here to mean extensive longitudinal migrations necessary for successful life strategies. The flash floods described above can be so severe in terms of suspended load that gills become coated with enough fine particles (probably flocs of clay minerals) to restrict respiration, sometimes to the point of death. But most fish escape by moving downstream until they find the nearest non-flooding affluent or backwater. Since flash flooding is the result of localized cloudbursts, not all streams in a given catchment area flood violently at the same time. These processes, which are reported from over 20 years ago, before any forest cover in the upper catchment area was removed, are natural, although their frequency has increased recently (See Chapter 6). These constant evacuations and redistributions of fish result in a similar species composition in the main river and the tributaries. Also there is low fish diversity and species with wide geographical distributions. Without an intensive, year round sampling program which would include the few lakes in the region, I cannot be certain that no species endemic to the R. Palcazu exist. But I consider it unlikely in the rivers and streams where environmental damage is most probable. This situation contrasts with the high species diversity in small streams in eastern Bolivia and the Central Amazon which do not suffer violent flooding with high sediment load (personal observations).

4. PRESENT FISHERY, YIELD AND POTENTIAL

4.1. Gear

Dynamite is the most common method used in both the main river and tributaries. In fact one could conveniently measure fishing effort by recording the frequency of explosions in a given range. Usually, half a stick tied to a stone and wrapped in thick paper is thrown in likely places. In shallow areas most fish stunned are recovered unless the water is turbid, but unfortunately the method is also used in the deeper pools where fishing mortality is much higher than recovery. As with any fishing gear fish have adapted to some extent. When the fuse is burning many fish escape (in particular large paco) probably because they can hear it. This has resulted in the use of even shorter fuses, the hazard resulting in the occasional armless fisherman.

The tarraya on castnet is also used, and is effective in shallow water except when it is very clear. It can then be used at night effectively. Fish have learned to avoid the tarraya to some extent by migrating near the center of large rivers. Tarrayas are used effectively in the smaller tributaries also. It catches mainly bocachico and other large characoids, but not large catfish or paco which are in the deeper pools. Hook-and-line is used for paco and large catfish, in particular zungaru in the large pools at night. In the shallow runs a "spinner" or "spoon" is successful for sábalo and corvina by day.

Traps at tributary mouths catch many fish species moving into the main river when the water is subsiding in March to May. Traditionally these have consisted of a fence of saplings and leaves with a collecting chamber in the middle. A similar effect is now obtained by using a gillnet of about 10 cm stretched mesh, but which has the advantage of allowing smaller fish, such as one-year old bocachico, to pass through.

Harpoons are used at night with light to catch zungaro as they come into the shallows to feed.

Bows and arrows were used more often in thepast by the Amuesha, but the case of using dynamite has resulted in its decline.

Chemofishing using barbasco is reported to be rare (as opposed to parts of the Pichis Valley) which is fortunate since it is even more damaging to fish resources than dynamite.

No seine nets are in use in the Palcazu.

4.2. Seasonality of Fishing

Certain items of gear are used seasonally as is described above. Overall, fish catches drop during the highest water period in December and January. However, this is most marked for communities only living near the main river. As mentioned above, not all fish move downstream after the first flood, and residents can be caught in the smaller, shallower tributaries, in particular small and adult bocachico and sábalo. Also most or all of the large zungaro and paco remain and can be caught by hook-and-line.

During other months, lowering of the water level does not necessarily increase catches as the fish become more wary in the clearer water. However, catch per effort increases in August - November when new arrivals migrate from downstream.

Because of the fact that at least 90% of the catch is consumed locally and there are limited opportunities for export of excess catches, catch per effort varies more than total catch.

4.3. Yield

Since there are no fish markets or commercial operations, and fishing effort and catch per effort are diffuse and occur during different times during the day, methods of estimating yield from direct catch observations would be highly inaccurate and expensive.

Fortunately there exist various sources of information on local, daily consumption of fish, including one from the Shiringamazu community on the Rio Palcazu from mid-March until mid-May (Table 3), The mean of this data is 122 g of fresh fish per person per day which includes a small quantity of salted fish converted to fresh weight. This compares with an estimate by Gavinia (1980) of the Campas in the Pichis of 175 g/person/day. He also estimated game meat at 108 g/person/day and domestic meat (cows and chickens) at 21 g/person/day.

Applying the Rio Palcazu estimates for the estimated population of 12,000 in the catchment area as far as the Rio Palcazu's confluence with the Rio Pozuzo on a year round basis gives a subsistence yield of 530 tons. Assuming a maximum of 10% of the total yield is exported by SASA to San Ramón, a total yield of about 590 tons is estimated. This is equivalent to a gross value of about 240 million soles (US$570,000). There is no data on species proportions, but on the basis of interviews I have estimated that 70% of the total yield by weight are of bocachico, 15% of zungaro, 10% of sábalo and the remaining 5% of mainly corvina, paco and piraña.

4.4. Potential yield

As is the situation with any other fishery in the world, it is not possible to estimate potential yield with any degree of reliability using primary productivity and food web efficiencies of energy transfers from one level to another. We need to turn to comparative data from ecologically-similar systems under long-standing fishing effort. Arguments have been put forward (Bayley, 1981) that the African river-floodplain systems are comparable in terms of total yield under a moderatly intense artesanal fishery. Welcome (1976) has compared the yields of 18 African river systems of "normal" floodplain development and explained 90% of the variance of the logarithms of catches by the logarithm of main channel river length, and 88% by the logarithm of the catchment area. The whole Pachitea-Pichis-Palcazu basin would be expected to yield 900 tons (upper and lower 95% confidence limits of about 1500 tons and 500 tons), if subjected to a similar artesanal fishing pressure as in Africa. Since the Palcazu basin (up to the Pozuzo confluence) is yielding 590 tons, but is only one ninth of the total catchment area (Table 2) it is already yielding more than an equivalent-sized African river. This is almost certainly not due to higher fishing effort in the Palcazu compared to that in the much more densely-populated African rivers.

It may be due to the much higher rainfall in the Palcazu than the average African basin. More probably it is due to the arbitrary selection of the basin as being down to the mouth of the Rio Pachitea. It is highly probable that the extensive floodplain of the Rio Ucayali contributes fish to the system. As Welcomme (1975, 1976) has shown, basins with extensive floodplains (of area more than 1% of the catchment area) produce considerably more fish.

Two factors emerge. Firstly the Palcazu is already well exploited due to the high per capita fish consumption rate. Secondly, any management must take into account the commercial fleet based at Pucallpa. This is expanding in the Rio Ucayali system and is already fishing in the lower Rio Pachitea.

5. RIVERINE REPTILES

This chapter is confined to observations of the lagarto or caiman (_Caiman Sclerops_) and the turtle (_Podocnemis unifilis_). Neither the black caiman (_Melanosuchus niger_) nor the large river turtle (_Podocnemis expansa_) occur as far upstream as the Rio Palcazu. Smaller reptiles were not observed, and observations were confined to the Rio Palcazu.

Counts were made descending from the Iscozacín confluence tothe Rio Pachitea. The maximum count of turtles was 18 and that for caiman 45. These are both underestimates. With warm, sunny conditions turtle counts increased, but caiman tend to shelter in shoreline vegetation. However, both species were apparently most abundant between the Rio Chuchurras and Rio Lagarto confluences. Large numbers of caiman are reported from within these tributaries also. From Iscozacin upstream to Loma Linda 6 caiman and 3 turtles were counted.

Caiman are not exploited for their skins and rarely for their meat, but they had been shot for sport which decimated their number considerably between about five and ten years ago. Local reports indicate that there has been a marked recovery in recent years.

Turtles are exploited for both their meat, and eggs and they are extremely vulnerable to over-exploitation.

6. EFFECTS OF ROAD CONSTRUCTION

There are already effects due to the present road construction from Villa Rica to the Rio Pichinaz, which borders the Rio Cacazu for about 24 Kms. Formerly bocachico reached this stretch despite the waterfalls and lower temperatures. The road has filled the pools with rubble and silt, and the bocachico no longer reach this stretch. The exact cause is not clear, since dynamiting by road building crews was also prevalent

The road is planned to follow the Rio Cacazu until it forms the Palcazu and follow the latter as far as the Rio Barbón: a total of about 28 Km in addition to the 24 Km mentioned above.

The fact that the upstream extent of migration will be almost certainly further inhibited should not in itself give rise to concern about the survival of the bocachico stock as a whole. Almost complete deforestation prior to 1969 in the upper Rio Pilcomayo in Bolivia has indirectly affected the extent of upstream migration of bocachico. But the stock survives and has supported a large fishery lower downstream for the last ten years. But that fishery would probably have yielded more fish without that drastic environmental alteration. The point is that bocachico (and corvina) are open water spawners and do not require specific spawning sites, and partial limitation of upstream migration is unlikely to eliminate the stock.

There are however, two considerations which give rise to concern. Firstly, the supply of fish to the people of the upstream communities at Loma Linda, Santa Rosa and Lagunas is likely to be affected adversely. Secondly, increased suspended load in the Rio Palcazu will affect the subpopulations of fish which remain in the river during the high water period, in particular that of bocachico whose feeding would be adversely affected. Much of the present fishing depends on these sub-populations.

In the Rio Pilcomayo they do not exist, but this is mainly due to the very limited number of tributaries. This results in a highly seasonal fishery depending entirely on the migrants from the floodplain downstream. I would not expect such a drastic change to occur in the Palcazu system on the basis of the road construction alone, but widespread removal of the protection forest would relegate the major tributaries to the same status, and result in fresh fish protein shortages for eight months of the year.

In conclusion, the positioning of the upper section of the road is unfortunate from the point of view of the fisheries. Very harmful effects to the fishery as a whole can be avoided if there is prevention of (a) deforestation along this section, (b) dumping of material in the river, and (c) dynamiting of fish by construction workers.

7. EFFECTS OF COLONIZATION

The golden rule in maintaining a fishery is maintenance of the hydrological regime, which is meant to imply water quality as well as supply. Fisheries can recover rapidly from the most misguided management strategies or gross overfishing providing that the above rule is respected. This means two things. Firstly the protection forest must be protected. Secondly, river bank erosion must be limited in suceptible zones by preventing deforestation right up tothe water. Some zones in the Rio Palcazu below the Rio Pozuzu are very susceptible. Fortunately in most parts of the Rio Palcazu upstream the course of the river is well maintained by bedrock.

It should be clear from Chapter 4 that the fishery cannot be expected to support more people at present at the same level of fish protein consumption. Even the present human population may be affected by increased fishing by the Pucallpa fleet, which is supplying fish for expanding markets within and without Pucallpa such as Tingo Maria. One has to look at the situation with respect to all sources of animal protein, which is discussed in the following chapter.

The worst possible scenario resulting from increased colonization would be a devastation of the fish resources due to immediate demands for animal protein which would most easily be satisfied by the widespread use of dynamite.

8. THE FUTURE OF FISH AS A SOURCE OF ANIMAL PROTEIN TO THE REGION IN THE CONTEXT OF ALTERNATIVES

When attempting to plan the colonization of a new area much attention is paid to cash crops but little to the food supply of the colonists themselves. It is often implicitly understood that the cash crops will support a market economy in which campesinos will be able to buy whatever extra sources of animal protein they need. This may be correct in the longer term, but short term difficulties leading to protein defficiencies can occur, as I have observed in colonization projects in similar areas in Bolivia.

It should be clear from the above estimates that the fishery plays the most important role in animal protein supply for the present population. However, even if management were improved, it should also be apparent that increased fishing effort is unlikely to increase the yield. In fact the latter may reduce due to increased pressure from the Pucallpa fleet and colonization in the Rio Pachitea region.

There are a number of other sources of animal protein which will be considered in turn:

8.1. Game Meat

This is at present the second most important source of protein in the Palcazu. In some areas it is a primary source, in particular during December and January. However, with increased colonization it will inevitably become scarce and more expensive either in terms of price or time invested in hunting.

8.2. Livestock

Locally produced beef sells for about S/ 650/Kg compared with fish which range from S/ 300 - S/ 500/kg and chicken at about S/ 800. I would think that it would be relatively easy to reduce the price of chicken through increased production.

Because of traditional dependence on fish and game meat, little effort has been made to raise animals. Whatever happens to the fishery, this will have to change. Chickens, pigs, cuys, geese and ducks are obvious candidates.

8.3. Marine Fish from Lima

This may sound preposterous, but at present markets in Villa Rica and San Ramón are being supplied with fresh fish at least on Fridays and Saturdays. Retail prices vary from S/ 350 to S/ 900/kg, the price depending more on the condition of the fish than the species. In contrast chicken was selling for S/ 850/kg and beef for S/ 900/kg in San Ramón. Fish from Lima needs to arrive within 24 hours of capture and some losses occur. Freight costs are S/ 15/kg from Lima to San Ramon (300 Kms) and S/ 20/kg from Lima to Villa Rica (380 km). Since Iscozacín would be 100 Km further on from Villa Rica by road, it is conceivable that marine fish would be competitive in the Palcazu if local shortages drove the price up and the fish from Lima did not spoil.

8.4. Fish from Pucallpa

The fishery at Pucallpa is based on the highly productive Rio Ucayali floodplain. However, road connections via the proposed road via San Ramon are very distant. The proposed connection via the "carretera marginal" from San Alejandro would shorten the road distance from Pucallpa to Iscozacín to about 270 km. This may take too long for fresh fish at selva baja altitudes, but a salted fish trade may be feasible. However it will be some time before this road connection is made, and one cannot guarantee that Pucallpa fish merchants would be interested.

The present freight rate by river from Pucallpa to Iscozacín is S/ 130/ kg, a route which is not possible for one or two months each year. I suspect this price is too high to interest Pucallpa tradesmen.

8.5. Fish Culture

A present this is very undeveloped in Peru, but I believe that attempts at an extensive, non-sophisticated level should be tried providing certain conditions are satisfied:

1. Nothing more sophisticated than growing fish caught as one-year olds in the river should be attempted. The best candidate is bocachico of which, as mentioned in Chapter 3, young specimens of 12-20 cm appear in the Palcazu in August and can be caught by tarraya. Also the omniverous sábalo is a promising candidate if sufficient smaller specimens can be caught.

2. Siting of the reservoir is critical. Water should be fed by gravity for convenience and cost reasons, but the flash flooding mentioned above could require the construction of a by-pass more expensive than the reservoir itself. This was born out by the fish culture experiment of Mr. Zehender Sarmiento, who lost his paco during a flood. Siting should also result in an area and depth of reservoir such that deoxygenation problems do not cause fish kills during cold nights. Siting is so crucial that only some landowners can seriously consider trying fish culture under the present technological and economic circumstances. However, I have found some sites where it was suggested the method should be tried with young bocachico, and have discussed possibilities with the owners.

9. SPORT FISHING AND TOURISM

Obviously the protein requirement of the inhabitants should be top priority. But in the future it is conceivable that alternatives will have been developed to the extent that the food fishery is less important and may even fail to be competitive with alternative protein sources.

The opportunities for sport fishing and the attendent income from tourism would be excellent if the hydrology and fishery have been well managed. Sábalo and corvina are in the opinion of many to be superior to salmon and trout as sport fish, and can be caught by identical gear. Also the much larger zungaro and paco would be favored by bait fishermen in pools.

The international market for exotic sport fishing is good, especially for Japanese and North American tourists, and has hardly been exploited in Perú.

10. CONCLUSIONS AND RECOMMENDATIONS

The present fishery is not expected to respond positively to increased fishing effort. In fact the present effects of dynamite and/or increased effort from the Pucallpa fleet may reduce the yield. However, maintenance of the fishery is vital, being the most important source of animal protein.

The management of the fisheries in the Pachitea basin jointly with the Pucallpa fleet present enormous logistical difficulties. However, maintenance of the hydrological regime and serious efforts to persuade fishermen to comply with the law against dynamite should be undertaken. Half stick of dynamite costs S/ 500 compared with a tarraya (cast net) costing S/ 20,000, and yet the latter lasts about two years. In terms of gear costs the tarraya is many times cheaper for a given catch. It is only less efficient than dynamite during July and August when the water is clear, but can be used effectively at night. Education in the schools about the effects of dynamite is essential, and I have talked to the Regional Education Director about this.

If dynamite is effectively banned, I do not consider that a closed season ("veda") during the spawning period is necessary. It is a popular misconception that catching a female during its spawning period is more harmful than catching the same female at any other time of the year. The effect on population fecundity is virtually the same.

However, if some sort of management other than mere enforcement of the present regulations is indicated by a downward trend in total catch, a flexible closed season will probably be the only profitable method. The combined effects of natural and fishing mortality reduce the biomass of the fish stocks to a minimum during the low water period.

But obviously one has to monitor the fishery and provide evidence whether total catch is declining or not. It is essential that surveys of per capita fish consumption be made annually during March (or February or April) and September (or August or October). These surveys should include animal protein from different sources as Gaviria (1980) did in the Rio Pichis, and should break down the fish consumption by species.

Recommendations for implementation in the near future are summarized below:

1. Stop use of dynamite for fishing. This should be done indirectly through education and directly through the cooperation of riparian landowners.

2. Per capita consumption of different sources of animal protein should be made during two months each year, preferably around March and September. Fish consumption should be broken down into major species and whether fresh or salted.

3. Human population in the area should be estimated annually by accounting for imigration and emigration. Combined with recommendation 2 and fish exports, total annual catch can thus be estimated.

4. Conservation of the hydrological regime is of paramount importance. Removal of the protection forest will result in violent changes in river discharge and a much reduced, highly seasonal fishery. In addition, a strip of at least 30 m wide of forest should remain on river banks, unless there is very clear evidence that bank erosion will not occur because of substantial bedrock.

11. ACKNOWLEDGEMENTS

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13. SCHEDULE

12/13 July	Halifax - Lima
13-18th July	Collection of data in Lima pertaining to hydrology, fish species, reptile species, per capita fish consumption
20th July	Lima - San Ramon - Iscozacín
21st July	Canoe journey upstream (Rio Palcazu) Iscozacín-Loma Linda. Fishermen interviewed
22nd July	Canoe journey downstream to San Pedro de Longin. Fishermen interviewed. Reptiles counted
23rd July	Canoe journey from San Pedro de Longin to commencement of Rio Pachitea (Pto. Victoria) and return. Reptiles counted.
24th July	Fishing expedition to Rio Yamushimás, affluent of Rio Palcazu near San Pedro de Longin
25th July	Return journey to Iscozacín. Night fishing in Rio Palcazu
26th July	Daytime fishing in Rio Palcazu
27/28th July	Interviewed fishermen from Iscozacín and surrounding communities, including upper reaches of major tributaries.
29th July	Iscozacín - San Ramon - Appraisal of fish prices and origins in San Ramon. Report preparation begun
30th July	San Ramon - Lima
31st July	Data collected from IMARPE, Lima
1st August	Data Preparation
3 - 8 th Aug.	Report Preparation
9th August	Depart Lima

14. CHECKLIST OF FISH SPECIES (found or reported during this study)

Scientific Taxa	Common Name	Observed	Preserved
Sub-Order Characoidei			
Family Characidae			
Brycon cf melanopterum	sábalo	yes	no
Salminus affinis	corvina	yes	yes
Charax sp. 2	mullón	yes	yes
Raphiodon sp.	machete	no	-
Triportheus angulatus	sardina	no	-
Acestrorhynchus sp.[1]	-	yes	yes
Tetragonopterus argenteus	espejito	yes	yes
Astyanax sp.	pushi	yes	yes
Moenkhausia sp	-	yes	yes
Family Prochilodontidae			
Prochilodus cf nigricans	bocachico	yes	yes
Semaprochilodus sp.[2]	bocachico de Ucayali	yes	no
Family Curimatidae			
Curimata cf laticeps	yahuarache	yes	yes
Curimata spp.	-	yes	yes (2 spp)
Curimatella sp	-	yes	yes
Family Serrasalmidae			
Colossoma cf brachypomum	paco	no	-
Serrasalmus sp.	piraña	yes	yes
Mylossoma sp.[2]	palometa	no	-
Family Anostomidae			
Schizodon fasciatum	lisa	yes	no
Leporinus cf friderici	lisa	yes	yes
Family Erythrinidae			
Hoplias malabaricus	uasacu	yes	no
Sub-order Gymnotoidei			
Electrophorus electricus	anguila electrica	no	-
Order Perciformes			
Family Cichlidae			
Aequidens cf tetramerus	bujurqui	yes	yes
Crenichichla spp.	anashua, anwashi	yes	yes (2 spp)
Order Rajiformes			
Potamotrygon sp.	raya	yes	yes

Order Siluriformes			
Family Pimelodidae	zungaro	no	-
Zungaro zungaro (?)	(probably 2 spp.)		
Pseudoplatystoma fasciatum	doncella	no	-
Pseudoplatystoma tigrinum	charagua	no	-
Pimelodus sp.	cunchi	no	-
Family Doradidae			
Pterodoras cf granulosus	piru	yes	no
Pseudodoras cf niger	Turuchuqui	no	-
Family loricariidae (many genera and species; only Plecostomus spp. observed)	carachama	yes	no
Family Salmonidae 3 Salmo gairdnari	trucho	no	-

1 Only reported from lower Rio Palcazu

2 Large species reported to be found infrequently in Rio Palcazu

3 Reported with accurate description from the upper Rio Iscozacin by J. Frantzen; this exotic species probably introduced itself from the Rio Pozuzo.

TABLE 1

LENGTHS OF RIVER (From ONERN 1970)

Rio Palcazu	182 Km.
Rio Bocaz	36
Rio Pichis	130
Rio Cacazu	35
Rio Pachitea	330
Main channel length to mouth of Rio Pachitea	548

TABLE 2

PRINCIPAL CATCHMENT AREAS

Basin	Area (Km2)
Pachitea (inc. Palcazu, Pozuzo, Pichis)	27,900
Pichis	9,500
Pozuzo	5,800
Palcazu plus Pozuzo	9,800
Palcazu as far as Pozuzo confluence	3,400

TABLE 3

PER CAPITA CONSUMPTION OF FISH IN THE SHIRINGAMAZU COMMUNITY, RIO PALCAZU DURING MID-MARCH TO MID-MAY (FROM ENCUESTA DE CONSUMO DE PESCADO, IMARPE - PROGRAMA BILINGUE) 1972*

Number of week in the year (1972)	Kg of fresh fish	Kg of salted fish	Equivalent fresh wt Kg	Number of persons	Per capita Consumption (grms. per day)
13	54	9	76.5	127	87
14	98	-	98	195	68
15	130.5	-	130.5	258	72
16	170	-	170	166	146
17	89	-	89	73	174
18	79	-	79	76	148
19	71	-	71	77	132
20	79	-	79	75	150

Mean per capita consumption = 122/g/day of fresh fish

* Data supplied by Sr. A. Lander, IMARPE, Lima

APPENDIX B

REPORT ON THE EVALUATION OF LAND USE CAPACITY

Rafael A. Bolanos M.
Vicente Watson C.

CONTENTS

27

1. INTRODUCTION

The present report evaluates general aspects of the classification of the Major Land Use Capacity by the National Office of Natural Resources Evaluation (ONERN) for the Palcazu Valley.

Work consisted of visiting a large part of the valley, mainly relating bioclimatic conditions with the Major Use Land Capacity map prepared during the present year. In addition, we had a preliminary Land Qualification map of this same area, which has not yet been published and which is being prepared by the National Agrarian University at La Molina. Since this last map is not yet finished and because of its general nature, this map was not taken into consideration to make observations, thus prefering the ONERN map on which this report is based.

After comparing ONERN's map and report with the Ecological Map of the Palcazu and with observations made in the field, we offer some suggestions and ideas for possible changes in this map. Far from being a criticism of ONERN's work, we believe that these suggestions can at least serve as a basis for discussion of some points or aspects that might be in error, as is the case of the bioclimatic factor, which was considered similar for all the area studied and in a more mild form than what it really is.

2. OBSERVATIONS ON MAPS

2.1. Ecological Aspects

The ecological aspect is very important for land capability classification. When the land classification study of the Palcazu was carried out, only the Ecological map of Peru at a scale of 1:1,000,000 was available. At present there is an ecological map of the zone at a much larger scale (1:100,000), specifying strong changes that negatively affect land classification, since all the valley had formerly been classified as Tropical moist forest, and the greater part of it belongs to the life zones: Premontane wet forest, transition to Basal and to Tropical wet forest, which have more limitations for use.

2.2. Edaphic Aspects

ONERN technicians express in their Palcazu study the problems of the soils of the area: strong acidity, low natural fertility, high content of interchangeable aluminum and heavy textures. To this must be added the low capacity of some of these soils to eliminate water from their surface.

2.3. Technological Aspects

Of the total clean-tilled crops (16% of the area), the greatest portion (12%) belong to sub-class A3S. This sub-class was included in this group but having many restrictions for its use. It also assumes the application of doubtful technology in the zone, and above all, very difficult to control.

3. SUGGESTED RE-GROUPING OF SUB-CLASSES OF ONERN LAND USE CAPABILITY

Taking into account the observations made on maps and other concepts expressed later, a new re-grouping and distribution of sub-classes was made according to their aptitude, which is shown on the following table:

<u>Grouping of Sub-classes of Use Capacity (of ONERN); considering Life Zones and other criteria</u>

Sub-classes of Major Land Use Capacity

Life Zones	Row Crops (A)	Pastures (P)	Permanent Crops (C)	Forestry Production (F)	Protection (X)
T-mf	A2i A2s A3s	C2S C2es	C2es (*)	P2s P2es F1 F2es	Same as ONERN
P-wf	A2i A2s	A3s	C2s C2es	P2s P2es F1 F2es	" " "
T-wf	A2i	A2S	A3s C2s	C2es C2es (*) P2s P2es F1	" " " F2es

According to this suggested re-grouping for the Major Land Use Capacity subclasses presented on the ONERN map, a fast percentage estimate is made of the seasonal crop Groups; pastures, permanent crops, forestry and protection, using the same map as a base. These number are only a reference of the possible modification and cannot be taken as final form.

GROUP	A	P	C	F	X
ONERN (%)	16.8	8.9	24.0	36.7	13.6
Suggested (%)	6.5	9.0	18.1	50.7	15.7

3.1. Most Important Changes

The most important changes are:

a) Decrease of area suitable for clean-tilled crops

b) Decrease of area and change of units suitable for pastures

c) Circumstantial increase of area suitable for permanent crops

d) Increase of area suitable for forestry production

3.1.1. Decrease of Area Suitable for Clean-Tilled Crops

The area suitable for clean-tilled crops is reduced considerably (more than 50%) due to the fact that sub-class A3s should not be assigned for this use on account of its strong fertility limitations, acidity and high concentration of interchangeable aluminum. In addition, the more humid Life Zones limit this use category, which reduces in large part the area.

3.1.2. Decrease of Area and Change of Sub-Classes Suitable for Pastures

We disagree with the authors of the map in regard to the interpretation of the effect of poor drainage on Major Land Use Capacity. ONERN technicians classified poorly drained lands as apt for pastures, which appears risky, due to the possibility of producing in these sites an irreversible process of soil degradation. Such a process would be favored by the nature of the soils: heavy textures, slow infiltration and also by the deficient soil management, as well as by high rainfall in the area. Under these circumstances, it is possible that cattle trampling would produce soil compaction to such an extent that it could be limiting even for livestock activity itself and for the majority of production activities. For these reasons, it is considered that Forestry Production is the best alternative use for these types of soils. This is the case for sub-classes P2s and P2es. For the same reason, subclasses C2s and C2es, classified by ONERN as suitable for permanent crops, but with the option to be used for pastures, should be better defined as suitable only for Permanent Crops, except in the Moist Tropical Forest Life Zone because of its lower humidity. The most important subclass from the point of view of extension, is A3s, which has a flat topography, good drainage and low fertility.

3.1.3. Circumstantial Increase of Area Suitable for Permanent Crops

ONERN classified 24% of the area in the Permanent Crops group, but sub-classes C2s and part of C2es, are put with the option of pastures. Taking into account the trend towards livestock that the majority of the valley inhabitants have, it can be expected that any opportunity in this sense will be used. If this principle is valid, it can be said that the area with maximum aptitude for agricultural use (Permanent Crops) would triple approximately from 5.3%.

3.1.4. Increase of Area Suitable for Forestry Production

Several sub-classes were added to the Forestry Production group. Among the most important are those classified by ONERN as suitable for pastures due to their poor drainage. Also included here were the sub-classes with greater limitations due to slope, soil erodability and low fertility, when these are found in the more humid Life Zones. This is the case of sub-classes C2es and C2es (*) in the Tropical wet forest.

4. POTENTIAL OF THE VALLEY

Basically all the area classified according to the new sub-class grouping as apt for Clean-tilled Crops and Pastures, are already being used for these last two, which represents approximately 15% of the total area. But not only this area is used for pastures, but also the greater part of that suggested for Permanent Crops. This involves risks of soil degradation as mentioned earlier. The other two strong alternatives are, according to the new grouping of sub-classes, Permanent Crops and Forestry Production. Approximately 18% of the area is suitable for Permanent Crops. It is known beforehand that the majority of Permanent Crops are not adapted to the ecological conditions of the zone, but there is always the possibility of selecting at least a few that can be adapted. In this manner, if a test fails for a crop, there are always other feasible alternatives, while this would not happen with pasture uses. Therefore, a very important problem to be solved in the Palcazu Valley, in order to be able to

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* Subdivided into suitable and non-suitable for pastures

draw out efficient and non-destructive agricultural development plans, is the selection of Permanent Crops that can adapt to the following conditions: relief from flat to gently undulating, marked acidity, heavy textures, moderate drainage, very low fertility and average annual rainfall of 3000 to 4000 mm. It is preferable not to use heavy machinery to avoid soil compaction.

Definitely the strongest point in the Palcazu Valley is Forestry Production, for approximately 50% of the area is suitable, but unfortunately at present there are problems of socio-economic acceptance of forestry, hence its development requires vast implementation programs.

5. CONCLUSIONS AND RECOMMENDATIONS

Changes found in the new ecological mapping of the Palcazu affect the classification of the Major Land Use Capacity, tending to put more restrictions than those which had been made previously by the ONERN technicians. Such restrictions result in: decrease of the area suitable for "Clean-tilled Crops" of approximately 50%, around a 60% decrease in the area with the option to be used for pastures, and an increase in the area whose maximum use is exclusively for Permanent Crops to approximately double, and also an increase in the area whose Major Use Capacity is Forestry Production. According to a rough calculation of the area, this means that 50% of the area has Forestry Production as it maximum suitability, 18% for Permanent Crops and 9% for Pastures. Only 6% would be for "Clean-tilled Crops".

We agree with ONERN in the multiple limitations expressed for some of the soils of the area, adding serious problems with respect to drainage and percolation. However, we do not agree with the way of confronting these problems, since the hope of a significant improvement in soil management practices does not seem advisable, it being preferable to lower their category in the priority scale at the time of classification.

In ordering priorities, it is better to place Pastures before Permanent Crops, owing to the greater requirements of the first with respect to soils, especially its high degradation power, either by erosion, compaction, or both.

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APPENDIX C

REPORT ON THE ECOLOGICAL MAP OF THE PALCAZU VALLEY

Rafael A. Bolaños M.
Vicente Watson C.

CONTENTS

1. SUMMARY

A detailed ecological map of the Palcazu valley, located in the central jungle region of Peru, was prepared to assist a rural settlement project. Dr. Holdridge's Life Zone Classification system was used and due to the lack of meteorological station data from within the valley, mapping was done based solely on vegetation. This valley was included in the Ecological Map of Peru at a scale of 1:1,000,000, but changed considerably in the new mapping noting the increase in humidity.

New mapping was prepared at a scale of 1:100,000 and in it were differentiated six life zones and four transitions. The bottom of the valley which is the part of great interest from the agri-livestock potential point of view, covers three life zones: 40% in Tropical wet forest , 45% in Premontane wet forest, transition to Tropical wet forest, and 15% in Tropical moist forest. Of these, the first is most restricted for livestock production, the second is a little less restrictive, and the last shows more favorable conditions for agri-livestock activities.

2. INTRODUCTION

AID, through JRB Associates, Inc., contracted two consultants to carry out the preparation of a detailed ecological map of the Palcazu valley located in the Central Jungle region of Peru.

This map was prepared at a scale of 1:100,000 and it shows the Life Zones present, including the most important transitions. The bottom of the valley and the San Matías range were worked on a good base map at a scale of 1:25,000, with contour lines each 25 m.,while the Yanachaga range was approximated and the southern part of the watershed was excluded since there was no base map for this area. For this reason a reliability line was placed in the map to separate the more accurate area from the other.

Mapping was done exclusively on the basis of physiognomy and vegetative composition, due to the absence of meteorological stations within the valley. Therefore, it was necessary to go over the area in an exhaustive manner and also to visit neighboring zones which did have temperature and rainfall data to use as reference.

The work took 45 days of which 30 were spent in the field and the remainder on information search and map and report preparation.

3. GENERAL CLIMATIC ASPECTS OF THE VALLEY

3.1. Rainfall

No meteorological or rain-gauging stations exist within the studied area. There are some stations around the watershed and although this data was not used, it did serve as reference for the present work.

The climate of the Palcazu valley is rainy and there is really no definite dry period, since rains come any time of the year, although two seasons or periods are defined: winter, which goes largely from October - November up to April or May; and summer during the remaining months of the year.

Rains are torrential; intermittent rain lasting from a few hours to up to a week or more is frequent during winter or even summer.

The Palcazu zone is more humid than sectors such as San Ramon, Oxapampa, Pozuzo and Villa Rica, from which come most of the present population of the valley. Rainfall estimations for the lower part vary from 3,000 to 4,500 mm/year on average and in general rain increases from Mairo towards Loma Linda (from north to south) and from the San Matías range towards the Yanachaga range (east to west). However, there are in the southern part of the Rio Palcazu watershed, at medium-high elevations, some small sectors protected from rainfall. Such is the case of the Cacazú Valley, which has an average annual rainfall estimated at something more than 2,000 mm.

3.2. Temperature

Taking as reference some temperature data recorded at sites neighboring the Palcazu, we can say temperature in the valley is more or less stable during the whole year, having normal variations between maximum and minimum for the tropical latitude region.

At the lowest point of the area studied (270 m.a.s.l.), average annual temperature is estimated at 25.7°C and at the highest part of the bottom of the valley (around 400 m) somewhat less than 25°C. In this area the maximum extreme temperature is calculated as close to 33°C and the minimum at 18°C average. Temperature descends climbing towards the Yanachaga range and in the higher parts of it (about 3000 m) annual average temperature would be approximately 8 - 10°C.

3.3. Wind and Cloudiness

No information is available for these climatic parameters at points close to the Palcazu. According to the characteristics of vegetation, these seem not to happen constantly, although according to the inhabitants, during winter, torrential rains are frequently accompanied by strong winds. This valley is affected by the hot, humid trade winds, which are very unstable, generating high pluvial rainfall and abundant cloudiness during winter.

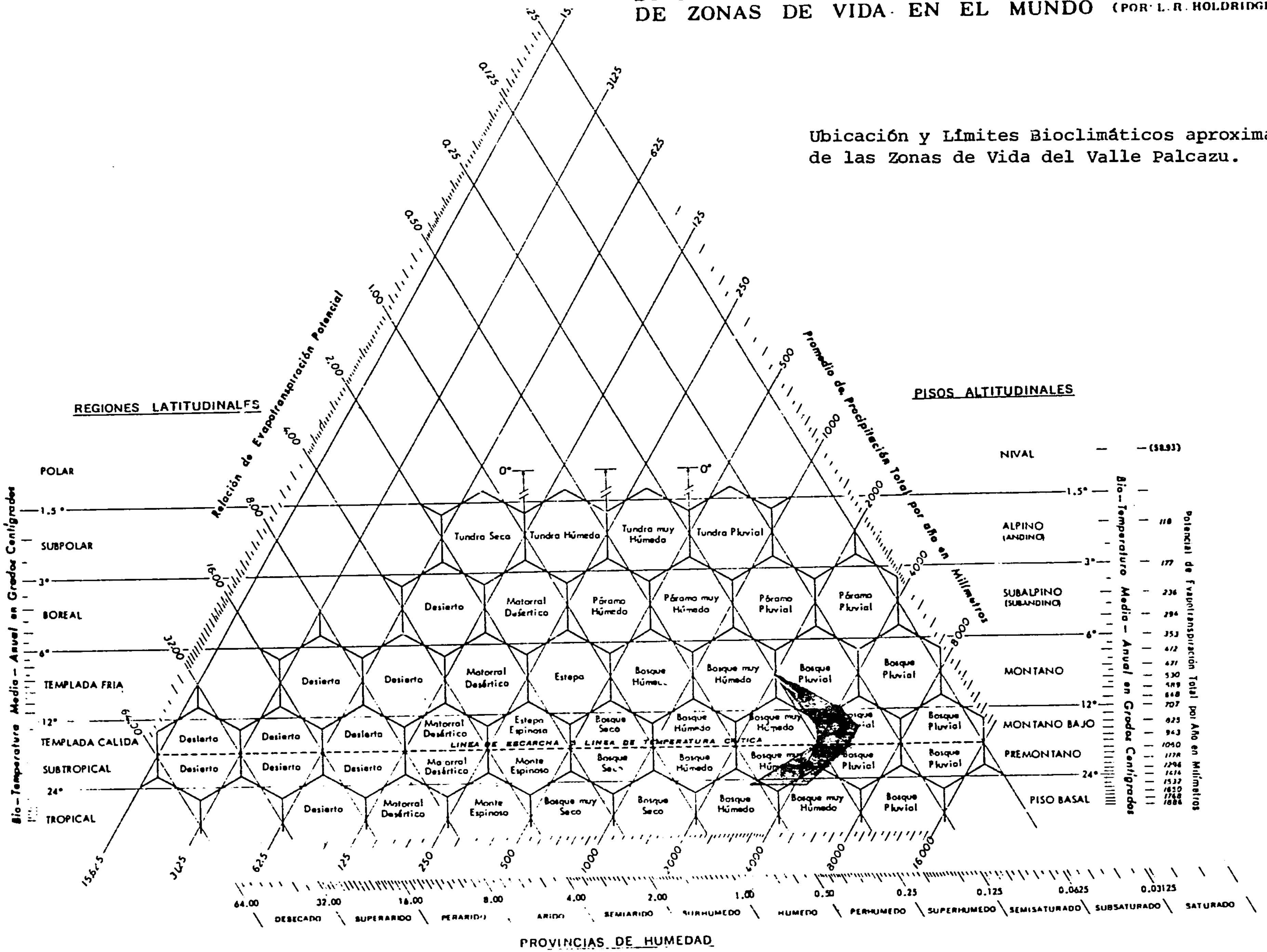
4. CLASSIFICATION OF LIFE ZONES

4.1. The Life Zone System

The Life Zone classification system created by Dr. Leslie R. Holdridge, is based on three fundamental factors: precipitation, biotemperature, and ambient humidity on which biotic factors depend. A mathematical model containing quantitative values of the aforementioned bioclimatic factors allow determination of the life zone directly from data on precipitation and temperature from meteorological stations, since the other factor is the product of the interrelation of these two. In zones where one does not find this type of information, life zones can be determined from the physiognomy and composition of the vegetation itself, since these are particular characteristics of each Life Zone.

DIAGRAMA BIOCLIMATICO PARA LA CLASIFICACION DE ZONAS DE VIDA EN EL MUNDO (POR L. R. HOLDRIDGE)

Ubicación y Límites Bioclimáticos aproximados de las Zonas de Vida del Valle Palcazu.



ESTIMATED BIOCLIMATIC DATA FOR THE PALCAZU AREA

	ELEVATION (m.a.s.l.)	BIOTEMPERATURE ANNUAL AVERAGE °C	RAINFALL (mm)
Tropical moist forest	270-700	24-25	2900-3000
Tropical moist forest, transition to Tropical wet forest	270-320	24-25	3000-3200
Tropical wet forest	300-700	24-25	4000-4600
Tropical wet forest, transition to Premontane wet forest	700-900	23-24	4000-4300
Premontane wet forest	700-1100	21-24	3000-4000
Premontane wet forest, transition Tropical wet forest	280-700	24-25	3200-4000
Premontane wet forest, transition to Premontane rain forest	800-1100	21-23	4000-4500
Premontane rain forest	900-1650	17-22	4000-5000
Lower Montane rain forest	1550-2400	12-17	3600-5000
Montane rain forest	2400-3000	8-13	2500-4000

Note: These data are estimated by the authors on the basis of Life Zones using the Bioclimatic Diagram for Life Zones of the World Classification by Dr. L. Holdridge.

4.2. Life Zones in the Valley

Six life zones were identified plus four transitions, all located in the tropical latitudinal region. The majority belong to the Per - humid and Superhumid provinces and only one to the Humid province. An outstanding fact is that the area in general is more humid than had been classified in the Ecological Map of Peru prepared at a scale of 1:1,000,000 in 1976. The bottom of the valley which constitutes the area of greatest interest from the agri-livestock point of view was classified almost completely as Tropical moist forest , but really only 15% of it is in this Life Zone, while the remaining 85% belongs to Premontane wet forest, transition to Tropical wet forest and Tropical wet forest .

Changes made in the mapping of the high part of the valley, specifically over the Yanachaga range are not significant and in general coincide with the original mapping.

In view of the absence of precipitation and temperature data, estimates were made from Life Zones, using a Life Zone classification diagram. Therefore, data provided on the following pages are approximate.

4.2.1. Tropical moist forest

This area is located in the northern part of the area studied; it covers approximately 15% of the valley lands with agricultural or forestry potential, according to ONERN studies. One fourth of this 15% belongs to the perhumid transition, thus being more humid than normal for that Life Zone. Average annual biotemperature is between 24 and 25°C. It is found at elevations comprising between 270 and 700 m.a.s.l.

The general aspect of the vegetation is different from that of its neighbor Premontane wet forest, transition to Tropical wet forest, differing from it in the size of the trees, the density, as well as the composition of species. Indicative of this Life Zone is the success of fruit trees, mainly avocado and citrus, which in more humid life zones, show in general high mortality, and in the case of "mango" the production is almost nil. Some of the species indicative of the Tropical moist forest life zone are: "zapote" (Matisia sp), Guazuma trinita, Terminalia (oblonga?), Sloania sp (with large leaves), Genipa sp, Scheelea sp, Erithryna sp (with orange flowers), Hieronyma sp, Muntigia calabura, Pithecelobium longifolium , Cordia alliodora, Hura crepitans In addition to the changes formerly listed, on river borders Calliandra disappears and Pithecelobium longifolium takes its place, and Chorisia sp is more common.

4.2.2. Tropical wet forest

The Tropical wet forest has average annual precipitation limits which oscillate between approximately 4000 and 4600 mm. Average annual biotemperature is over 24°C and probably is close to 25°C. Only the transitional to Premontane part has annual averages lower than 24°C, which can reach about 23°C. Elevations where this is found vary from 300 to 700 m. and its transitional part to the premontane level reaches 850 m.

This Life Zone can be recognized in the field by its exuberant vegetation, the presence of a large amount of high, thick trees and the high density. Some of the outstanding species are the following: Cedrelinga cataneformis (tornillo), Caryocar sp ("almendro"), Copaifera sp ("copaiba"), Coumarouna sp ("shihuahuaco"), Protium sp ("copal"),Virola sp.

("cumala"), Hevea brasiliensis ("shiringa"), Jacaranda copaia ("banderillo"), Erithryna ulei ("oropel"), Inga spp ("pacai"), Sclerolobium spp, Tachigalia spp, Iriartea sp and Socrates sp . Also there are several species belonging to the Mimosaceae family which constitute a group known as "pashaco" by the dwellers of the region.

The Tropical wet forest life zone covers the lower part of the area between Porto Nuevo (located south of Loma Linda) and the mouth of Gallinazo River (a little to the north of Shiringamazu), and continuing toward the northeast and crossing the Iscozacín river at a point even with the base of Cerro Chontilla. It continues along the border of the flat area of the valley up to Rio Comparachimaz. Further on it goes into the flat area of the valley very close to the Palcazu river (midway between Puerto Mairo and San Juan de Chuchurras), and continues to the small village of Rio Negro. In general terms this Life Zone covers 40% of the area studied by ONERN.

4.2.3. Premontane wet forest

The Premontane wet forest is located in the sections of the valley of medium elevations having the lowest humidity in the area studied. In addition, in its tropical transition, this Life Zone covers a large portion of the valley floor. Because of the importance this transition zone has in relation to agricultural and livestock potential, it will be described separately in this report. Rainfall in this Life Zone varies from 3000 to 4500 mm at the transition to Premontane rain forest. Annual average biotemperature varies from 24 to 21°C, at elevations from 700 to to 1,100 m.a.s.l.

This Life Zone is identified in the valley as medium elevations are reached, such as in the San Matías range of mountains, by observing the absence of trees found at lower levels, among which are "tornillo" (Cedrelinga catanaeformis), "oropel" (Erithryna ulei), Schizolobium parahybum. Predominant species are: "shiringa" (Hevea brasiliensis), "lupuna" (Chorisia sp), Terminalia sp (amazonía?). Many large trees belonging to the Sopotaceae family can also be noted, as well as some Lauraceae and many Tachigalia spp, Inga spp and Ficus spp. Main areas included in this Life Zone are the San Matías range at medium elevations, and a portion of the lower slopes of the Yanachaga range, at a point close to the "elbow" of the Pozuzo River.

4.2.4. Premontane wet forest, transition to Tropical wet forest

This is the life zone that covers the largest area within the floor of the Palcazu River valley. Average annual rainfall varies from 3200 to 4000 mm and average annual biotemperature from 24 to 25°C. It occurs in the study area at elevations between 280 and 700 m.a.s.l.

The physiognomy of this Life Zone in the valley, perhaps because of the effect of soils, looks more like that of Tropical wet forest than like that of the other neighboring Life Zone, Tropical moist forest. The latter one shows a stronger change which makes it easier to note in the field, while the change to the first one (Twf) is more subtle. Indicator species for this Life Zone are: Guarea sp growing on the border of the rivers, and abundant Calliandra sp, also growing on the border of the rivers. In addition there is increased incidence of Schizolobium parahybum, Cassia reticulata and Calycophyllum sp. In general, the height this forest and especially the diameters of its trees are lower than in the Tropical wet forest. Some of the more common species are: *Tachigalia* spp, *Sclerolobium* sp, *Cedrelinga catenaeformis*, *Inga* spp, *Hyberodendron* sp, *vitex* sp, *Hevea brasiliensis*, *Chorisia* sp, *Parkia* sp, *Coumarouna* sp, *Caryocar* sp and several species of Mimosaceae.

The area included in this life zone is practically all of the center of the flat section of the valley, from the mouth of the Gallinazo river to a point v ry close to Puerto Mairo, interrupted only by a small portion of the Tropical wet forest located around the mouth of the Chuchurras river. Approximately 45% of the area studied by ONERN is included within this Life Zone.

4.2.5. Premontane rain forest

The Premontane rain forest is locatel entirely in the area studied in less ɉetail (see ecological map of the Palcazu valley, reliability line). This Life Zone has an extensive area and covers a large part of the middle of the Yanachaga range. Average annual rainfall varies from 4000 to a little more than 5000 mm. Average annual biotemperature is from 22 to 17°C. The Life Zone occurs between elevations of 900 and 1650 m.a.s.l. An outstanding characteristic of this area is the occurrance of small and large palm trees: *Iriartea* sp, *Socratea* sp and others not identified.

This forest in general is fairly dense, but trees are thin, and epiphytes are abundant. Several *Tachigalia* species are found.

4.2.6. Lower Montane rain forest

This Life Zone is found in the higher sections of the Yanachaga range and average annual rainfall varies from 3600 to 5000 mm. Average annual biotemperature is between 12 to 17°C, at elevations from 1550 to

2400 m.a.s.l. This life zone covers an area of considerable size. The zone can be identified in the field by the presence of a large amount of brown colored moss, a characteristic that can be observed from a fair distance. Also, there is an abundance of large palm trees (Welfia?). Some prevalent species are: Iriartea sp, Socratea sp. and various Lauraceae

4.2.7. Montane rain forest

Montane rain forest is found in the highest sections of the Yanachaga range, at elevations above 2400 m.a.s.l., reaching around 3000 m.a.s.l. Average annual rainfall varies from 2500 to 4000 mm and average annual biotemperature should be from 8 to 13°C. This Life Zone covers only a small area. Indicator species are the following: Podocarpus spp, Weinmannia spp (one species with alternate leaves) several melastomaceae, Myrica sp, Clussia sp. Vegetation is very small and conspicuous. In addition the soil is covered by a layer of organic matter about 30 cm thick.

5. EFFECT OF LIFE ZONES ON THE AGRICULTURAL AND LIVESTOCK POTENTIAL OF THE VALLEY

In addition to limitations of soils for certain agricultural and livestock activities in the Palcazu Valley, a large part of this area has certain use limitations due to the very wet Life Zones found there. These restrictions basically affect agricultural and livestock activities, whereas forestry activities, because of their characteristics, are tolerant of this factor. Among the Life Zones in the Palcazu, and only from the bioclimatic point of view, the Tropical moist forest is the most adequate for agricultural and livestock development, but it only covers approximately 15% of the area in the valley. The Premontane wet forest Life Zone, in its transition to Tropical wet forest, is perhaps the most important one from the standpoint of soils and area. It covers around 45% of the area and, although it is more or less adequate for the development of these activities, it is necessary to take into account that crops here must tolerate a little more moisture in comparison with the Tropical moist forest. Additionally, erosion risks increase as rainfall and runoff increase. The Tropical wet forest Life Zone covers a considerable area (about 40%) and presents greater limitations for agricultural and livestock potential due to the high rainfall rate (more than 4000 mm/year). This factor limits location of these activities because of the high erosion risk involved, in crop lands as well as on lands trampled by livestock. Furthermore, crops which are adequate for the Tropical moist forest Life Zone (such as peanuts, mango, Yaragua pastures, etc.) do not yield well in the Tropical wet forest , hence production of these crops is limited (although this is not so for forestry production). It is necessary to find other crops adapted to the wet conditions.

The remaining Life Zones do not directly influence the area of present agricultural and livestock interest, because they are located in the San Matías and Yanachaga ranges. They do however, have great importance because they provide the largest part of the volume of the rivers. The Premontane rain forest and the Lower Montane rain forest are most significant in this regard because they occupy a large part of the total area of the watershed, but this is not true of the Montane rain forest which has a small area.

6. CONCLUSIONS

In general terms and strictly from a bioclimatic point of view, the area located in the valley floor of the Palcazu River classified as Tropical wet forest (40%) can be considered very limited for agricultural and livestock production. Also the part found to be Premontane wet forest, transition to Tropical wet forest has strong limitations for such activities and only the area occupied by the Tropical moist forest (15%) has favorable conditions for agricultural and livestock activities. The main negative factor is the high rainfall in the valley area.

A large part of this area has soils with heavy texture, restricted internal drainage and slow infiltration, thus having an inadequate elimination of excess rainfall, which, in many cases, gives the vegetation an aspect of being wetter than what is normal for this Life Zone.

The Palcazu Valley turned out to be much wetter than shown on the Ecological Map of Peru, at a scale of 1:1,000,000.

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APPENDIX D

ECOLOGICAL EVALUATION OF THE PALCAZU RIVER VALLEY (PASCO, PERU) AND GUIDELINES FOR AN ENVIRONMENTAL CONSERVATION PROGRAM

Dr. Antonio Brack Egg

CONTENTS

1. INTRODUCTION

The Government of Peru is placing special emphasis on development activities in the Central jungle (Chanchamayo, Satipo, Oxapampa and Pachitea Provinces) as well as the integration of this area into the economy of the country by stimulating settlement of new colonists in order to relieve coastal and central sierra population. The governmental program contemplates the construction of a large highway system which will permit the influx of new settlers to these unaltered areas that will bring along negative impacts for the ecology of the region.

The Palcazu River Valley (Oxapampa Province, Pasco Department) is included within the zone to be colonized and it is envisioned that in few years (1982-1985), the human population will be very dense due to the penetration roads to be constructed.

Although it is well known that the jungle must be integrated into the Peruvian economy, it is necessary, however, to take into consideration the ecological aspects of the zone as well as the development of environmental conservation programs which will ensure survival of the ecosystems, protection of the flora and faunal species,and watershed and forestry resources preservation.

In order to comply with this objective, both the ecology and the flora and fauna of the Palcazu River valley have been evaluated in order to establish the necessary guidelines for the development of an environmental conservation program which must be implemented together with development and colonization actions.

2. ECOLOGY OF THE PALCAZU RIVER VALLEY

2.1. Zoogeographic Zoning

Peru is one the richer countries in wildlife. It has eleven zoogeographic provinces: Cold Sea of the Peruvian Current, Tropical Sea, Pacific Desert, Ecuadorean Dry Forest, Steppes of the Sierra, Puna or high plateau, Heath, Yungas, Amazonic and Chaqueña.

The Palcazu drainage basin is located in two of these provinces: Yungas and Amazonic.

2.1.1. Amazonic Province (Lower jungle)

The characteristic of this province is the presence of species typical of the Amazon or Hylea jungle such as aquatic turtles (*Podocnemis* spp) and land turtles (*Geochelone*), caimans, river dolphins, primates (*Ateles*, *Cebus*, *Lagothrix*, etc.), great quantities of birds, and amphibians.

In the Palcazu River valley, the Amazonic Province comprises the lower area, its upper limit being between 600 and 800 m. altitude (Map No. 1).

2.1.2. Yungas Province (Upper jungle)

This province encompasses the upper zone of the Amazon jungle in the Andes eastern slopes having an altitude between 600 and 800 m. and up to 3,500 - 3,800 m.

This area is characterized by the presence of numerous mammal species, (spectacled bears and pudu, some primates, etc.), birds (cock of the rock , toucans, hummingbirds, etc.) reptiles, amphibians

(Phrynopus), etc.

In general, the Yungas province has three zones or floors very clearly defined which also are present in the Palcazu River basin (Fig. No.1).

1. Upper jungle: 600-800 m. altitude and up to 1,600 - 1,800 m. altitude. This is a transition zone between the Amazonic province and the Yungas province where can be found species typical of both provinces (jaguars, peccaries,"huangamas", etc. for the Amazonic province; and spectacle bears, cock of the rocks, etc. for the Yungas province).

2. Cloud Forest: The altitude of this zone is from 1,600 - 1,800 m. and up to 2,500 - 2,800 m. This is the richer zone in species typical of the Yungas province and very rich in endemism.

3. Dwarf Forest or Monte Chico: This zone is located at 2,500 - 2,800 m. altitude and up to 3,500 - 3,800 m. This area constitutes a transition zone between the Yungas province and the high plateau or Puna, where species common to both zones are found. However in the Palcazu River watershed, this area is not large; therefore, being found only in the highest peaks of the Yanachaga range to the west.

2.1.3. Pleistocene Refugium

Based on studies of birds (Haffer, 1974) and butterflies (Brown, 1977; Lamas, 1979), it has been established that the Palcazu River basin is part of the Pleistocene Refugium of the central jungle or the Chanchamayo - Perené.

This characteristic makes the zone especially interesting due to the richness and peculiarity of its fauna within the context of the Amazon.

2.2. Phytogeographic Zoning

According to Hueck, 1978, the Palcazu River valley includes three phytogeographic formations:

2.2.1. Hylea near the Andes: a Tropical rain forest with ~~species~~ Cedrela sp. (Cedar) Cedrelinga sp. Calophyllum, sp. , Caryocar, sp., Myroxylon, sp. and others.

2.2.2. Eastern slopes of the central Andes (Yungas jungle): includes the rain forest of both the upper and lower mountains (up to 1,800 - 2,000 m) as well as the high jungle forests (1,800 - 2,000 and 3,400 - 3,600 m. altitude).

2.2.3. Andean vegetation of the upper mountain type: in the highest parts of the Yanachaga range.

2.3 Wildlife

2.3.1. Principal Species and Actual situation : The Palcazu river watershed is rich in wildlife; due to space limitations we will only mention the principal species.

a. Mammals

Order Marsupialia Family Didelphidae; Glironia venusta; Marmosa rapposa ; Marmosa quichua ; Marmosa noctivaga; Philander opossum; Didelphis azarae; Chironectes minimus. None of these species may be considered rare or in danger of extinction.

Order Cairoptera:

Family Desmodontidae: Desmodus rotundus (vampire bat). There are various other species, however the bat is mentioned due to its importance for local livestock activities because it transmits rabies.

Order Primates:

Family Cebidae (New World Monkeys)

Aotus trivirgatus (night monkey): rare

Alouatta seniculus (Howler monkey): quite rare. Found in isolated forests

Cebus apella (Capuchin): this is one of the most common species from 300 to 1,800 m.

Saimiri sciureus (Squirrel monkey): common

Ateles paniscus (Spider monkey): very rare

Lagothrix lagotricha (woolly monkey) has disappeared from several areas; from the low jungle to 1,600 m. altitude.

Family Callithricidae (Marmosets)

Saguinus sp (Marmoset): common in both upper and lower regions of the the valley.

Order Edentata:

Family Myrmecophagidae (Anteaters)

Myrmecophaga tridactyla (Great anteater): uncommon

Tamandua tetradactyla (Collared anteater): uncommon

Cyclopes didactylus (Two-toed anteater): very rare

Family Bradypodidae (Tree sloths)

Bradypus infuscus (Three-toed sloth): common

Choloepus hoffmanni (Two-toed sloth): rare

Family Dasypodidae (Armadillos)

Priodontes giganteus (Giant Armadillo): very rare

Dasypus novemcinctus (Nine - banded armadillo): commonly found in pastures

Cabassous sp (Naked-tailed Armadillo): very rare

Order Lagomorpha:

Family Leporidae (Hares and Rabbits)

Sylvilagus brasiliensis (Wild rabbit): in the lower part of the valley toward the Pozuzo river elbow: rare

Order Rodentia :

Family Sciuridae (squirrels): several species; Sciurus ignitus; S. pyrrhinus.

Family Hydrochaeridae (Capybaras)

Hydrochaeris hydrochaeris (Capybara) common and menaces crops

Family Dinomydae (Pacaranas)

Dinomys branickii (Pacarana or False Paca): common in highlands, over 1,000 m.

Family Dasyproctidae

Dasyprocta variegata (Agouti): very abundant

Myoprocta pratti (Acushi): uncommon

Agouti paca: very common

Family Erethizontidae

Coendou bicolor: (prehensile - tailed porcupine): common

Order Cetacea:

During the season when the lower Palcazu river swells, a river dolphin can be observed. This is considered rare.

Order Carnivora:

Family Canidae (Dogs, Wolves, Foxes)

Atelocynus microtis: (Small-eared dog): very rare

Speothos venaticus (bush dog): very rare

Family Ursidae

Tremarctos ornatus (Spectacled bear): present in the Yanachaga range over 1,000 m. altitude): rare

Family Procyonidae

Nasua nasua (Coatimundi): common

Potos flavus (Kinkajou): common

Bassaricyon alleni (Olingo): rare

Family Mustelidae

Mustela frenata (Long tailed weasel): in the Yanachaga range

Galictis vittata: very rare

Eira barbara : common

Lutra incarum (Otter): rare

Pteronura brasiliensis (Flat tailed or giant otter): very rare, at present it can be found only in the Izcozacin River.

Family Felidae

Felis pardalis (Ocelot): common

Felis wiedii (Margay cat): common

Felis yagouaroundi (Jaguarundi): rare

Felis concolor (Puma or Mountain lion): common

Felis onca : common

Order Perissodactyla

Family Tapiridae

Tapirus terrestris (Tapir): common

Order Artiodactyla:

Family Tayassuidae

Tayassu pecari (White lipped peccary):common

Tayassu tajacu (Collared peccary):more common than Tayassu pecari

Family Cervidae

Mazama americana (Red Deer):common

Mazama gouazoubira (Grey Deer):rare

Pudu nephistophelis (Pudu):this rare specie has been found in the upper part of the Yanachaga range over 1,800 m.

b. Birds

The variety of species is very great and we will only mention the principal species.

Order Tinamiformes

Family Tinamidae (Tinamous)

Tinamus tao (Gray Tinamou):common

Tinamus major (Great Tinamous):common

Crypturellus obsoletus (Brown Tinamou):common

Order Plelecaniformes:

Family Phalacrocoracidae

Phalacrocora olivaceus (Netropic Cormorant):uncommon

Order Ciconiformes:

Family Ardeidae (Herons)

Bubulcus ibis (Cattle egret):common

Nycticorax nycticorax (Black Crowned Night Heron) : common

Ixobrychu exilis (Least Bittern): common

Family Thereskionithidae (Ibises)

Mesembrinibis cayennensis (Green Ibis): commor

Order Falconiformes

Family Cathartidae (American Vultures)

Sarcoramiphus papa (King Vulture): common

Coragyps stratus (Balck Vulture): very common

Cathartes aura (Turkey Vulture): common

Cathartes Melanbrotos (Greater Yellow Headed Vulture:) common

Family Accipitridae (Eagles and Hawks)

Elanoides forficatus (Swallow-Tailed Kike): common

Harpia curassow :(Harpy Eagle): rare

Family Pandionidae (Ospreys)

Pandion haliaetus (Osprey): common from October through March

Family Falconidae

Micrastur sp (Falson) very common

Daptrius americanus (Red - Throated Caracara): common

Order Galliformes

Family Cracidae (Chachalacas, Guans and Curassows)

Mitu mitu (Razor-Billed sharpyja) : common

Penelope jacquacu (Spixis Guan): common

Ortalis guttata (Speckled Chachalaca): common

Family Opisthocomidae

Opisthocomus hoatzin (Hoatzin): common

Order Gruiformes

Family Psophiidae

Psophia leucoptera (Pare-Winged Trumpeter)

Family Eurypygidae

Eurypyga helias (Sunbittern): common

Order Psittaciformes

Ara spp. (Macaw): rare

Pionus menstruus (Blue headed Parrot): very common

Order Cuculiformes

Family Cuculidae

Piaya cayana (Squirrel Cickoo): common

Crotophaga ani (Smooth-Billed Ani): common

Order Coraciiformes

Family Alcedinidae

Ceryle torquata (Ringed Kingsfisher): common

Chloroceryle amazona (Amazon Kingfisher): common

Chloroceryle americana (Green Kingfisher): common

Family Memotidae

Mometus momota (Blue-Crowned Motmot): common

Order Trogoniformes

Pharamacrus pavoninus (Pavonine Quetzal): common

Order Piciformes

Family Ramphastidae (toucans)

Ramphastos cuvieri (Cuviers Toucan): common

Pteroglossus mariae (Brown-Mandibled Aracari): common

Family Piscidae (Woodpeckers)

Dryocopus lineatus: common

Order Passeriformes

Family Furnariidae

Furvarius leucopus: common

Family Rupicolidae

Rupicola peruviana (Andean-Cock of the Rock): common in the Yanachanga range over 1,800 m.

Family Corvidae

Cyanocorax yncas (Green Jay): common in areas over 1,000 m.

Cyanocorax violaceus (Cilaceous Jay): common

Cyanolyca viridiciana (Collared Jay): common in the highlands of Yanachaga range

Family Icteridae

Psarocolius decumanus (Crested Oropendola): common

Psrocolius angustifrons (Russet-Backed Oropendola): common

Cacicus cela (Yellow-Rumped Cacique): common

Family Thraupidae

Thraupis episcopus (Blue-Gray Tanager): common

Thraupis palmarum (Palm Tanager): common

Ramphocelus carbo (Silver-Beaked Tanager): common

Cissopis leveriana (Magpie Tanager): common

Family Fringillidae

Paroacaris gularis (Red-Capped Cardinal): common

Violatinia jacarina (Blue-Black Grassquit): common

C. Reptiles

Order Chelonia (Turtles)

Family Pelomedusidae

Podocnemis unifilis (Aquatic Turtle): Apparently this is the only aquatic turtle in the Palca river. It is an uncommon specie at present in the process of extinction

Family Testudinidae

Geochelone denticulata (Land Turtle) Forest specie; uncommon

Order Squamata

Sub-Order Ophidia

Family Boidae

Boa constrictor (Boa): uncommon

Corallus caninus (Green Boa) : common

Family Elapidae

Micrurus spp. (Coral Snake): common; accidents are rare with this species

Family Vipiridae

Bothrops spp. (Fer-de-lance): Native communities distinguished betwee several types. Accidents are uncommon.

Family Crotalidae

Lachesis muta (Bushmaster snake): common

Sub-order Lacertilia

Family Iguanidae

Iguana iguana (Iguana): common

Order Crocodilia

Family Alligatoridae

Caiman sclerops : (Caiman) Apparently this is the only caiman in the Palcazu River. It is rare and has been reduced drastically during the last two decades.

D. Amphibia

Family Bufonidae

- *Bufo marinus* (Giant toad): common
- *Bufo* (Toad): common

2.3.2. Endangered Species in the Area

A. Rare Species

The species in the area which may be considered rare for the Peruvian fauna, are the following:

- *Priodontes giganteus* (Giant Armadillo) very rare in the zone and found in the forests below 1,000 m.
- *Cabassous* sp.(Small armadillo): in the forest below 1,000 m. altitude
- *Sylvilagus brasiliensis* (Wild rabbit): apparently it only lives around the "Codo del Pozuzo" area
- *Atelocynus* and *Speothos*
- *Pudu mephistophelis*: only in the Yanachaga range
- *Harpia harpyja* (Harpy Eagle)

B. Endangered Species

Primates

- *Aotus tririrgatus*
- *Alouatta seniculus*: already rare in the zone due to indiscriminate and forest destruction
- *Ateles paniscus*: (Spider monkey) very rare for the same reasons
- *Lagothrix lagothricha* (Wooly monkey) rare for the same reasons

Edentates

- *Myrmecophaga tridactyla* (Great Anteater) :each day more scarce

Carnivora

Tremarctos ornatus (Spectacle bear): exists only in the Yanachaga range and the high Palcazu River basin (San Carlos and Cerros de la Sal ranges). Rapidly disppearing due to hunting and forest clearing.

Lutra incarum (Otter): rare

Pteronura brasiliensis very rare

Felis onca (Jaguar)

Felis wiedii (ocelot)

Reptiles

Podocnemis unifilis (Aquatic turtle)

Caiman sclerops (Caiman)

In general, and according to experience of the native people of the region, fauna is rapidly disppearing due to hunting pressure, river traffic and tree felling.

2.3.3 Wildlife Utilization

Wildlife is fully used in the Palcazu River Valley for subsistence hunting, supplementary luxury food, sport hunting and hunting for sanitary purposes.

A. Subsistence Hunting

Subsistence hunting for food is practiced by native communities settled in the valley. This type of hunting is essential for the provision of protein for the Amuesha. Hunting comprises all edible species both large or small mammals, birds, reptiles and amphibians.

The species most hunted are:

Mammals: pecaries, hares, armadillos, tapirs, red deers, etc.

Birds: partridges, pigeons, speckled chachalacas, parrots, hoatzins, etc. Almost all birds are hunted with few exceptions.

Reptiles: land turtles, caiman, etc.

Amphibians: wood frogs

An interesting phenomenum of native religion: Adventist communities avoid meat consumption from animals with cloven hoofs or fish without scales. Therefore, in areas surrounding these adventists communities, species such as peccaries, "huanganas" and deer can be seen. Communities not practicing the adventist religion, hunt indiscriminately all fauna species, thus these are scarse around their territories. In general, subsistence hunting pressure is acute and the wildlife are suffering a slow but inexorable process of extinction, principally forest species.

B. Hunting for Additional Food and Sport

Large ranchers of the area carry out these hunting activities. They don't need proteins to survive, however they appreciate the meat. Also this type of hunting could be considered as sport but the meat is used. Hares are most appreciated and are hunted in the yucca plantations; they represent more than 90% of this type of hunting. Other species are hunted sporadically, such as peccaries, "huanganas", deers, tapirs, aquatic turtles, speckled chachalaca and pigeons.

This type of hunting does not depreciate the resource.

C. Sport Hunting

Sport hunting is generally practiced by visitors to the zone and is quite irrational because it implies the killing of the most improbable species which are not trophies. This is the case in the hunting of falcons, hoatzins at the river banks, black vultures or any other bird which they find. Some visitors like to practice night hunting of hares.

The caiman is one of the species most preferred for target shooting practice.

D. Hunting for Sanitary Purposes

This type of hunting is carried out to control such species which are a menace to livestock or crops. Principal species are:

- Jaguar or tiger: when some of these attack the cattle. These are sporadic.
- Puma or lion: same as above
- "Ronsocó" harmful to corn, bananas, yucca plantations etc. Its meat is used but is not highly appreciated.
- Hare: harmful to yucca plantations
- Falconidae: when they attack poulty
- Caiman : because it is considered a menace to livestock
- Ophidia: in general, any snake is immediately eliminated whether poisonous or not.

2.3.4. Faunal Species adapted to Cultivated Landscape

With the clearing of thousands of hectares of natural forest for pasture and livestock production, extensive areas of the valley have been transformed into open zones. Equally, some types of crops involve the clearing and destruction of the original forests.

This phenomenum implies the establishment of large open areas offering food to some faunal species (corn, yucca, bananas and other crops).

Open pasture areas are the habitat for species such as the tiranidae, Throupidae, Ani, Oropendola, Ostinops spp, etc. Crops favor the proliferation of hares, "añujes", "roncosos" and oropendolas.

Intensive livestook activities favors proliferation of vultures that use dead animals and armadillos that frequent dung in search of worms and insects.

2.4. Biotic Communities

It is not possible to enumerate all the biotic communities of the area. However, some preliminary information is provided.

The principal biotic communities are the following: aquatic communities (rivers, lagoons and swamps) and land communities (tropical forests of the low jungle, high jungle; cloud forest; dwarf forest and the highland steppes) with their respective transition zones.

2.4.1. Aquatic Communities

A. Rivers

This biotic community is one of the most important in the zone due to the faunal species which are present (fish, amphibians, reptiles and mammals) which are closely associated with the area in a delicate ecological equilibrium.

At least four different communities must be differentiated: rivers of the lower areas (below 600 m. altitude); rivers of the high jungle: small rivers of the cloud forest and channels or streams of the lower jungle.

Unfortunately, there are few studies regarding this matter and the information available is general.

The river communities are of great importance for the area for the following reasons:

a. due to the fauna present in the area, especially the icthyological fauna which constitute an important source of food for the populations, particularly the native communities.
b. due to the faunal species which are economically, ecologically, scientifically and culturally important; many of which are in danger of extinction in all of the Amazon such as the aquatic turtles, caimas, "lobos de río" (otter), etc.
c. because at the present time, these communities are the natural means of communication for the entire valley.

Actual Situation

At present, the river communities show serious ecological alteration due to human influence.

- Reduction of the fish population and the aquatic fauna due to irrational hunting and fishing. Fishing with dynamite, rotenone and sometimes with highly toxic chemicals,(i.e. folidol), is very common. Natives agree that the fish population has diminished. Likewise, irrational hunting of lizards, otters, aquatic turtles, etc. has put these species on the edge of extinction in the lower part of the valley. Some species have totally disappeared from this zone as in the case of the "lobo grande de río".

- Increasing boat traffic in the rivers of the lower part forces many species to emigrate due to human disturbance.
- Water contamination as a result of the construction of channels for cattle slaughtering; the construction of roads (Cacazú, Bocaz, and Pichinas) in the high part which alters the rivers (sediment) and which fills up the "pozas", soil erosion and the resulting increase of sediments during rainfall due to forest clearing in the high part (Bocaz and Cacazú).

Up to what point this will alter the river communities, it is not possible to establish, due to lack of measurements, however the settlers affirm that in fact there are disturbances in the environment.

B. Lagoons, ponds and swamps

These communities are scarce in the region. There is a lagoon in the middle of the Izcozacín River. In the lower portion of Palcazu River, there are some ponds and swamps. However, these communities are not important for the region.

C. River banks

This transition community between river and forest is very important for the faunal species present in the region such as: caimans, aquatic turtles (for reproduction), hoatzins (which is a specie typical of the river bank trees) and the "lobo grande de río".

Herons are closely linked to this community. Likewise, riparian vegetation is important as a source of food (fruits, leaves, etc.), for various fish species.

Actual Situation

Forest clearing for livestock and agricultural activities reaches up to the river banks and a gradual destruction of the area can be observed.

2.4.2. Land Communities

A. Low Jungle Tropical Forest (up to 600 - 800 m)

This community is very rich in flora and fauna with species typical of the low jungle near the Andes.

This area is the habitat of large mammals (peccary, tapir, "huangana", deer and "felinos"), birds (harpy, king vulture), reptiles (boa , land turtle) and amphibians (giant toad). Various species of primates, principally the spider monkey are tied to this community.

Actual Situation

At present, this type of forest is suffering the greatest impact due to land clearing for agricultural and livestock activities; 30,000 has. have been opened. In the future this region will suffer the greatest major impact due to the influx of people as a result of the construction of the projected roads.

B. Upper Jungle (between 600 and 800, and 1,600 - 1,800 m)

This is a transition community between the tropical forest of the lower jungle and the cloud forest.

Here can be found species from the low jungle as well as the cloud forest. Also, due to the abundance and variety of palm trees, of species such as the Razor-Billed Curassows and Spixis Guans, are very abundant.

Actual Situation

This community remains intact throughout the Palcazu River watershed with the exception of the Mairo River. The zones most intact are in the San Matías range.

C. Cloud Forest (between 1,600 - 1,800 and 2,500 - 2,800 m. altitude)
This community is very interesting due to the flora (*Podocarpus*, spp, orchids and many others) and fauna (Spectacle bears, Pudú or Mountain Goat and Cock of the rock).

Actual Situation

This community is totally intact in the southern portion of San Matías range and the eastern slopes of Yanachaga mountains. However, in the Bocaz and Cacazú zones and in the Villa Rica access road there are serious alterations due to the clearing of protection forests and steep hills. From Oxapampa, in the Chacos Valley (Llamaquizú River) a forest extraction road which has already crossed the Yanachaga Range, there are invasions of migrating farmers.

D. Dwarf Forest or "Monte Chico" (between 2,500 - 2,800 and 3,500 - 3,800 m)

This biotic community is not vast since the Yanachaga range is over 2,800 m. in very few points (Cerro Pajonal, Chacos, Yanachaga, Huancabamba).

Fifty species of orchids are typical of this region, as well as dwarf palms, "ulcumano de puna" (*Podocarpus montanus?*)

The typical fauna of the region is represented by Spectacled bears, wild goats and many birds; there are also various amphibian species (*Phrynopus*).

Actual Situation

The zone is totally intact with the exception of the Cerro Pajonal (Chaoos), where the installation of a microwave antenna has aided the burning of a large part of this formation.

E. Highland Andes Steppes (over 3,500 - 3,800 m)

This biotic community may exist in the Yanachaga peaks over Huancabamba. Should this be the case, it would only be a small area, but with high scientific value due to its total isolation in the middle of the eastern slopes of the Andes.

3. COLONIZATION OF THE AREA AND ITS EFFECTS

3.1. Effects of Road Construction

3.1.1. Existing and Projected Roads (Map No. 3)

The existing roads in the Palcazu River Valley are the following:

- Oxapampa - Chacos - Alto Palcazu: from the Oxapampa trunk and following the Llamaquizú River by the Chacos valley, crosses the crest of the Yanachaga range in the Cerro Pajonal through Vaquerias and continues through the upper part of Palcazu valley in the Pescado River, tributary of Bocaz River. This is a forest-extraction road.
- Villa Rica - Yesú - San Miguel Road: enters the Bocaz River valley up to the former San Miguel farm. It was constructed to colonize the zone during the sixties. Along this road, colonists have settled and native communities exist.
- Villa Rica - Enseñas - Cacazu - Pichinas Road: trunk road through Puerto Bermudez and corresponds to the "Marginal de la Selva". This road borders the upper part of the Palcazu valley penetrating steep areas which are protection forest.

The projected roads are the following:

- Pichinaz - Izcozacín - Puerto Mairo - Puerto Victoria Road: This longitudinal road of the Palcazu would start from the "Marginal de la Selva" between Cacazú and Pichinaz and would cross all the Palcazu River valley up to Puerto Victoria where it would be connected again with the "Marginal de la Selva". It would also have a series of branch roads "carreteras vecinales"

- Pozuzo - "Codo del Pozuzo" - Puerto Mairo Road:

  This road would penetrate the lower part of the valley through the "Codo del Pozuzo" following the Pozuzo River.

- Tunque River - Abra de Cojanpata - Chuchurras Road:

  10 km of this road are already constructed in the eastern slopes of the Yanachaga range along the Tunqui River between Huancabamba and Pozuzo. This road is considered in the project because the Oxapampa forest industries are exerting pressure to penetrate the Palcazu River valley by the Chuchurras - Omais River. At present a private bulldozer is working on the road.

3.1.2. Effects of Road Construction

A. Actual Effects

At present time and as a result of the existing roads, the following environmental impacts are seen:

1. Indiscriminate clearing of protection forests and working forests by spontaneous colonists. There is no control by officials, (Ministry of Agriculture and Forestry Police) along the roads under construction and spontaneous colonists settle themselves in areas not suitable for agriculture or livestock activities.

In addition, there is evidence that the Ministry of Agriculture, through its local offices, authorizes forest clearing without any technical criteria, stimulating the destruction of the forestry and protection areas. As a result of this situation, the Bocaz and Cacazu River valleys have been transformed into critical zones of rapid soil erosion and degradation. If appropriate measures are not taken, large areas of virgin forest will not be reduced and destroyed along the roads.

2. Soil Erosion - This adverse effect is a consequence of the previous one. The erosion, accelerated by the rough orography and the high pluvial precipitation, damages the newly constructed roads and also the rivers by the accumulation of sediment and stream bank vegetation, adversely affecting the navigability in the lower Palcazu.

3. Invasion of Forestry Extraction Contracts - Industrialists and forest extractors have obtained concessions for lumber extraction. This produces immediate invasion of the areas under contract by spontaneous colonists in spite of the existing legal provisions. Officials do not control these invasions and in some cases they promote them.

4. Pressure on native communities - Native communities ancestrally settled in the area and some of them with titled lands, suffer the aggression of the colonists migrating to the area as a result of the construction of roads and the consequent invasion of their lands.

5. Extermination of Wildlife - Land invasions and forest clearing are causing a gradual extermination of the wildlife.

It must be pointed out that forestry extraction does not have a severe adverse impact and a joint coordination between extraction and forest and faunal conservation could be obtained. It is the deforestation that destroys the ecosystem.

B. Future Effects

If the present processes of spontaneous colonization, invasion, the indiscriminate clearing, lack of control, etc., continue, the adverse effects that are evidenced at present in the upper portions of the valley will be rapidly extended to the whole area.

Therefore, it is necessary to develop an integral plan which balances colonization, road construction and the conservation of watersheds, forests, soils, flora and fauna. If this plan is not implemented, the negative consequences for the whole region of the Palcazu Valley will be catatrophic on the medium and long term.

The consequences of a non-directed colonization process, that has as its sole objective construction of roads and settlement of colonists are the following:

- Destruction of the drainage basin of the Palcazu River upper portion with adverse effects on soils, water, and on the hydrological system.

- Destruction of the forest reserves of the zone with serious damage . even for the forest industry in Oxapampa and Villa Rica due to the lack of raw material.

- Extinction of faunal species of high ecological, scientific and cultural value.

- Total destruction of the forests of the low jungle of the valley.

3.2. Effects of the Settlement of New Colonists

The valley already has a good number of colonists and it is expected that in the future there will be a major influx of people due to the construction of highways and the promotion of the zone.

The effects of the settlement of new colonists will be as follows:

- If it is in the upper part of the valley, over 1,000 m, it will result in the destruction of forests and soils, therefore an effective control must be exerted in the zone.

- If in the lower portion of the valley, it will occupy the total area of same and will also mean deforestation. Both alternatives will have adverse impacts on the environment and the ecology of the zone which could be ameliorated with an adequate environmental conservation program.

3.3. Critical Zones

For a better understanding of the environmental problem and those resulting from the construction of roads, the critical zones have been evaluated and classified in three categories: critical due to ecology of the area; critical zones due to actual settlements; and potential critical zones in terms of future development. Also, these zones could be identified as "problem zones"

(Map No.4). Critical zones due to the ecology of the area - These zones are those which should maintain their natural vegetation since they are not suitable for agricultural and livestock activities which would result in deforestation. Orography and soils aptitude are also determinant factors. However, the presence of faunal species has been taken into account.

Map No. 4 shows the critical zones which are riparian woods and the overall area over 1,000 m of the eastern side of Yanachaga range and over 500 m in the San Matías range.

(Map No.5) Actual Critical Zones due to human settlements

These zones are being devastated at present by an indiscriminate settlement of spontaneous colonists, showing problems of erosion, destruction of protection forests, and forestry lands.

(Map No. 6) Future Critical Zones

The construction of proposed roads and new population settlements without the necessary and adequate control, will create in medium and long term, new critical zones.

4. GUIDELINES FOR AN ENVIRONMENTAL CONSERVATION PROGRAM IN THE PALCAZU RIVER VALLEY

4.1. Permissible Roads (Map No. 7)

Based on the issues stated in previous chapters and in order to guaranty a harmonious development between colonization and environment, the only highways which should be permitted in the Palcazu River valley are the following:

4.1.1. Cacazú - Iscozacín - Puerto Victoria

This longitudinal road of the valley would pass through protection zones where adequate control must be established to prohibit new settlements or clearing along the total route of the road.

Authorization of this road should be accompanied by a total prohibition against forest clearing for agriculture or livestock purposes up to the confluence of Cacazú and Pichanaz rivers. Forestry actvities would be permitted.

Transverse branches to the valley must be planned so as not to surpass 1,000 m altitude.

Vecinity roads between the Palcazu river and San Matías range up to 10°00' Lat. South, should not be authorized.

4.1.2. Cacazú - Pichanaz - Puerto Bermudez Road

This route which is the "Marginal de la Selva", will cross the San Matías range to Puerto Bermudez. Authorization should be accompanied by total prohibition of land clearing for agricultural or livestock purposes in all the route up to 500 m. in the eastern side, i.e. the

Pichis River valley.

4.1.3. Pozuzo - "Codo del Pozuzo" - Puerto Mairo

This vecinity road would not bring major ecological problems provided that an organized settlement be made along the whole route.

4.1.4. Tunqui River - Chuchurras Road

Would cross the Yanachaga range and would open an access way from Oxapampa to the Palcazu valley. This would be the only permissible road which would cross the Yanachaga range from Oxapampa - Huancabamba to the Palcazu River. It would bring the following advantages:

- lumber supply for the forest industry in Oxapampa.
- it would interconnect the capital of the province with the Palcazu valley.
- it would be permissible only if it is accompanied by a prohibition of forest destruction in the area, from the mouth of the Tunqui River (in the Oxapampa - Pozuzo trunk) up to 1,000 m. in the eastern side, i.e. the Palcazu valley.

4.1.5. Pozuzo - Seso - Puerto Mairo Road

This road would connect the Pozuzo with Puerto Mairo without turning through the "Codo del Pozuzo". This should be permitted only with a prohibition of clearing over 1,000 m. on both sides of Yanachaga range.

Apart from these roads, no other construction or lengthing should be permitted for colonization purposes. Only construction of forest roads for timber extraction from forest zones with appropriate control to prevent invasions would be permitted.

4.1.6. Oxapampa - Villa Rica road

This road would interconnect the capital of the province with the important Villa Rica district. It should be accompanied by prohibition of forest clearing in almost all the route, over 1,800 m.

4.2. Areas to be Protected (Map No. 8)

In all the Palcazu River basin, protection must be given to zones which are not to be destroyed for agricultural purposes; these being the protection forests, forest reserves and conservations units.

4.2.1. The protection forests to be established are the following:

- San Matías range: totally over 500 m. on both sides; from the Pichis valley.
- Riparian forests: all over the zone on both sides of the rivers a 50 m. (minimum) wide forest strip must be reserved.

4.2.2. Conservation unit

All the Yanachaga range over 1,500 m. should form a conservation unit as National Park with the following objectives:

- Conservation of the varied flora and fauna of the region.
- Protection of the upper basin of Palcazu and Pozuzo rivers
- Conservation of the beautiful landscape for tourist purposes
- Conservation of the genetic material of forest species of the zone.

The Yanachaga - Chemillen National Park should include a low jungle zone between the Chuchuras and Lagarto rivers in order to preserve the ecosystems of the lower part of the valley.

4.2.3. Forest Reserves

Based on the results of the forest inventory, forest reserves must be established in order to supply permanently the forestry industry of the zone.

4.3. Establishment of an Administrative and Control System

To ensure effectiveness of an environmental conservation program in the zone, it is necessary to establish an official administration system as well as a control system for the areas to be protected.

4.3.1. Administrative Offices (Map No. 9)

The Ministry of Agriculture and/or the Proyecto Especial Pichis - Palcazu should have administrative offices in strategic zones for monitoring the project area and for providing orientation to the colonists. These offices should be staffed with forest engineers and biologists who will ensure the execution of an environmental conservation program.

The offices should be located in the following areas:

- Villa Rica: with jurisdication over the valleys of the Bocaz, Cacazu, and Pichanaz rivers.
- Oxapampa: with jurisdication over the west flank of the Yanachaga range and the Cachos - Pescado river area (south) and the Tunqui river.
- Pozuzo: with jurisdiction over the Pozuzo and the "Codo del Pozuzo" up to the Mairo river.
- Iscozacín: with jurisdication over the Palcazu River valley from the junction of Cacazu and Pichanaz rivers up to the mouth Pozuzo River and Puerto Victoria.

The head office for the project supervision should be located either in Oxapampa or Iscozacín.

4.3.2. Control System (Map No. 9)

Control over the area and application of legal mechanisms, protection of the areas and forestry guidelines must be exercised by forestry police posts fully equipped.

Location of these posts should be in:

- Iscozacín: with jurisdication over the Palcazu valley
- Cacazu: at the dividing line of the road to Iscozacín
- Villa Rica: a post already exists, but lacks equipment.
- Oxapampa: a post already exists, but lacks equipment
- Tunqui River: between Huancabamba and Pozuzo
- Pozuzo: control over the Pozuzo valley and the "Codo del Pozuzo".

4.4. Environmental Education Program

So that the present population and colonists settling available areas understand the prohibitions, protected areas, fishing and forestry extraction and hunting regulations, an environmental education program must be implemented in the region.

The program will comprise:

4.4.1. Placing notices along the roads indicating areas where clear-cutting is prohibited. The key points are: Villa Rica, Cacazu, Bocaz, Iscozacín, Oxapampa, Chacos, Tunqui, Pozuzo, "Codo del Pozuzo", Puerto Mairo and Puerto Victoria.

4.4.2. Publication of a pamphlet detailing the regulations set forth, to be distributed among all population sectors, settlements, forest controls, schools, SASA office in San Ramón. etc.

4.4.3. Distribution of posters, decals and advertisements.

4.4.4. Training courses for all teachers in the zone regarding environmental conservation.

4.5. Legal Provisions

Through a legal instrument (Decreto Supremo or Resolución Suprema) deforestation in the zone should be totally prohibited as follows:

4.51. Eastern flank (west) of Yanachaga range: total prohbition of forest clearing for agricultural or livestock purposes over 2,000 m altitude from Miraflores (Oxapampa) up to Huancabamba; and, over 1,000 m. altitude from Huancabamba to Pozuzo and "Codo del Pozuzo".

4.5.2. Eastern flank (east) of Yanachaga range: total prohibition of forest clearing for agricultural and livestock activities over 1,000 m alt.

4.5.3. Southern zone(Cacazú - Bocaz - Pichanaz) total prohbition of forest clearing for agriculture and livestock activities over 1,000 m.

4.5.4. San Matias range: total prohibition of forest clearing for agricultural and livestock activities over 500 M. alt. on both flanks (Palcazu and Pichis).

4.5.5. Enforcement of riparian vegetation strips a minimum of 50 m. wide.

4.5.6. Administer sanctions to transgressors of Forestry and Fauna Law (D.L. No. 21147).

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

5.1.1 Ecology

- The Palcazu valley encompasses two zoogeographic provinces: Amazonica and Yungas, with a considerable variety of wildlife.

Rare species of Peruvian fauna are present in the area, such as the giant armadillo (Priodontes giganteus), (Cabassous unicinctus), wild rabbit (Sylvilagus), (Atelocynus and Speothos), pudu (Pudo mephistophelis) and harpy eagle.

Species in danger of extinction, are various primates,("coto", "maquispa", "choro"), "banderon", spectacled bear, nutria, "lobo de río", jaguar, ocelot, "huamburushu", aquatic turtle and the caiman. Wildlife constitutes an important source of food for the native communities of the area.

- Three phytogeographic formations are present in the valley: Hylea near the Andes, Yungas jungle with three floors (rainforest of upper and lower mountain and the high forest), and possibly the Andean high mountain vegetation.

- Three biotic communities present in the area are:

a. Aquatic communities: rivers, lagoons and river banks. Ecological alterations are present in the rivers and river banks due to contamination, forest destruction, erosion and over-fishing which is reducing the fishery resource.

b. Terrestrial communities: tropical forest of the low jungle, high jungle, cloud forest, dwarf forest and high Andean steppes.

Due to clearing and spontaneous colonization, serious alterations are affecting the tropical forest and cloud forest.

5.1.2. Effects of the Road Construction

1. The few access roads to the area through the west and south are producing the following effects:

a. Indiscriminate clearing of protection forests in the upper regions.

b. Soil erosion

c. Invasion of forest extraction contracts

d. Pressure on native communities

e. Wildlife extermination

2. If the colonization process does not include an integral environmental conservation program, the future effects on the zone will be catastrophic.

3. A series of zones critical to the colonization process have been identified in the Palcazu River valley.

a. Critical Zones due to the ecology of the area over 500 m. alt. in the San Matias range and over 1,000 m. alt. in the Yanachaga range

b. Actual critical zones due to spontaneous human settlements in the Bocaz, Cacazu and Mairo rivers.

c. Possible future critical zones if the roads are constructed without an environmental conservation program.

5.2. Recommendations

5.2.1. The Palcazu River valley colonization process which contemplates the construction of roads and the settlement of new colonists should be implemented in conjunction with an Environmental Conservation Program in order to avoid an ecological disaster that would affect the forest, fauna, hydrology, soils, and navigability of the rivers.

5.2.2. The Environmental Conservation Program for the Palcazu River valley should comprise the following:

a. Sole roads permissible:

- Cacazu-Iscozacin-Puerto Mairo-Puerto Victoria
- Cacazu - Pichanaz - Puerto Bermudez
- Pozuzo - Codo del Pozuzo - Puerto Mairo
- Tunqui river - Chuchurras
- Pozuzo - Seso - Puerto Mairo
- Oxapampa - Villa Rica

b. Areas to be protected:

- Protection forests
  - All the San Matias range area over 500 m alt.
  - Riparian woods to a width of 50 m.
- Establishment of Yanachaga-Chemilla National Park in the Yanachaga range over 1,500 m.
- Establishment of forest reserves in the zone.

c. Establishment of administrative offices and forest control posts in strategic sites.

- Administrative offices in Oxapampa, Pozuzo, Villa Rica and Iscozacín, with teams of professionals (biologists and forestry experts) to supervise and implement the enviromental program.

- Forest control posts adequately equipped for the Forestry Police in Villa Rica, Oxapampa, Tunqui, Pozuzo, Codo del Pozuzo, Iscozación and Cacazu.

d. Implementation of an environmental education campaign through schools and populations by distributing illustrative pamphlets, posting of areas prohbited for clearing, etc.

e. Promulgation of a legal instrument (Decreto or Resolución Suprema) that fix protection zones prohibiting clearing for agricultural or livestock activities.

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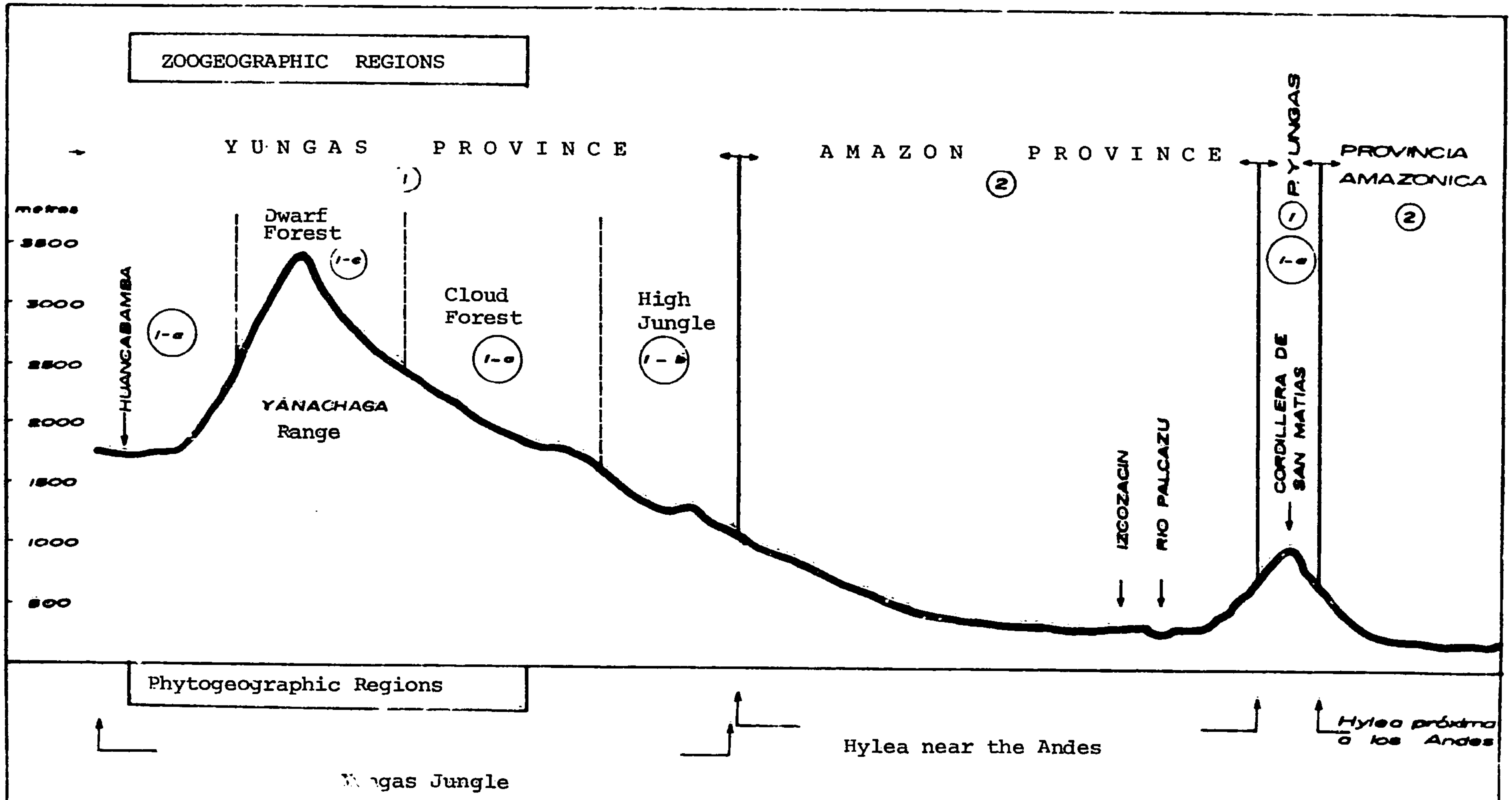
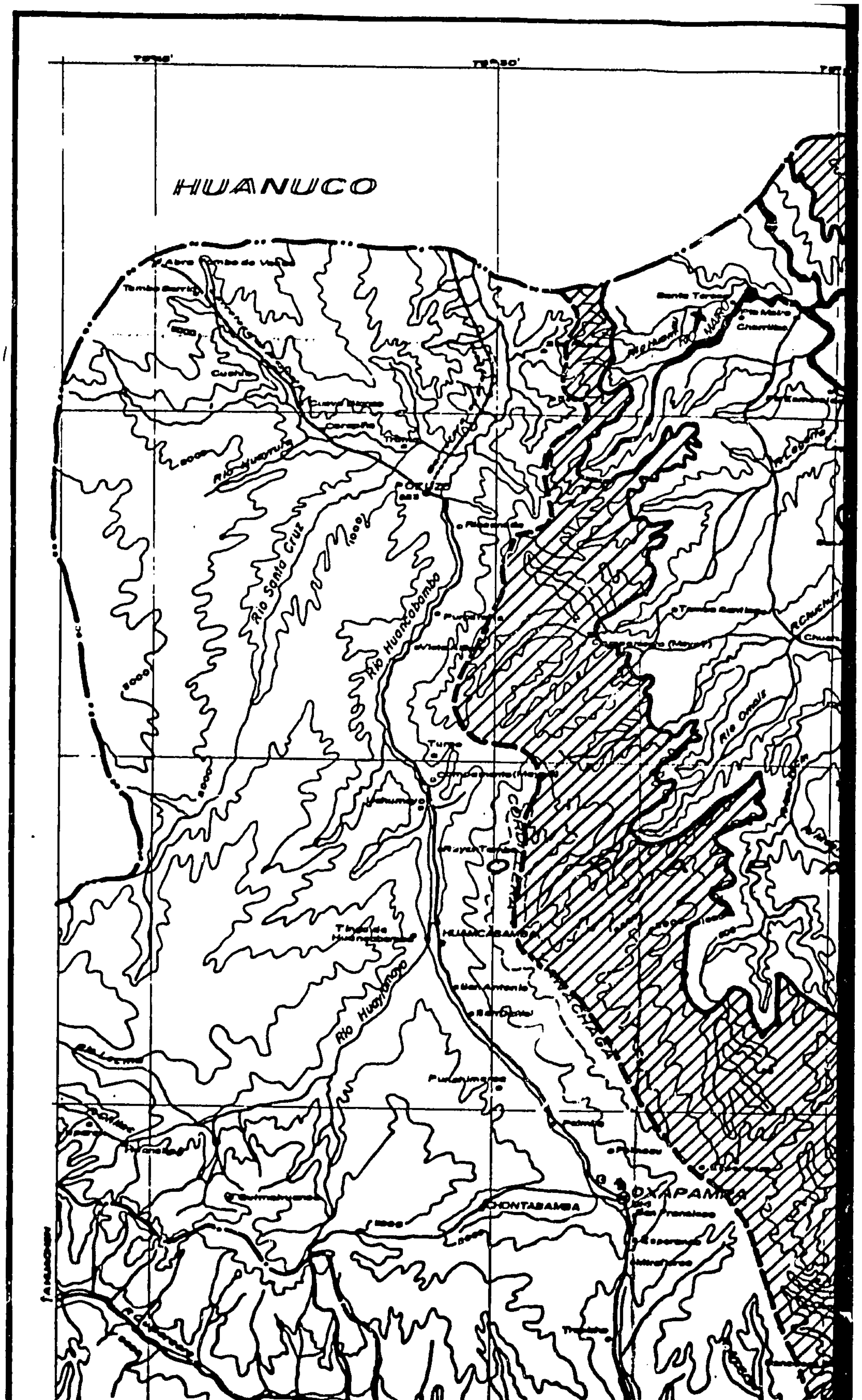


FIG. 1 - Transverse Cut (West to Fast) of Palcazu River Valley and location of the Zoogeographic (Brack) and Phytogeographic (Hueck, 1978) Provinces.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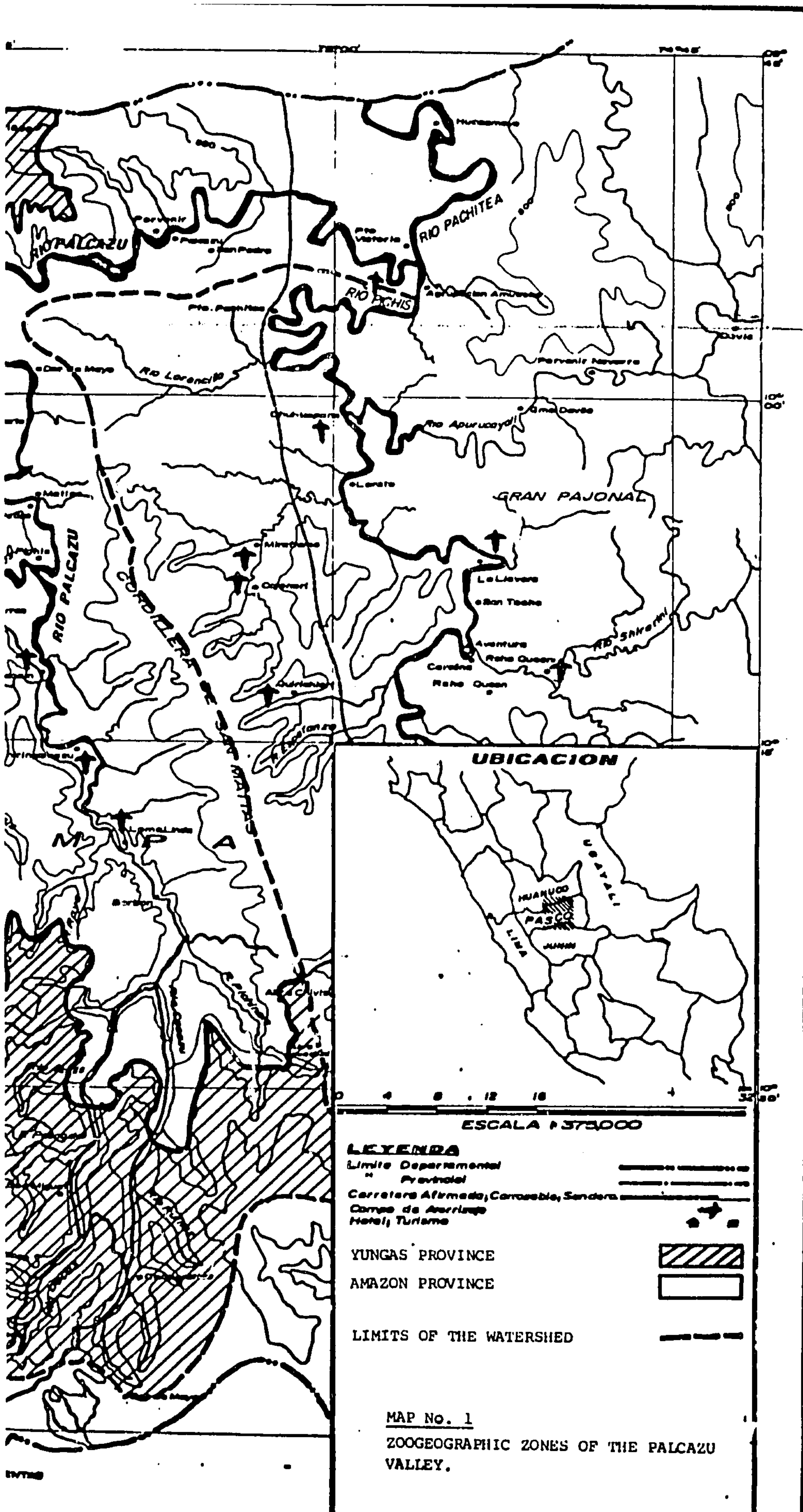
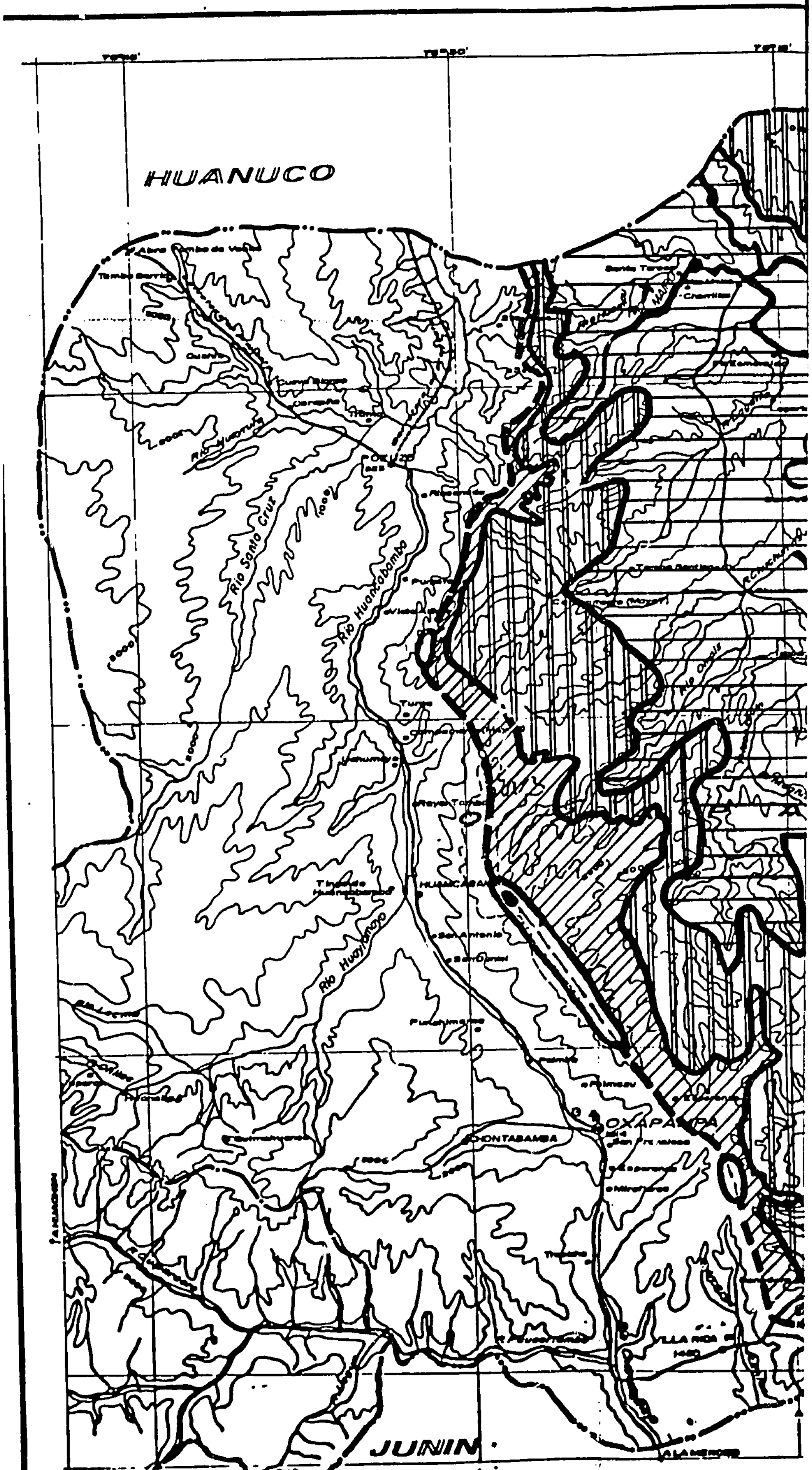


MAP No. 1

ZOOGEOGRAPHIC ZONES OF THE PALCAZU VALLEY.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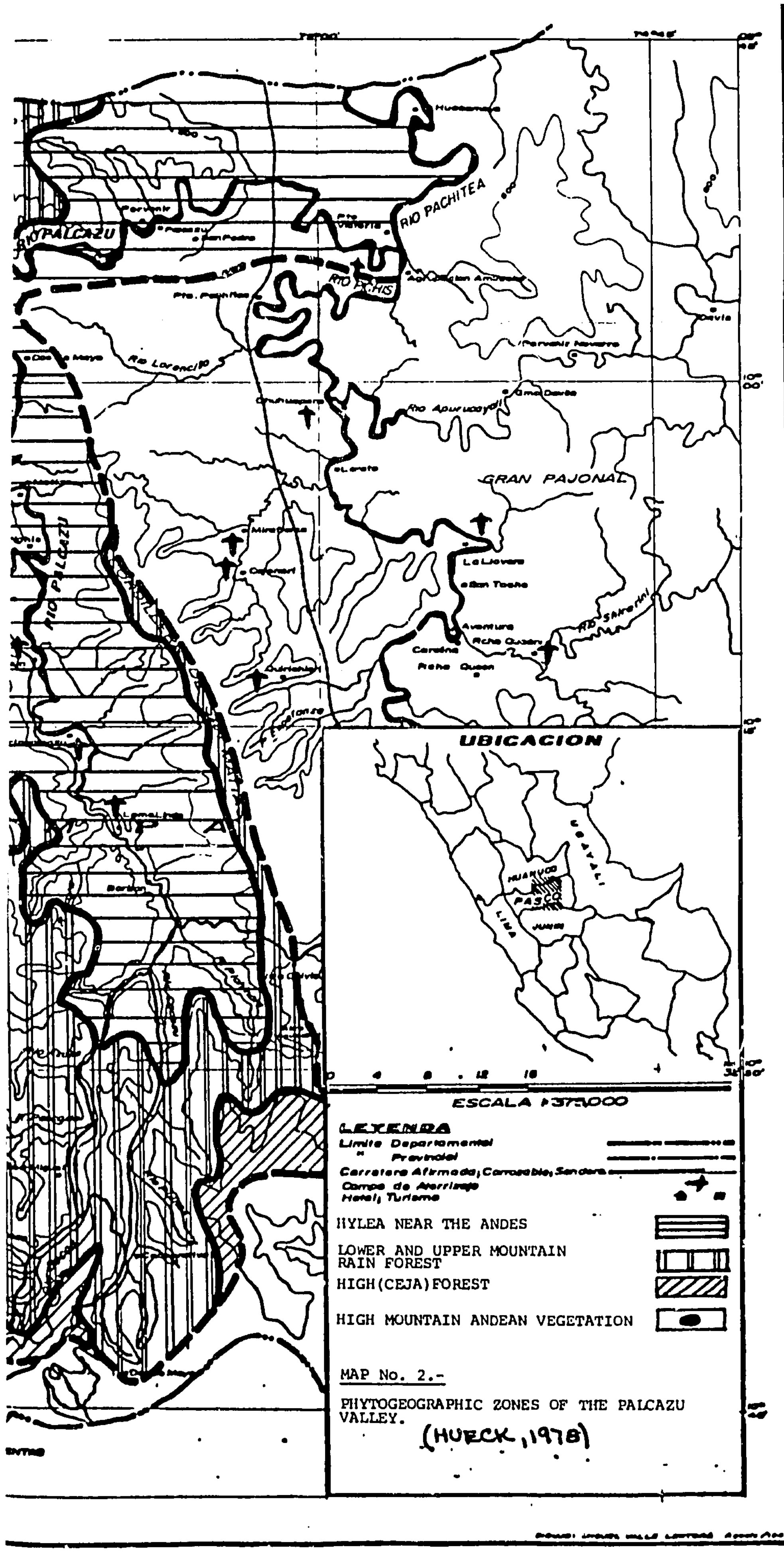
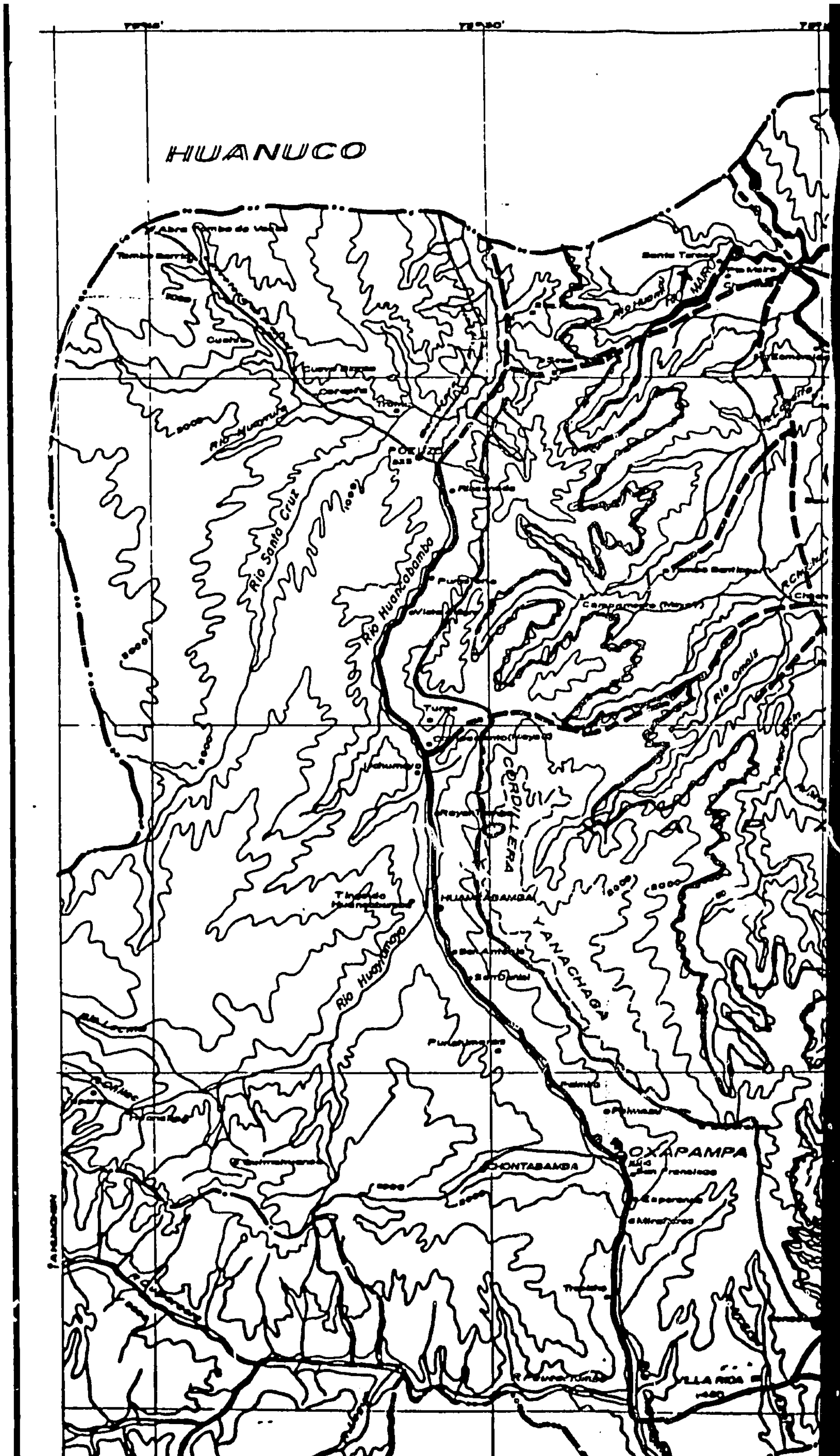


MAP No. 2.-

PHYTOGEOGRAPHIC ZONES OF THE PALCAZU VALLEY.

(HUECK, 1978)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VILLA RICA
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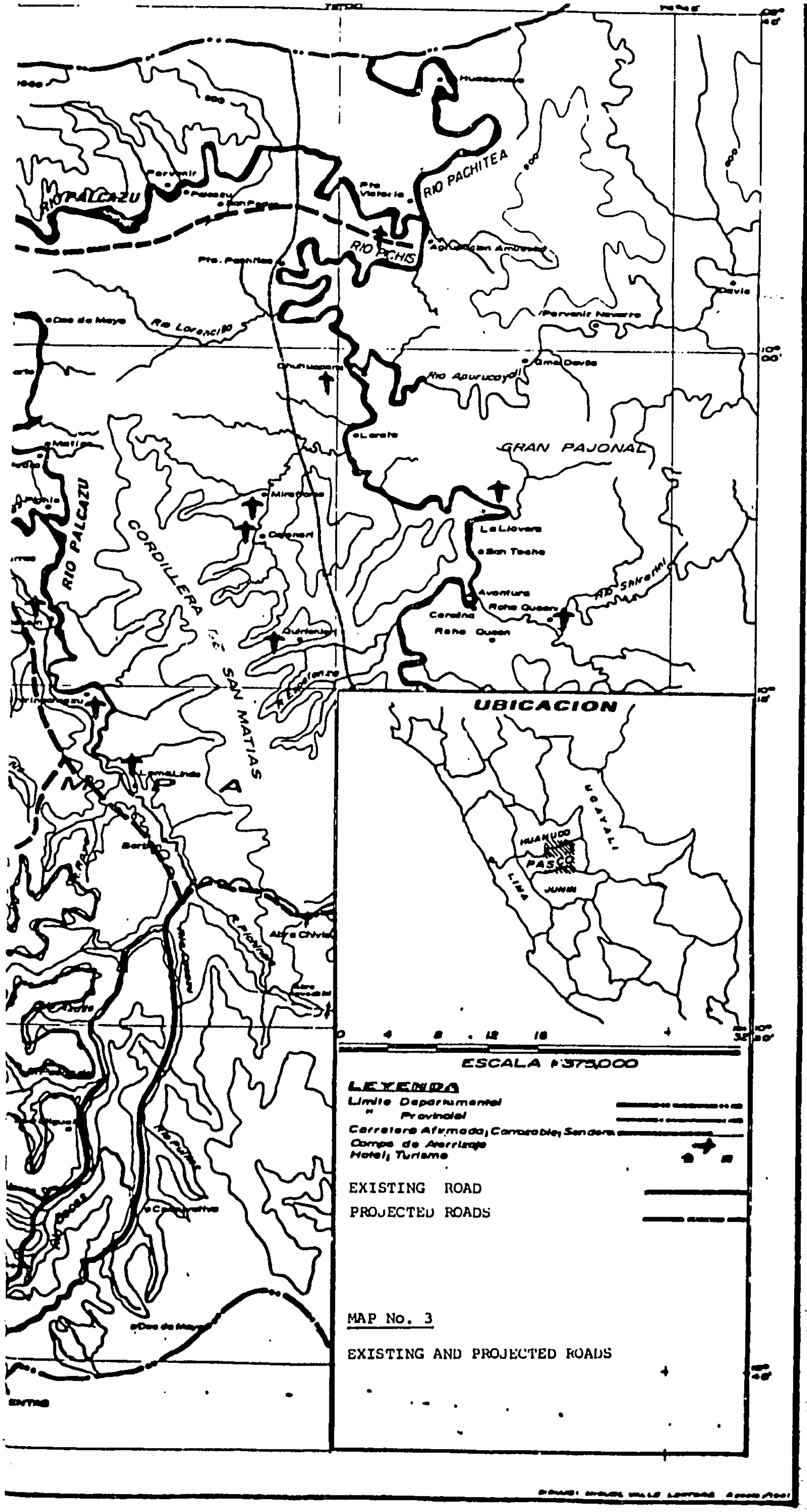
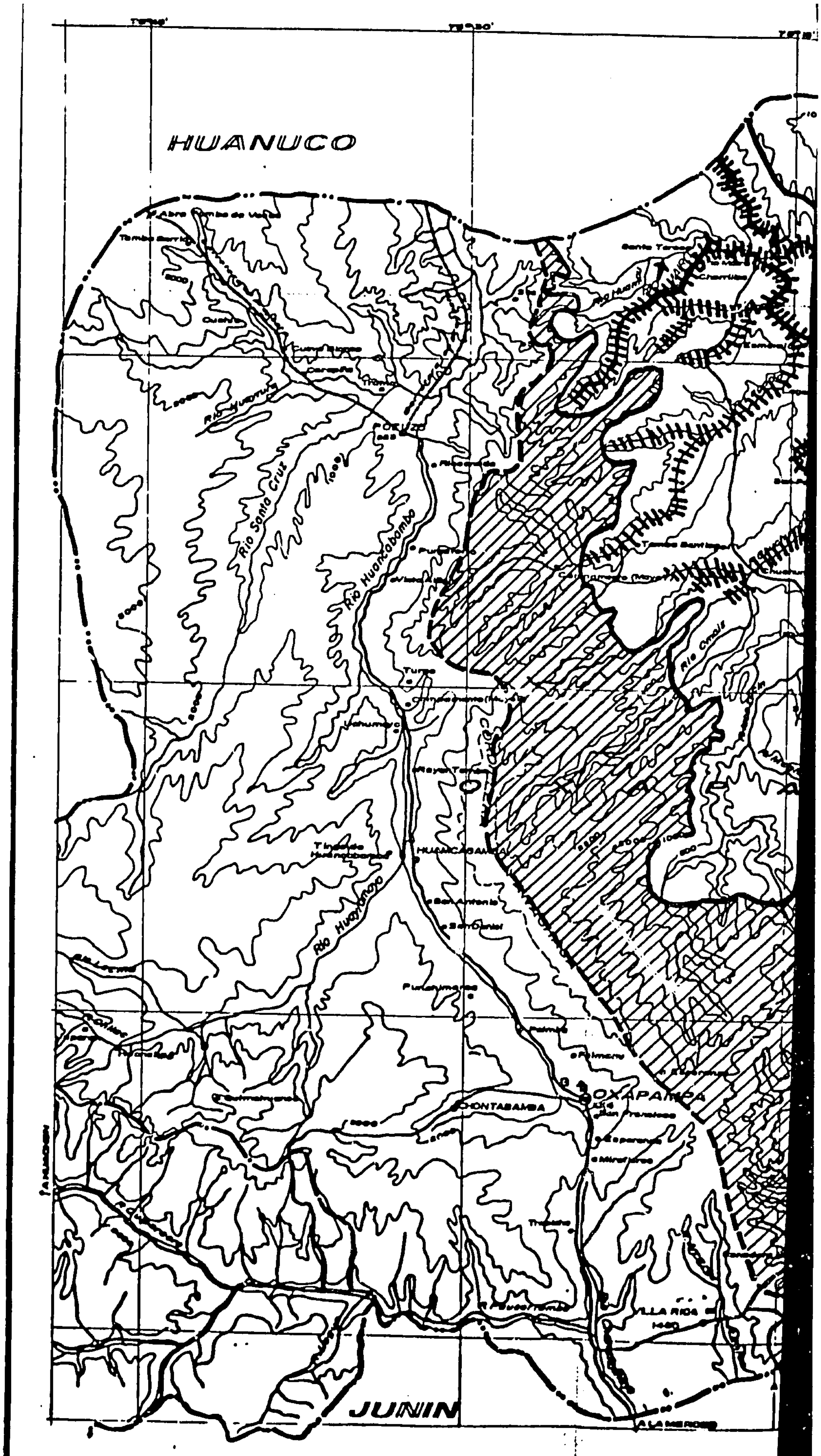


MAP No. 3

EXISTING AND PROJECTED ROADS



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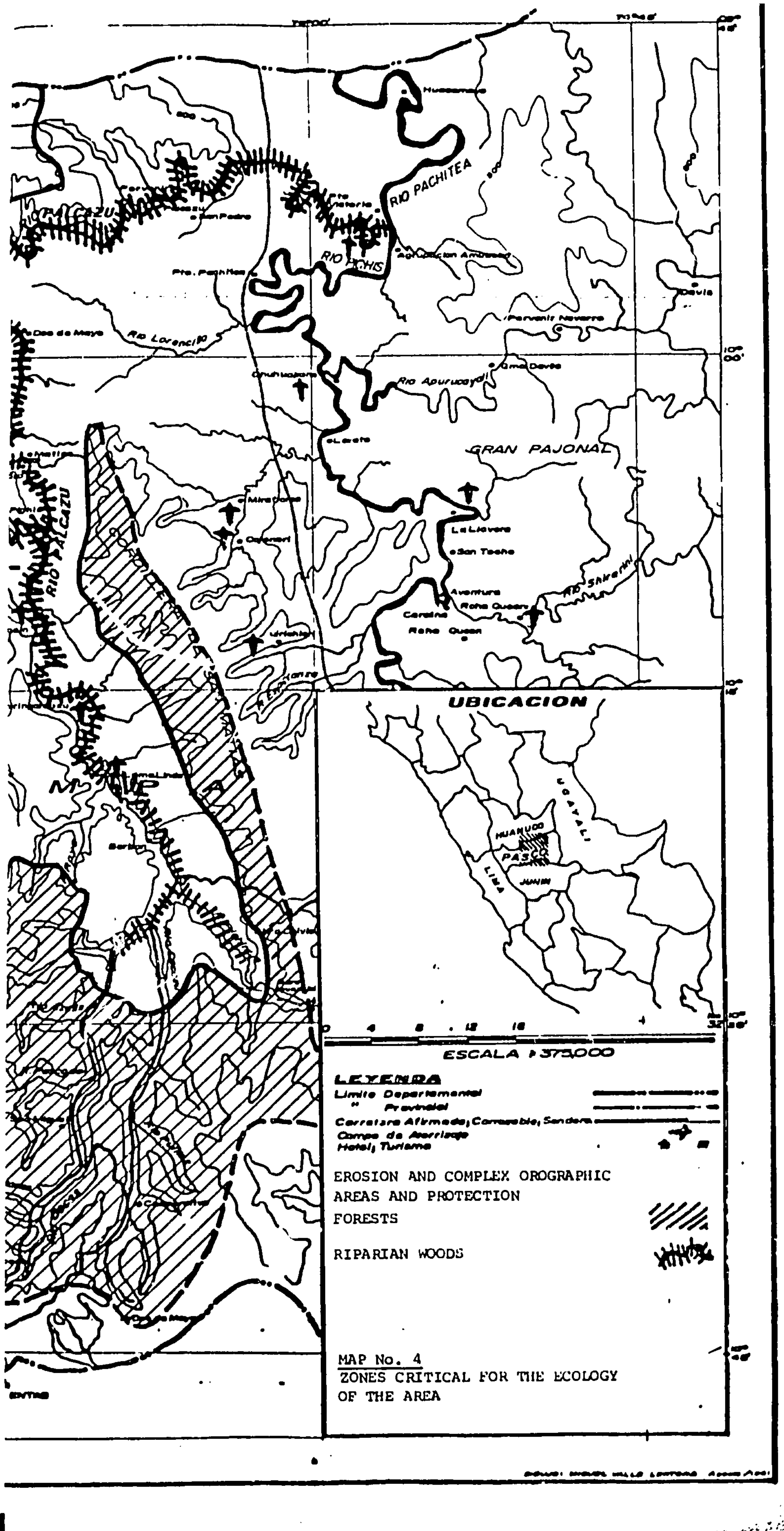
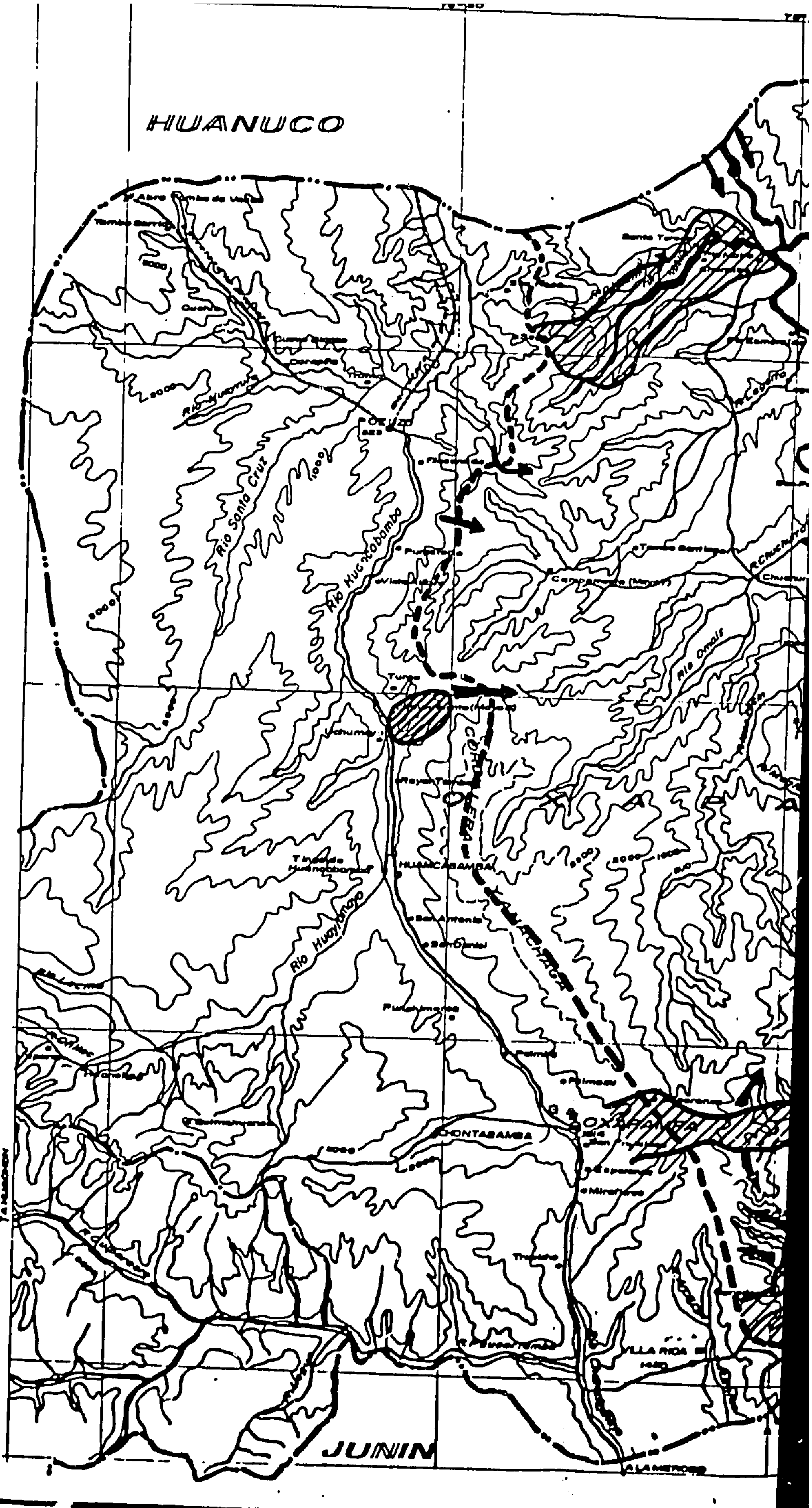


MAP No. 4
ZONES CRITICAL FOR THE ECOLOGY
OF THE AREA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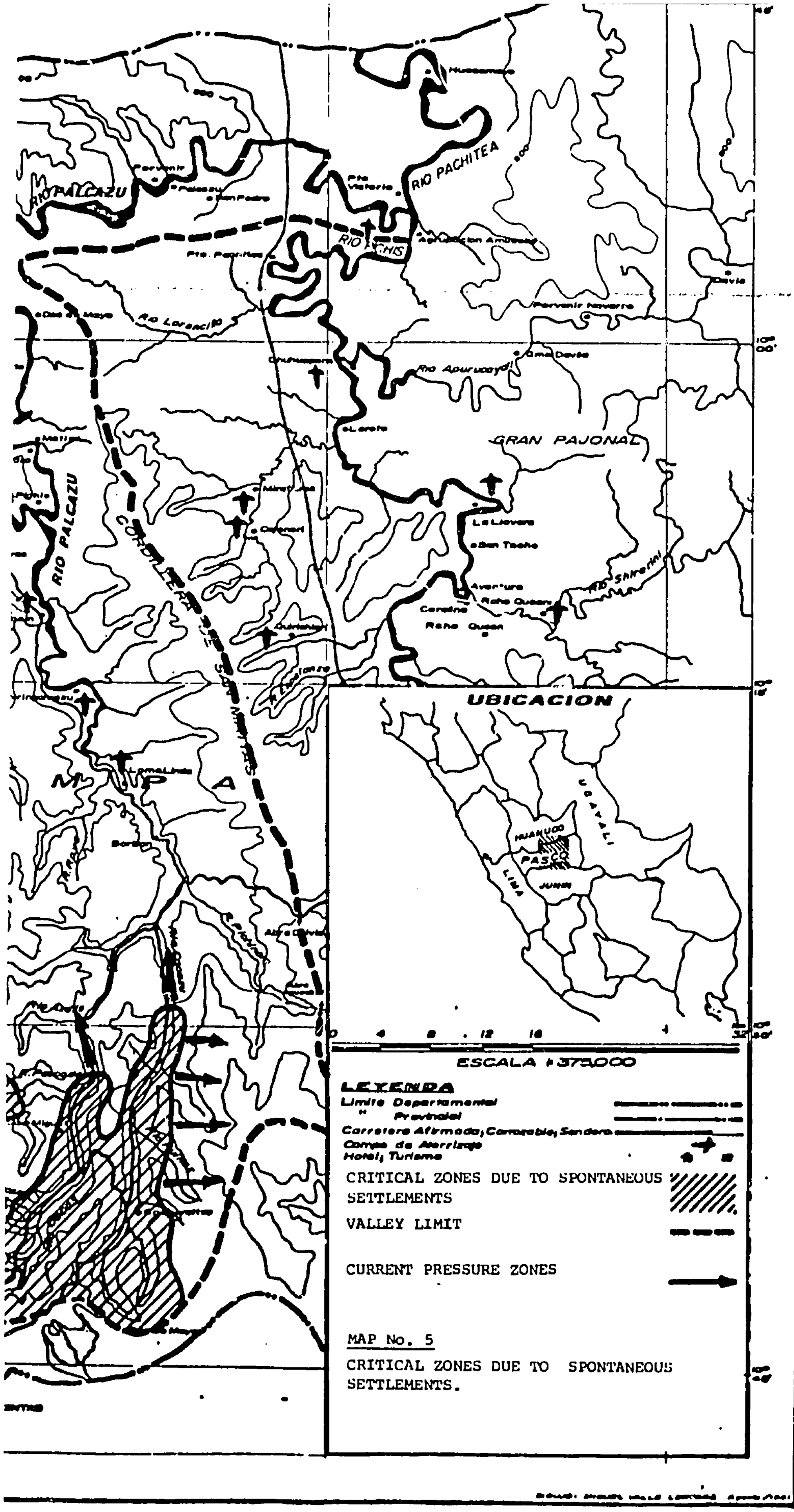
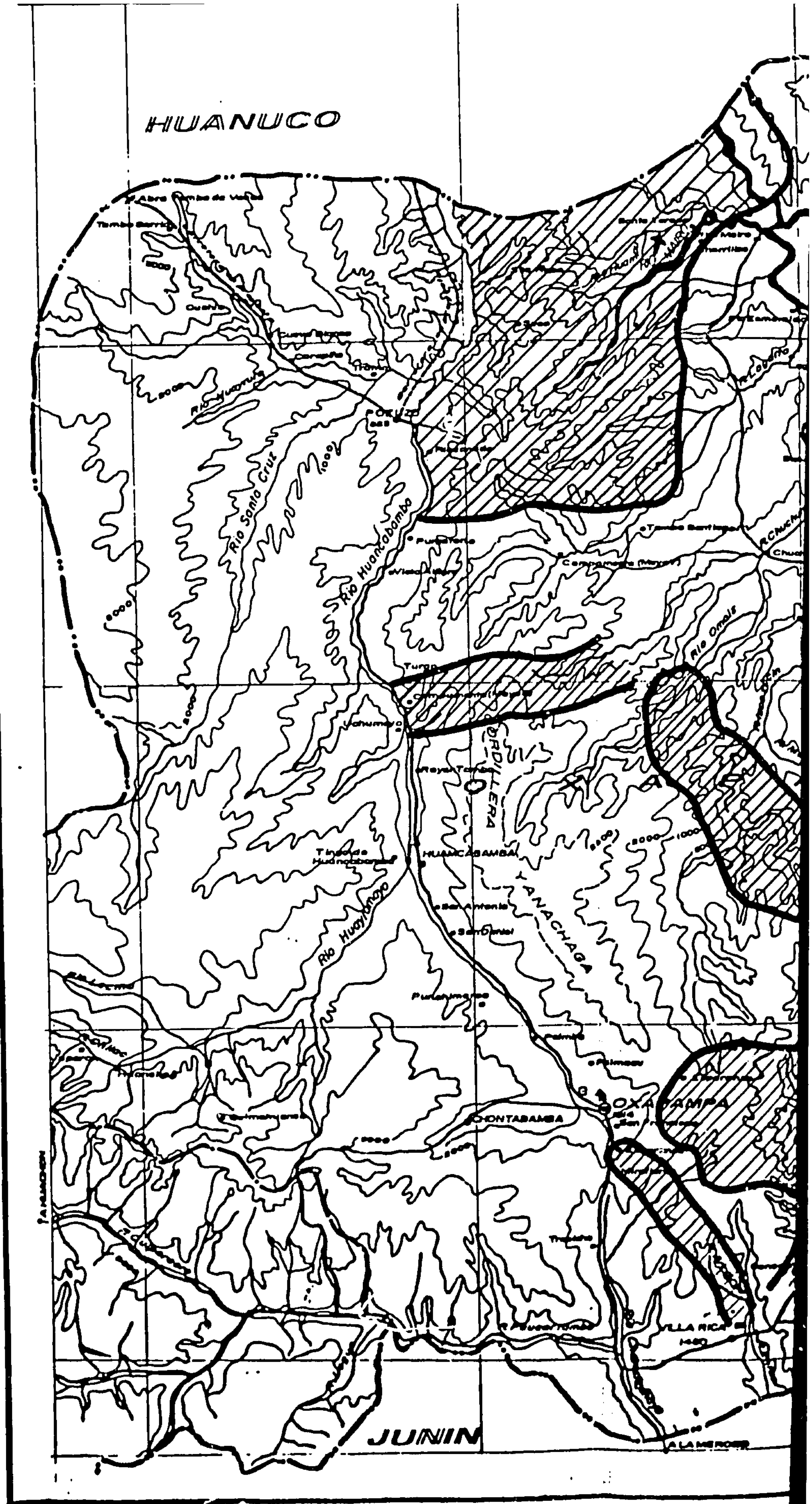


MAP No. 5

CRITICAL ZONES DUE TO SPONTANEOUS SETTLEMENTS.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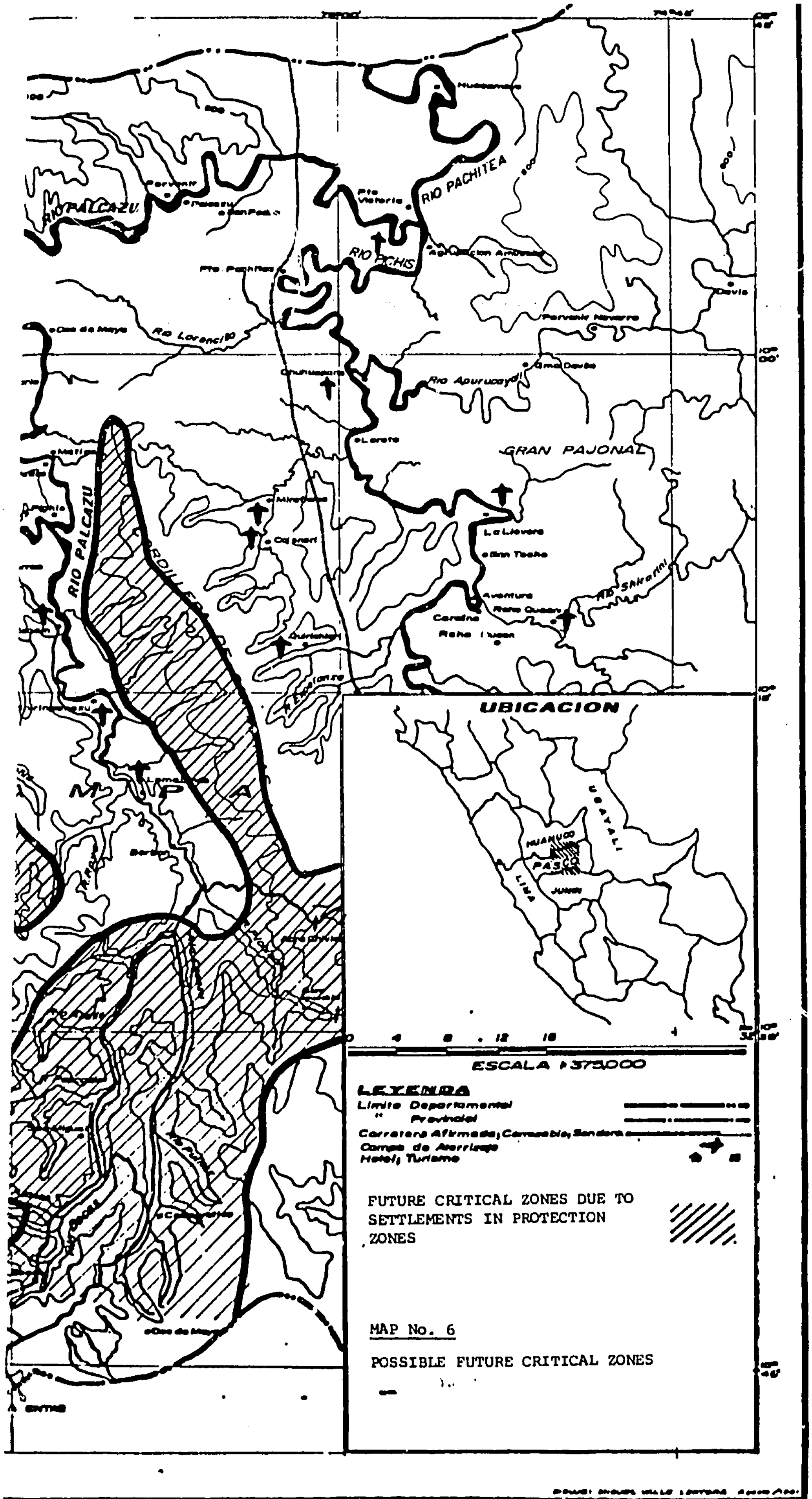
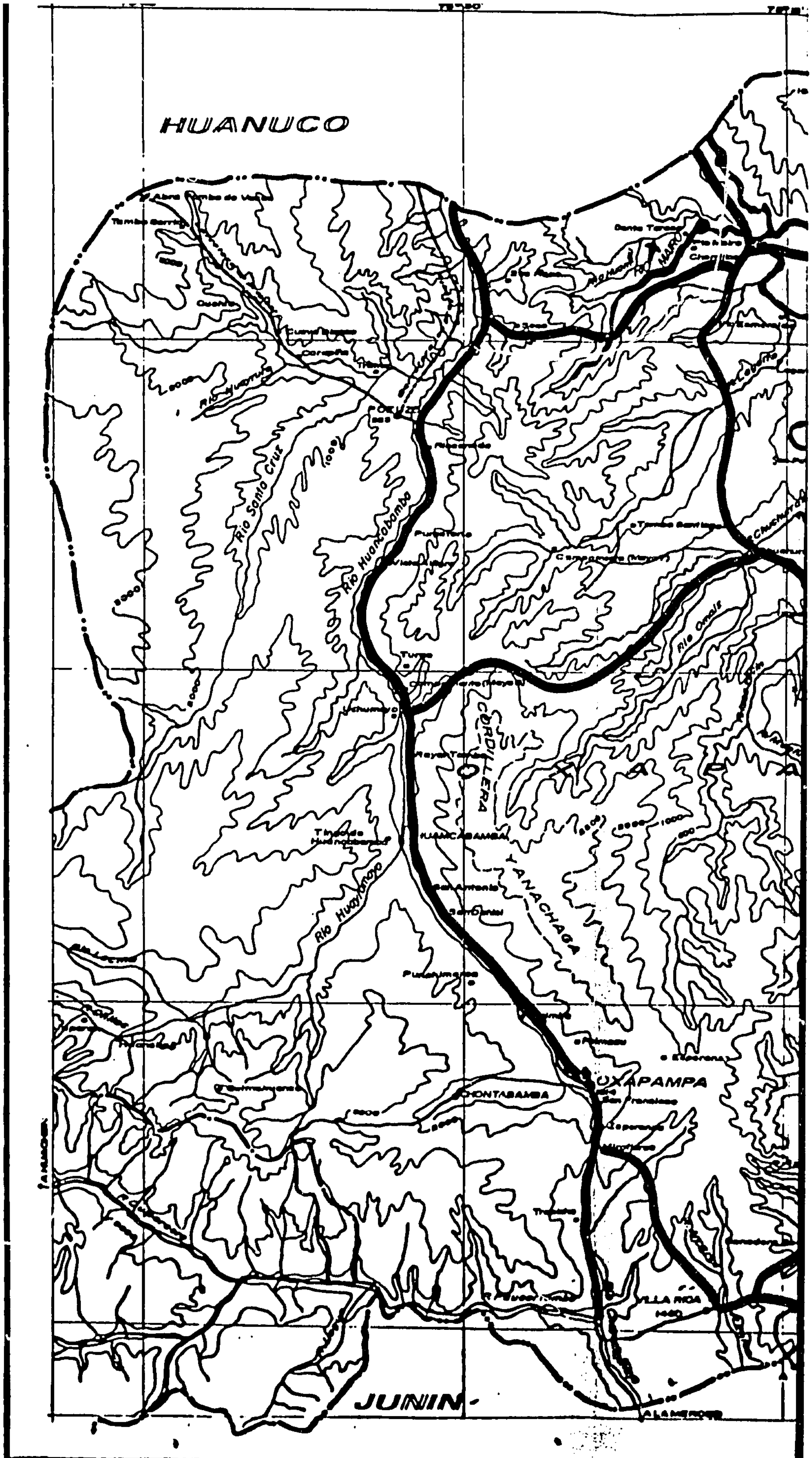


FUTURE CRITICAL ZONES DUE TO SETTLEMENTS IN PROTECTION ZONES

MAP No. 6

POSSIBLE FUTURE CRITICAL ZONES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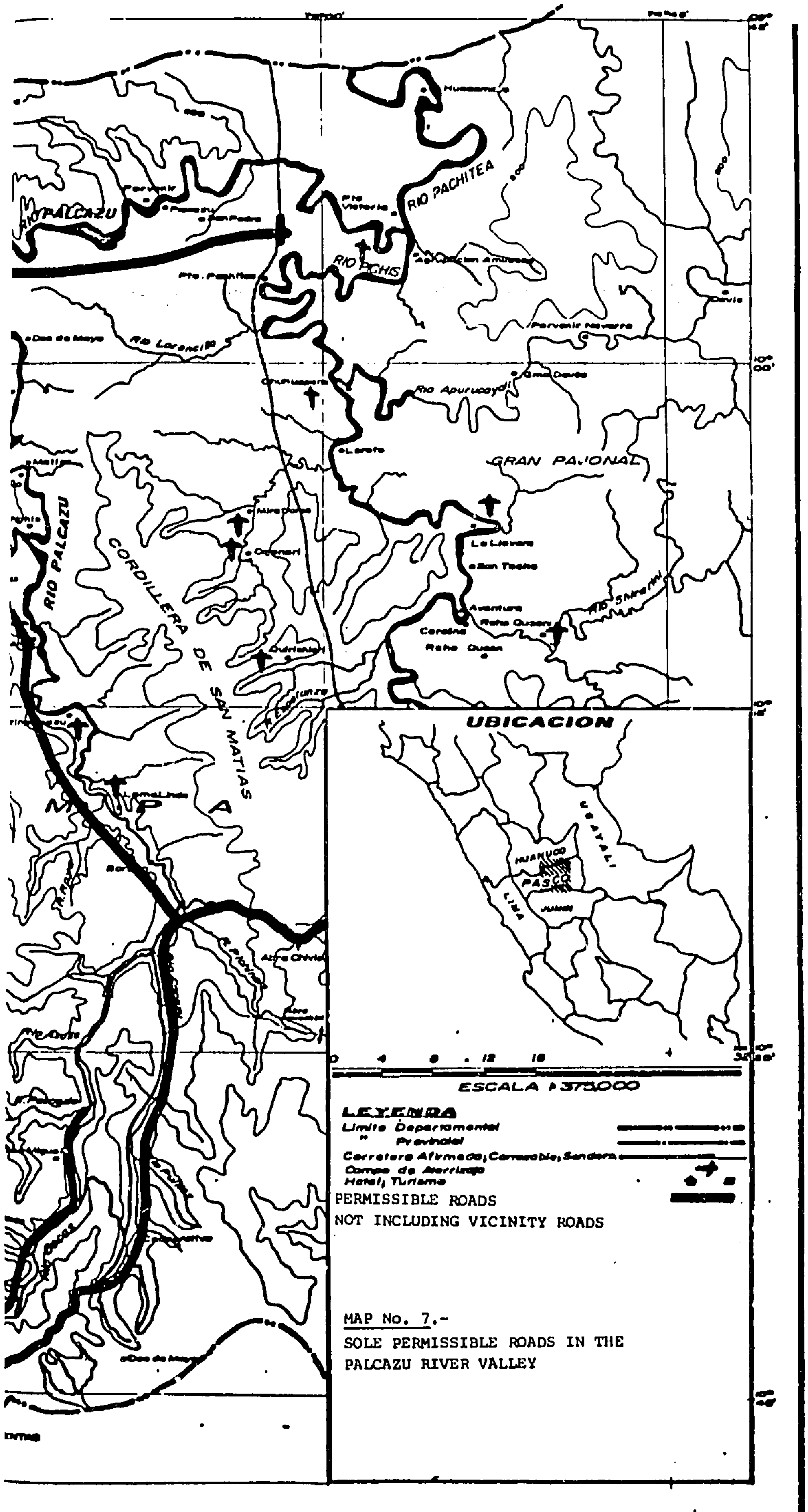
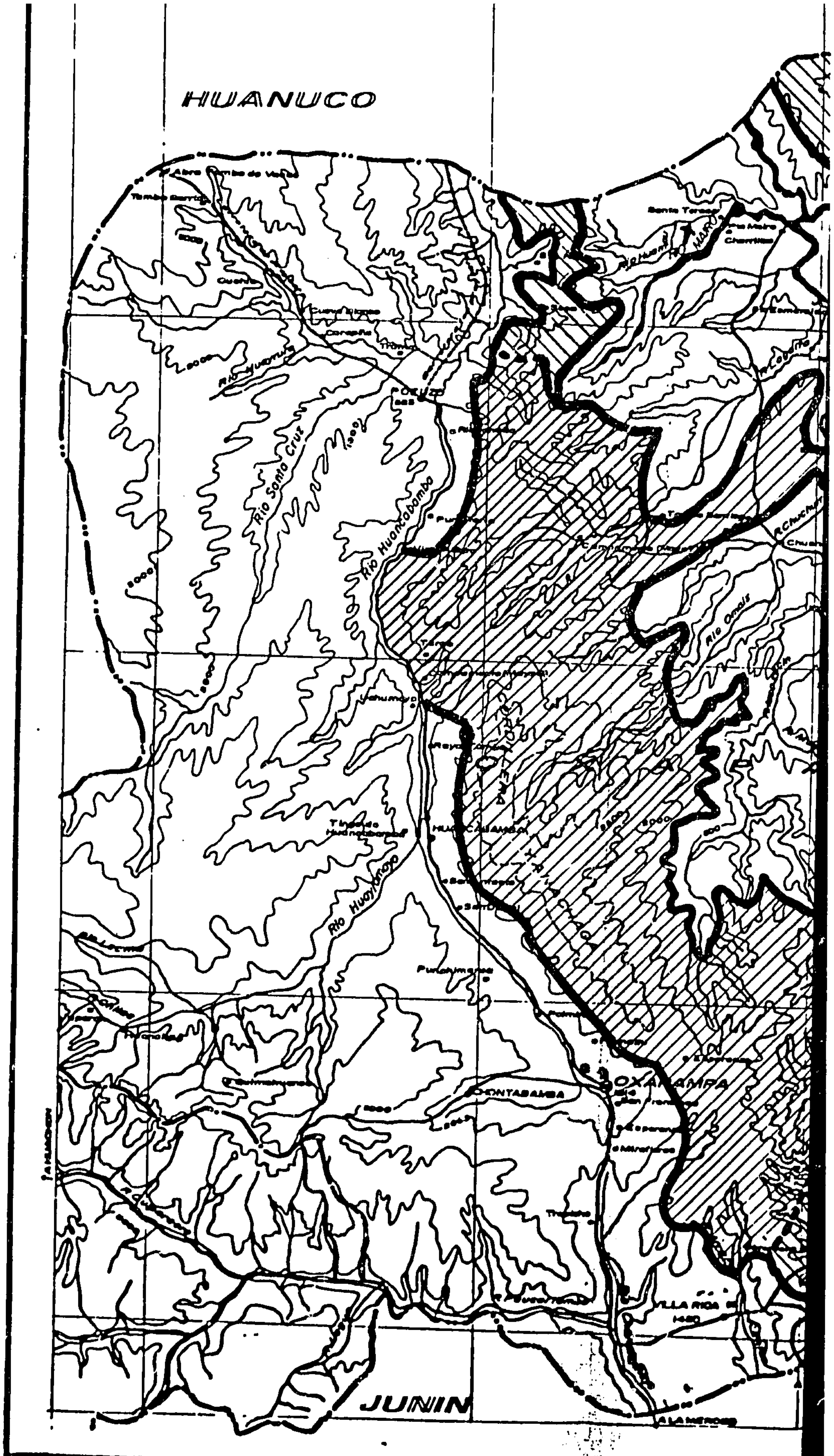


MAP No. 7.-
SOLE PERMISSIBLE ROADS IN THE
PALCAZU RIVER VALLEY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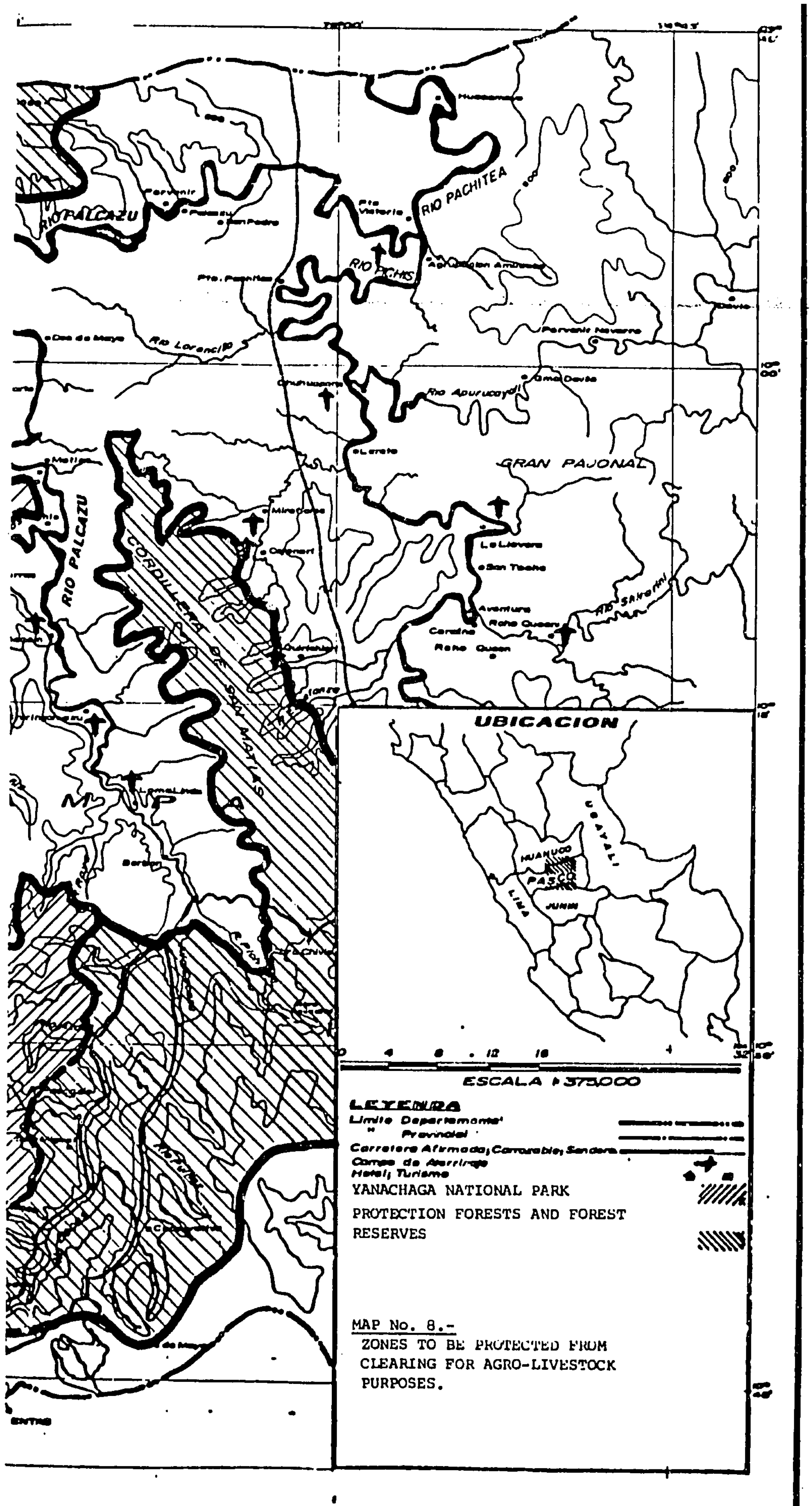
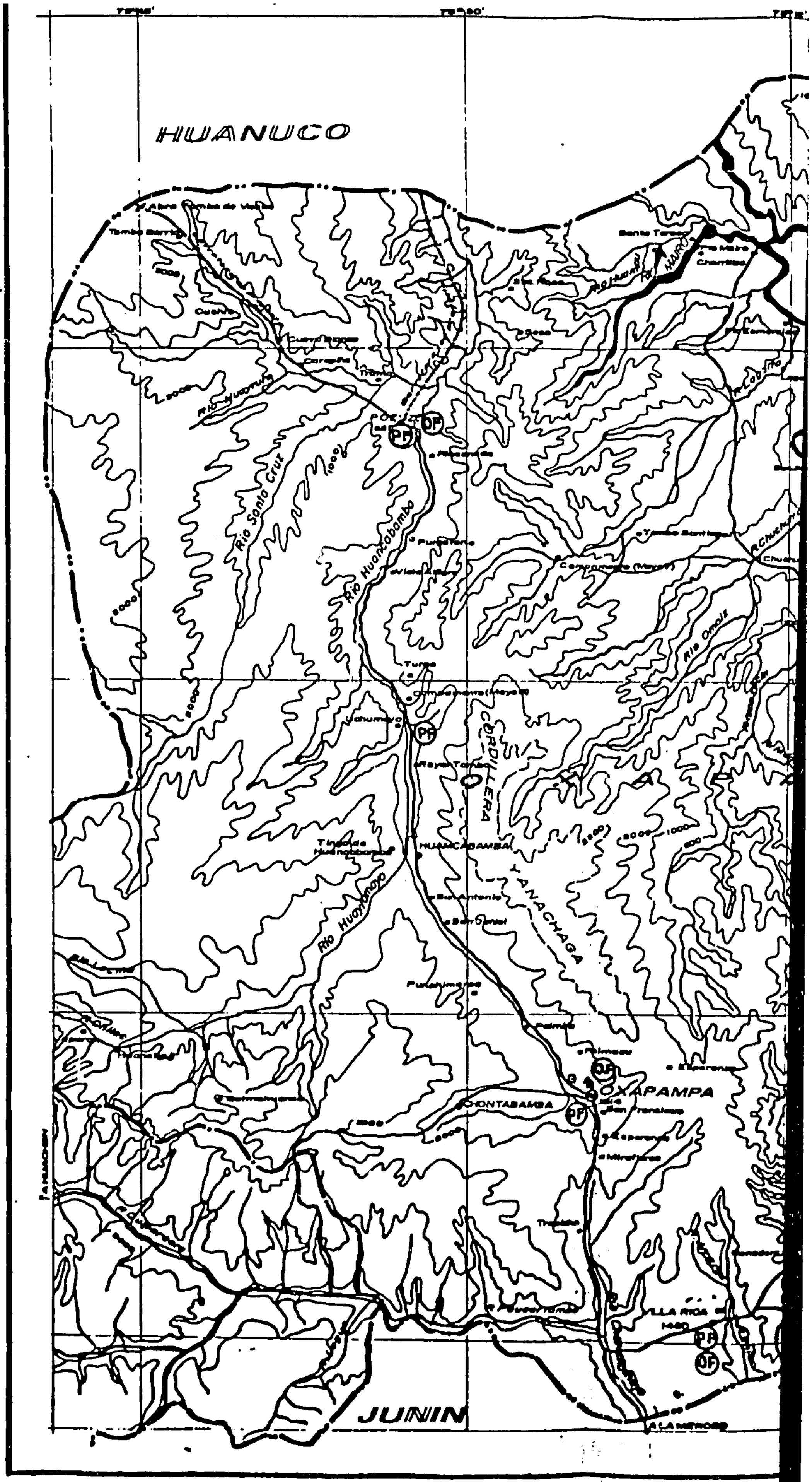
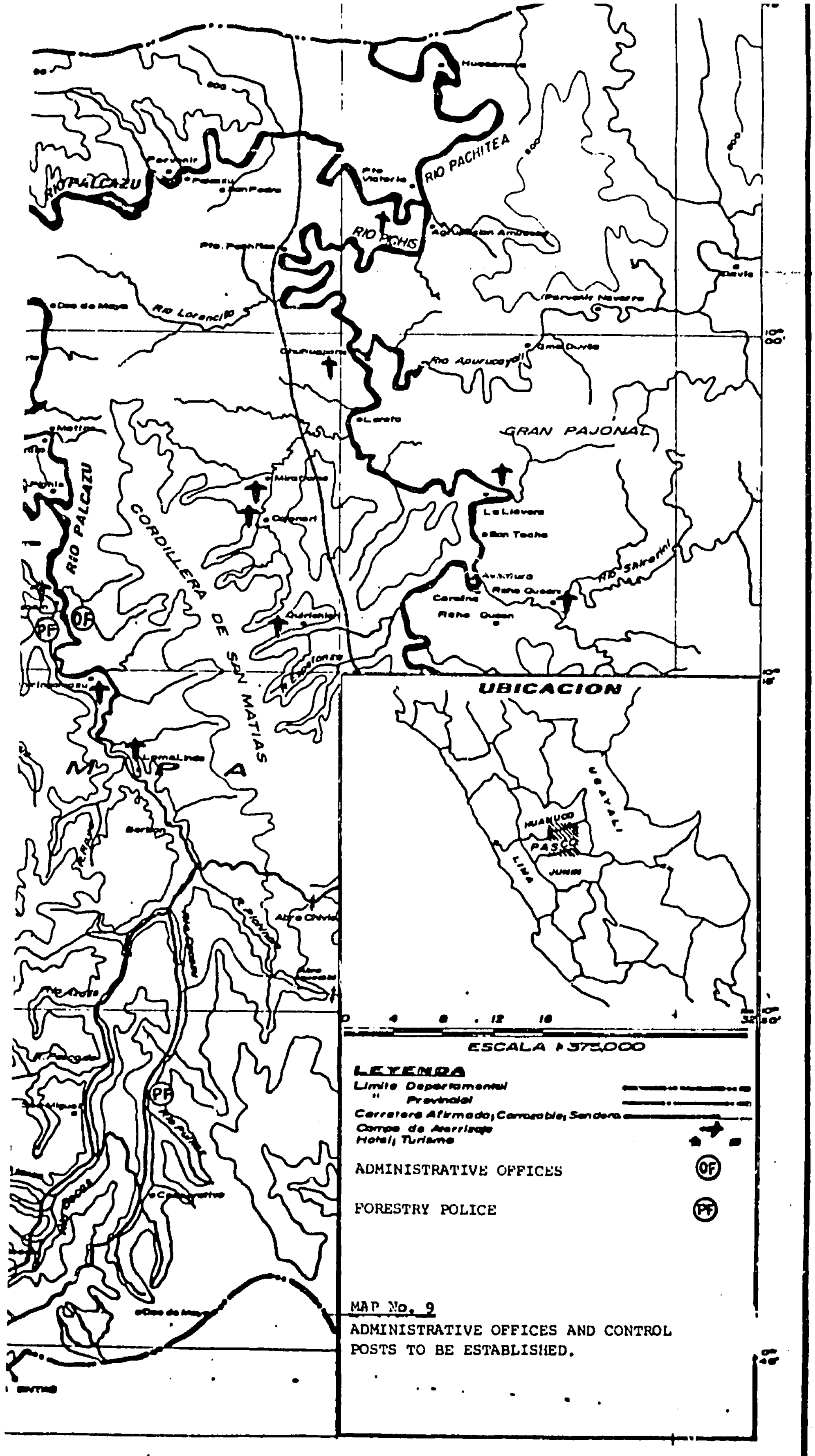


MAP No. 8.-
ZONES TO BE PROTECTED FROM CLEARING FOR AGRO-LIVESTOCK PURPOSES.



HUANUCO
Rio Santa Cruz
Rio Huancabamba
Rio Huaylamayo
CORDILLERA
YANACHAGA
HUANCABAMBA
CHONTABAMBA
OXAPAMPA
Rio Omaiz
JUNIN

118



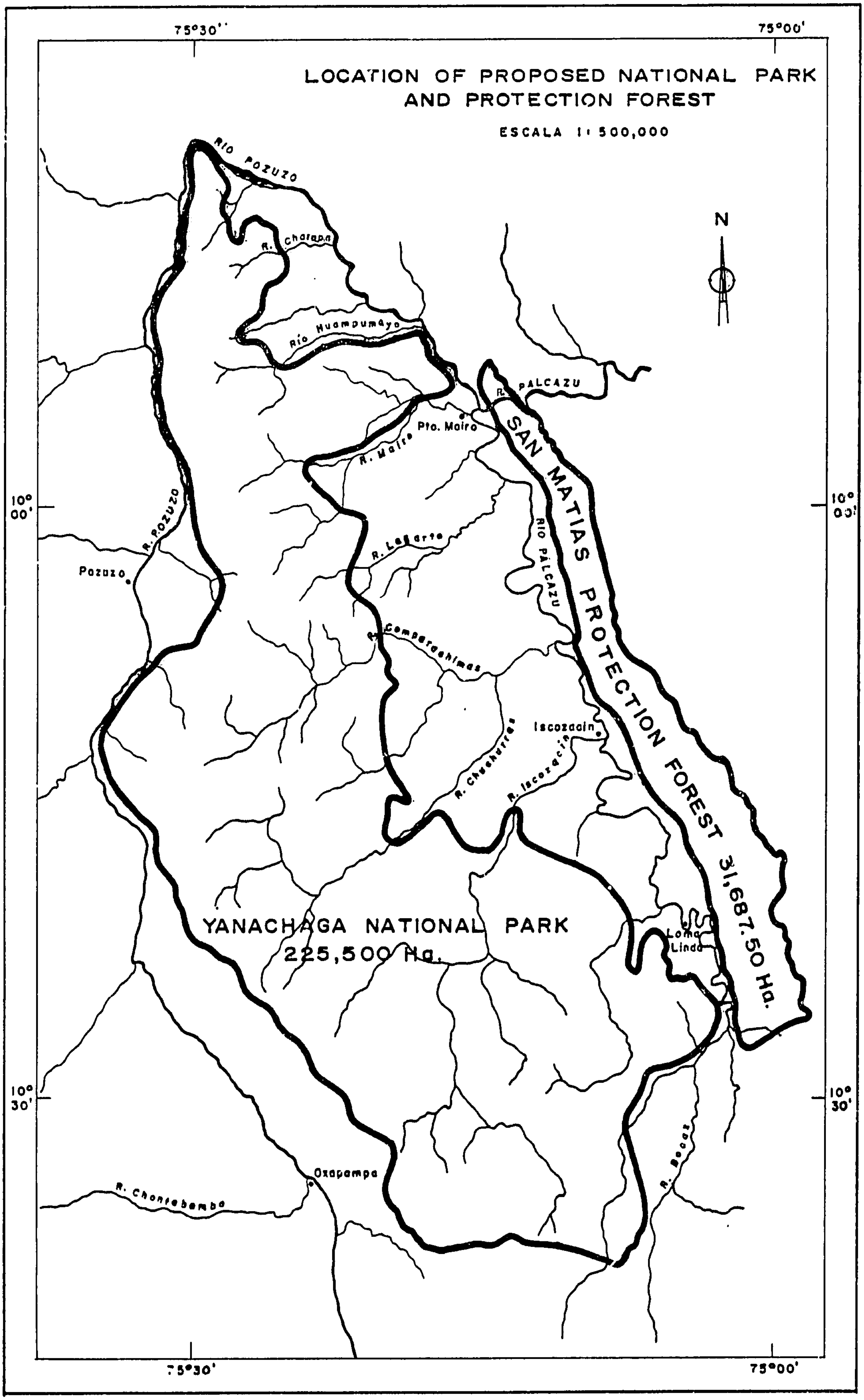
MAP No. 9
ADMINISTRATIVE OFFICES AND CONTROL POSTS TO BE ESTABLISHED.

APPENDIX E

FAUNA AND WILD AREA MANAGEMENT IN THE PALCAZU VALLEY, PERU

Marc J. Dourojeanni

CONTENTS



LOCATION OF PROPOSED NATIONAL PARK
AND PROTECTION FOREST
ESCALA 1:500,000
75°30'
75°00'
10° 00'
10° 30'
N
Río Pozuzo
R. Charapa
Río Huampumayo
R. Palcazu
Pto. Mairo
R. Mairo
R. Pozuzo
Pozuzo
R. Lagarte
Río Palcazu
SAN MATIAS PROTECTION FOREST 31,687.50 Ha.
Iscozacin
R. Iscozacin
YANACHAGA NATIONAL PARK
225,500 Ha.
Loma Linda
Oxapampa
R. Chontabamba

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1. SUMMARY

Wildlife species of present and/or potential economic interest in the Palcazu Valley are listed. Among the main meat-producing species are rodents of the *Cuniculus*, *Dasyprocta* and *Hydrochoerus genuses*; the edentate *Dasypus*, the tapir (*Tapirus*), the pecaries (*Tayassu*) and the deer (*Mazama*), in addition to birds and turtles (*Podocnemis* and *Geochelone*). For hides, the deer, pecaries and, especially, the white caiman (*Caiman sclerops*) stand out. As regards pelts, all the common felines of the Amazon Jungle (*Felia pardalis*, *F. Wiedii* and *Leo onca*) as well as the mustelids *Lutra* and *Pteronura* can be found. There are several species of primates which could be used as live animals for bio-medical science. For ornamentation, there are parrots and other similar birds, among many others.

Despite the existence of a broad range of useful species it can be stressed, in general terms, that the present populations are below the levels which would guarantee sustained production. For this reason a total ban on hunting is recommended, except for subsistence hunting of common species as practiced by the natives.

A list of species which could become pests is offered. From this we can highlight Passeriform birds as well as rodents which prey on agricultural crops and products; vampire bats as transmitters of rabies, poisonous snakes; monkeys, edentates and other animals bearing diseases which can be transmitted to man as well as diverse predators which attack poultry and cattle. The future importance of each species will change with the manipulation of natural resources.

An analysis of the different management alternatives for wildlife in the Palcazu shows the applicability of all levels of management (extensive, intensive and superintensive) to a great variety of situations as a result of present and future human intervention. The areas with the greatest management possibilities will be small woodlands in agricultural and livestock areas, woods under forestry exploitation, protection forests, pasture lands, riverbanks and water surfaces as well as artificial or semi-artificial environments. For each case we have set down the applicable guidelines as a function of the type of management and the species present.

The Palcazu Valley is flanked to the west by the Yanachaga mountain range which is an area of exceptional scientific interest because of its genetic diversity; a consequence of it being a pleistocene refuge. On the other hand, the range's vegetation in the very steep slopes is essential to preserve the natural cycles which provide, or can provide, the Palcazu Valley as well as the Oxapampa and Pozuzo Valleys with hydroelectric power, drinking and irrigation water, and protection against landslides, avalanches and floods. Furthermore, because of the beauty of its scenery, the Yanachaga mountain range could generate an important tourist traffic. Finally, this range offers no agricultural, livestock, or forestry potential over 500 to 1,000 m. above sea level and, because of its soil it can be classified as protection forest. Taking the above statements jointly with the fact that a prior analysis has shown that Peru's National System of Conservation Units lacks representative samples of the Central and Northern Jungle Mountain Slope ecosystems, it was deemed pertinent to support and renew previous proposals to consider the establishment of a conservation unit in the Yanachaga mountain range.

It was felt that the National Park category was the most appropriate while concurrently restressing the proposal that the park be named Yanachaga. Boundaries applicable to corridors on the lower parts of the Palcazu Valley are proposed to cover ecosystems and species typical of the Low Jungle as well as to maintain the viability of eventual migratory flows. Tentatively, the Yanachaga National Park could cover some 226,000 hectares. This paper gives some general guidelines for the preparation of the master plan for the proposed unit.

The San Matias mountain range, which flanks the Palcazu Valley on the east, should be declared intangible as protection forest while, in keeping with legislation in force, certain nondestructive activities such as gathering, hunting and tourism could be allowed. Boundaries which would cover some 32,000 Has. are proposed. Another protection forest in the Palcazu high basin, which corresponds to the Bocaz, Cacazu and Pichinaz Rivers, is also suggested. On the other hand, the possibility of establishing communal reserves in the Pàlcazu Valley are rather remote.

Finally, some guidelines are given to preserve the natural patrimony of the Palcazu Valley, which are not contained in previous chapters. It is stressed that only by enforcing Decrees Laws 22175 and 21147 and their regulations, would there be an excellent guarantee that the valley's renewable natural resources would be preserved.

2. INTRODUCTION

The present paper covers the possibilities of rational use of the wildlife resources of the Palcazu river valley (Province of Oxapampa, Department of Pasco, Peru) as well as the need to set up areas to protect some or part of that valley's ecosystems. Similarly, an effort is made to determine the guidelines which would assure conservation of the fauna, flora and ecosystems, both within as well as outside of the proposed protected areas.

This paper is only part of a series of studies which contribute to determining the effects of the environmental impact resulting from the colonization programs which the government of Peru is implementing in the Palcazu valley as well as to propose alternatives for an optimal development.

One of these studies, by Dr. A. Brack, which is referred to in the ecological evaluation of the Palcazu river valley, constitutes background information which is indispensable to understanding the present paper.

3. WILDLIFE OF ECONOMIC INTEREST AND POSSIBILITIES OF ITS USE

3.1 Species of Present and/or Potential Economic Interest

As can be seen in Charts 1, 2, and 3, there are many wildlife species which are of economic interest in the Palcazu area. However, few of them could be managed efficiently taking into account the limited area and the trend to further reducing their habitats as well as the status of their populations which, in the majority of best cases, rank from low to very low. Aside from this, which is discussed below, it is convenient to differentiate between species which are of a strictly local economic interest and those which, at least potentially, have a regional or national economic importance, including export possibilities. Among the species of local economic importance, basically we have those whose meat is desirable but which do not contribute any other marketable products. For the region under study, the most important of these animals are small mammals such as Cuniculus paca, Dasyprocta aguti or Dasypus novencinctus, as well as some birds. The Amuesha natives hunt a much broader range of smaller animals for eating, which the settlers usually ignore.

Species of major economic importance can be broken down into those which produce hides, those which produce pelts, those which are raised as pets or

CHART 1 -- LIST OF PALCAZU MAMMALS OF PRESENT AND/OR POTENTIAL ECONOMIC INTEREST

SCIENTIFIC NAME	COMMON NAME	ABUNDANCE	MAIN USES
Order Marsupiales			
Family Didelphidae			
Chironectes minimus (Zimm.)	cuica, water rat	rare	pelt
Order Primates			
Family Callithricidae			
Saguinus sp.	pichico	frequent	pet-meat-biomedicine
Family Cebidae			
Saimiri sciureus L.	fraile	frequent	pet-meat-biomedicine-ornamental
Aotus trivirgatus (Humb.)	musmuqui	rare	pet-biomedicine
Alouatta seniculus (L.)	coto	rare	pet-biomedicine-meat
Cebus apella (L.)	machin negro	frequent	meat-pet-biomedicine
Ateles paniscus (L.)	maquisapa	very rare	meat-pet-biomedicine
Lagothrix lagothricha (Humb.)	choro	very rare	meat-pet

CHART 1 - LIST OF PALCAZU MAMMALS OF PRESENT AND/OR POTENTIAL ECONOMIC INTEREST
(Continued)

SCIENTIFIC NAME	COMMON NAME	ABUNDANCE	MAIN USES
Order Edentata			
<u>Family Dasypodidae</u>			
Dasypus novencinctus L.	carachupa	frequent	meat-biomedicine
Priodontes giganteus (Geoff.)	yaungunturo	very rare	carapace for decoration
Order Lagomorpha			
<u>Family Leporidae</u>			
Sylvilagus brasiliensis (L.)	rabbit	rare	meat
Order Rodentia			
<u>Family Erethizontidae</u>			
Coendou bicolor Tschudi	hedgehog, cashacu-cuchillo	frequent	meat
<u>Family Hydrochoeridae</u>			
Hydrochoerus hydrochaeris (L.)	ronsoco	frequent	meat-hide
<u>Family Dinomyidae</u>			
Dinomys branickii Peters	machetero	rare	meat

CHART 1 - LIST OF PALCAZU MAMMALS OF PRESENT AND/OR POTENTIAL ECONOMIC INTEREST
(Continued)

SCIENTIFIC NAME	COMMON NAME	ABUNDANCE	MAIN USES
<u>Family Dasyproctidae</u>			
Cuniculus paca (L.)	majaz	very frequent	meat
Myoprocta pratti	misho	rare	meat
Dasyprocta punctata variegata Tschudi	anuje	very frequent	meat
Order Carnivota			
<u>Family Ursidae</u>			
Potos flavus (Schreber)	shosna	frequent	pelt
Tremarctos ornatus (Cuvier)	bear	very rare	mmeat-sports hunting (trophy)
<u>Family Procyonidae</u>			
Nasua nasua (L.)	ochumi	frequent	traditional medicine
<u>Family Mustelidae</u>			
Lutra incarum (L.)	otter	rare	fur
Pteronura brasiliensis (Gmelin)	lobo delrio	very rare	pelt

CHART 1 - LIST OF PALCAZU MAMMALS OF PRESENT AND/OR POTENTIAL ECONOMIC INTEREST
(Continued)

SCIENTIFIC NAME	COMMON NAME	ABUNDANCE	MAIN USES
<u>Family Felidae</u>			
Felis pardalis L.	ocelot	frequent	pelt-pet
Felis wiedii Schinz	huamburusho	frequent	pelt-pet
Felis concolor L.	puma	frequent	sports hunting (trophy)
Leo onca (L.)	jaguar	rare	pelt-sports hunting (trophy)
Order Perissodactyla			
<u>Family Tapiridae</u>			
Tapirus terrestris (L.)	tapir	frequent	meat-hide
Order Artyodactyla			
<u>Family Tayassuidae</u>			
Tayassu tajacu (L.)	sajino	frequent	meat-hide-biomedicine (physiology)
Tayassu pecari Fisher	huangana	rare	meat-hide-biomedicine (physiology)

CHART 1 - LIST OF PALCAZU MAMMALS OF PRESENT AND/OR POTENTIAL ECONOMIC INTEREST
(Continued)

SCIENTIFIC NAME	COMMON NAME	ABUNDANCE	MAIN USES
Family Cervidae			
Mazama americana (Erx.)	red deer	frequent	mmeat-hide
Mazama gouazoubira	gray deer	rare	meat-hide
Pudu mephistophiles (De W.)	sacha cabra	very rare	meat

Sources: Grimwood (1968)
Tovar (1971)
Cabrera (1957-60)

CHART 2 - LIST OF PALCAZU BIRDS OF PRESENT AND/OR POTENTIAL ECONOMIC INTEREST

SCIENTIFIC NAME	COMMON NAME	ABUNDANCE	MAIN USES
Order Tinamiformes			
Family Tinamidae			
Tinamus tao kleei (Tschudi)	gray partridge	frequent	meat
Tinamus major (Gmelin)	large partridge	frequent	meat
Crypturellus obsoletus (Temm.)	brown partridge	frequent	meat
Order Galliformes			
Family Cracidae			
Penelope j. jacquacu Spix	turkey hen	frequent	meat
Mitu mitu (L.)	paujil	frequent	meat
Ortalis g. guttata Spix	turkey hen	frequent	meat
Order Ralliformes			
Family Psophidae			
Psophia l. leucoptera Spix	trompetero	frequent	pet-meat

CHART 2 - LIST OF PALCAZU BIRDS OF PRESENT AND/OR POTENTIAL ECONOMIC INTEREST
(Continued)

SCIENTIFIC NAME	COMMON NAME	ABUNDANCE	MAIN USES
Family Rallidae			
Rallus n. nigricans Vieill.			meat
Laterallus melanophaius oenops (Sce. y Salv.)			meat
Laterallus v. viridis (Muell.)			meat
Order Columbiformes			
Family Columbidae			
Columba cayennensis sylvestris Vieill.			meat
Order Psittaciformes			
Family Psittacidae			
Ara spp.	macaws	rare	pet
Pionus menstruus	blue parrot	very frequent	pet
Family Rupicolidae			
Rupicola peruvianna (Lat.)	cock of the rock	frequent	ornamental, mounted and feathers

Sources: Brack (1969-72)
Schauensee (1966)

CHART 3 - LIST OF PALCAZU BATRACHIANS AND REPTILES OF PRESENT AND/OR POTENTIAL ECONOMIC INTEREST

SCIENTIFIC NAME	COMMON NAME	ABUNDANCE	MAIN USES
Order Anuros			
<u>Family Ranidae</u>			
Hyla spp.	frog	frequent	pet
Order Testudinata			
<u>Family Testudinidae</u>			
Geochelone denticulata (L.)	motelo	rare	meat
<u>Family Pelomedusidae</u>			
Podocnemis unifilis Trosch.	taricaya	very rare	meat and eggs
Order Squamata			
<u>Family Boidae</u>			
Boa c. constrictor L.	boa	rare	hide-meat
Corallus caninus (L.)	green boa	frequent	hide
Order Crocodilia			
<u>Family Alligatoridae</u>			
Caiman sclerops Schneider	caiman	rare	hide-meat

CHART 3 - LIST OF PALCAZU BATRACIANS AND REPTILES OF PRESENT AND/OR POTENTIAL ECONOMIC INTEREST (Continued)

SCIENTIFIC NAME	COMMON NAME	ABUNDANCE	MAIN USES
Order Sauri			
<u>Family Iguanidae</u>			
Iguana iguana (L.)	iguana	frequent	hide-meat

for ornamental purposes, those used for biomedical research and species for sport hunting. The meat from many of these species also is eaten but, in strictly economical terms, the greatest benefit derives from other products or other forms of use.

All the local species which produce hides also produce much sought-after meat. They are mainly the Tayassu tajacu, T. pecari, Mazama americana, M. gouazoubira and Hydrochoerus hydrochaeris. The tapir is mostly hunted for its meat rather than for its hide, for which there is little demand. The white alligator should also be mentioned (Caiman sclerops), the different Boidae and some saurians such as the iguana (Iguana, iguana).

Local species producing desirable pelts are Potos flavus, Lutra incarum, Pteronura brasiliensis, Felis pardalis, F. wiedii and Leo onca. This last species is of value both as a pelt animal as well as a sports hunting trophy.

Many species of primates are specifically sought after for biomedical research; the Saguinus sp, Saimiri sciureus, and Aotus trivirgatus, among others which can be found in the Palcazu. The armadillos and, to a lesser degree, several other species such as pecaries are also used for this purpose. Practically all primates are sought as sources of meat.

There is still a great demand for live animals to be kept as pets or for ornamental purposes. Birds, especially the Psittacidae, constitute the bulk of this market but primates are equally sought after.

The most locally desired animals for sports hunting are the spectacled bear and the jaguar. Of lesser interest but worth mentioning are the puma and the tapir. These four species are the only ones that offer internationally valued trophies. Obviously, under local sport hunting criteria, there are many species that could serve, although, given the fact that it is very difficult to hunt them, it is unlikely that this activity will develop.

3.2 Status of Their Populations

As pointed out by Brack (1981) Palcazu's fauna is rich, but many of the numerous species present, especially those of economic importance, have populations which, though in relative terms could be classified as frequent or very frequent, are clearly insufficient to withstand present hunting pressure and in no way can their present status be taken as an adequate starting point for purposes of culling within the context of a management plan. Hence, management of the fauna should start with a ban.

Obviously, this is a general comment. Some species are clearly more abundant than others and may continue to be hunted and, on the other hand, there are areas of the Palcazu Valley with little human activity where important populations of wild animals prevail. The species referred to are all those capable of benefiting from proximity to humans such as the *Cuniculus*, *Dasyprocta* and *Dasypus*, who benefit from plantations and grasslands. However, even in the case of the ronsoco, which is blamed for severely damaging crops and pastures, everything indicates that its population is still below minimum limits for purposes of culling.

Brack (1981) offers a detailed listing of rare species and species in danger of extinction and hence, it is unnecessary for the author of this report to touch on the subject.

3.3 Species Which Could Be Harmful

The economic importance of a species should be measured not only in terms of benefits but also in terms of real or potential damage they could cause. In Chart 4 a listing is given of the main species or groups of species of Palcazu Valley wild fauna, which could have a negative economic impact due to their direct action on humans or through damages to cattle and crops. For

CHART 4 - LIST OF PALCAZU VERTEBRATES LIKELY TO BE HARMFUL

SCIENTIFIC NAME	COMMON NAME	TYPES OF DAMAGES AND LOSSES
Family Didelphidae		
Didelphis azanae Temm.	muca, intuto	attacks on poultry birds
Families Cebidae and Callithricidae	monkeys	reservoirs for different human diseases such as yellow fever, rabies, malaria, hepatitis, etc.
Families Emballonuridae, Phyllostomatidae, Vespertilionidae Molossidae	bats	reservoirs for different human diseases such as rabies; damages to fruit crops
Family Desmodontidae		
Desmodus r. rotundus (Geoff)	vampire bat	attacking cattle and humans, reservoirs for rabies and other diseases
Family Bradypodidae		
Choloepus hoffmani Peters	pelejo, sloth	main reservoir for leishmaniasis
Family Dasypodidae		
Dasypus novencinctus L.	carachupa	reservoir for leprosy, damage to pastures and other crops
Family Cricetidae		
Oryzomis spp. and others	mice	pests for agriculture and stored products

CHART 4 - LIST OF PALCAZU VERTEBRATES LIKELY TO BE HARMFUL
(Continued)

SCIENTIFIC NAME	COMMON NAME	TYPES OF DAMAGES AND LOSSES
<u>Family Hydrochoeridae</u>		
Hydrochoerus hydrochaeris L.	ronsoco	damages cultivars and competes with cattle for pastures
<u>Family Dasyproctidae</u>		
Cuniculus paca L.	majas, samano	damages crops, especially cassava roots
Dasyprocta V. variegata Tsch.	anuje, picuro	damages crops, especially cassava roots
<u>Family Erethizontidae</u>		
Coendou b. bicolor Tsch.	hedgehog	accidents due to quills
<u>Family Mustelidae</u>		
Mustela frenata Licht.	weasel	damage to poultry birds and other small domestic animals
Eira barbara (L.)	manco, huamataro	damage to poultry birds and other small domestic animals
<u>Family Felidae</u>		
Felis pardalis L.	ocelot	damage to poultry birds and other small domestic animals

CHART 4 - LIST OF PALCAZU VERTEBRATES LIKELY TO BE HARMFUL
(Continued)

SCIENTIFIC NAME	COMMON NAME	TYPES OF DAMAGES AND LOSSES
Felis wiedii Schinz	huamburusho	damage to poultry birds and other small domestic animals
Felis concolor L.	puma	attacks on cattle
Felis onca (l.)	jaguar	attacks on cattle
<u>Family Falconidae</u>		
Micrastur sp.	hawk	damage to poultry birds
<u>Family Psittacidae</u>		
Amazona, Aratinga & Pionus	parrots	damage to crops and fruit trees
<u>Families Icteridae, Fringillidae y Thraupidae</u>	birds	plagues on agriculture, especially rice fields
<u>Family Elapidae</u>		
Micrusus spp.	coral snake	accidents to humans due to snake bites
<u>Familia Viperidae</u>		
Bothrops spp.	jergon, loro machac	accidents to humans due to snake bites
<u>Familia Crotalidae</u>		
Lachesis muta (L.)	bush master	accidents to humans due to snake bites

CHART 4 - LIST OF PALCAZU VERTEBRATES LIKELY TO BE HARMFUL
(Continued)

SCIENTIFIC NAME	COMMON NAME	TYPES OF DAMAGES AND LOSSES
<u>Family Iguanidae</u>		
Iguana iguana (L.)	iguana	damage to poultry birds
<u>Family Ranidae</u>		
Dendrobates sp	frogs	poisonous skin secretions

Sources: Christensen and Herrer (1978)
Herrer and Christensen (1978)
Cuba (1980)
Rizzo (1978)
Cabrera and Yepes
King (1976)

obvious reasons, insects (which in keeping with Peruvian forestry legislation are part of the wildlife) as well as all other invertebrates are excluded from such a list.

The most harmful, by far, are the different birds of the order Passeriformes which feed especially on rice crops and which are quite difficult to control. Vampire bats can be ranked second, more because of transmitting rabies than because of bleeding the cattle, even though frequent attacks of this kind affect production. Damage by rodents of the Cricetidae family, which attack different crops as well as stored products, rank third. In the fourth place are attacks by other birds on different crops, including food crops, as well as damage caused by larger rodents such as Cuniculus, Dasyprocta and Hydrochoerus in crops and pastures. The different furred (Eira, Didelphis, Mustela) or feathered (Micrastus) carnivores which attack poultry birds, guinea pigs and rabbits could rank fifth. Poisonous serpents rank sixth and, finally, major carnivores which could kill cattle or other domestic animals.

Furthermore, one should take into account the effects of the valley's invasion by para-domestic species such as the rat (Rattus spp.) and the mouse (Mus musculus brevirostris Waterhouse), or the sparrow (passer d. domesticus L.), which will surely arrive if they are not present already.

Other types of negative impacts to be taken into account are animals, which in general, could act as reservoirs of diseases communicable to man. This implies a long list of mammals as well as many birds. Among the first, we can highlight bats as carriers of rabies, primates as carriers of yellow fever, hepatitis, rabies, malaria, etc., armadilloes as carriers of leprosy and, other edentates, such as some sloths, as carriers of different leishmaniasis. Among birds there are many which can cause ornithosis, serve as intermediate hosts for diseases such as encephalitis, and also serve as pathogen reservoirs, such as the Histoplasma capsulatum fungus which produces the famous Tingo Maria fever associated with the habitats of Steatornis caripensis Humboldt, a bird which probably lives in the Yanachaga, San Carlos and San Matias ranges.

Many of the vertebrates which could be harmful will acquire increasing importance with the development of agriculture and cattle raising. Others will become agricultural pests while still others will lose importance to the extent that the natural ecosystems are destroyed -- i.e. primates, large felines and many chiroptera.

4. WILD FAUNA MANAGEMENT ALTERNATIVES

4.1 Management Options and Levels

The possibilities of utilizing wildlife in the Palcazu depend on the use of the land. The alternatives will be quite different if the proposed development plans, based on ecological criteria, are respected than those which would exist if indiscriminate occupation of the area continues, with the unnecessary destruction of forests as a consequence of migratory agriculture and expansion of pasture lands. Assuming the proposed development plans are respected, the six basic conditions for wildlife management, which are listed on Chart 2, would apply. As can be seen from this chart the premise is that wildlife can be managed under all conditions of land use except agriculture, with which there is a clear incompatibility. But, as can be seen, the possibilities for socio-economic benefits are quite different from one habitat's conditions to the other.

Before analyzing Chart 3, we must define what we mean by extensive, intensive and superintensive management in this context. The first applies to those cases in which fauna is utilized without applying valid census techniques. For example, extensive management is evaluated on the basis of indices or hunting statistics while the culling plan is set up through trial and error tests which are systematically readjusted. This simple form of management could imply the application of the concept of reserved areas and adjoining hunting areas which are repopulated to the extent that the reserve's population density increases or through rotation of hunting grounds. This does not assume any major tampering with the environment even though when areas are developed under forestry management conditions could be created which would favor an increase in population of certain species.

CHART 5. - HABITAT CONDITIONS AND POSSIBILITIES OF USING WILDLIFE IN THE PALCAZU

HABITAT CONDITIONS	SURFACE (HA)	TYPES OF MANAGEMENT ALTERNATIVES	MAIN PRODUCTIVE VOCATION
Small woodlands in agricultural and livestock areas	6,929	intensive or extensive	meat for local consumption or live animals
Woods under forestry ordinance	43,796	extensive	meat, pelts, hides, live animals
Protection forests	34,000	extensive	meat, hides, pelts, live animals, hunting and tourism
Pastureland	8,870	intensive	meat for industrial use and hides

CHART 5. - HABITAT CONDITIONS AND POSSIBILITIES OF USING WILDLIFE IN THE PALCAZU
(Continued)

HABITAT CONDITIONS	SURFACE (HA)	TYPES OF MANAGEMENT ALTERNATIVES	MAIN PRODUCTIVE VOCATION
Riverbanks and waterholes	2,839	extensive or intensive	hides, pelts and meat
Artificial or semi-artificial	-----	superintensive (game ranching)	hides and live animals, especially for bio-medical research
TOTAL	96,434		

Source: Tosi (1981)

Note: The surface estimates are based on the greatest soil use capacity (Tosi 1981), assuming that this classification is strictly followed.

Something similar can be done at a low cost in the small woodlands of the agricultural and livestock areas. Neither does this imply control of predators. Extensive management can be fully applied in woods under forestry ordinance or in protection forests and may be feasible in small woodlands in agricultural and livestock areas and in riverbanks and water courses. On the other hand, this type of management is frequently the only one with any possibility of success in the Amazon jungle if we bear in mind the low technological level which prevails among public officials, farmers, and lumbermen. Extensive management at the regional or local level is translated into hunting quotas by sex and species, seasonal and/or permanent prohibition or bans, minimum sizes, starting and closing dates for the hunting season, regulations on weapons, ammunition, the use of snares and other trapping and hunting methods, etc.

Intensive management applies when there are practical possibilities of measuring the animal population fairly exactly and furthermore, when this operation is economically feasible when costs are subtracted from expected benefits. This only applies to wet tropical forests in small, and hence, isolated spots and on riverbanks and water surfaces. The census, like any other advanced technique is justified as part of a technological package in which, as in this case, must be included a more or less important manipulation of the environment which includes control of natural enemies; favoring the development of food crops or of crops which offer fauna protection and cover; providing special conditions for nesting; supplying trace elements, etc. While in extensive management hunting quotas must be quite conservative, in this type of management they may be adjusted to a greater degree of accuracy depending on the biotic potential of each species and are, therefore, generally higher.

By superintensive management we mean management practiced with absolute or nearly absolute control of the environment in which the species live. Such an environment could become what is commonly known as a breeding farm. There are completely artificial environments such as cages, fences or pits as well as semi-artificial environments such as controlled natural lakes. Animals managed under these conditions are in no way domestic. At most they can be considered to be tame.

4.1.1 Management in Small Woodlands in Agro-livestock Areas

In the Palcazú small woodlands in agro-livestock areas may be basically of two types: 1) forest areas as defined by article 81° of Decree Law No.

22175, which means 15% of agricultural land and 30% of livestock land that is, theoretically, some 6,929 Has. in the Palcazu and; 2) areas with secondary forests or "purmas" of different ages which grow as a consequence of the rest given the land and which are used for cultivation and cattle raising and which at present are estimated at some 5,000 Has.

The legislators' obvious intention in including article 81° in the aforementioned law, was to maintain the original natural forest, especially on the banks of water courses and on steep areas, both to prevent erosion as well as to enjoy the forest's direct and indirect beneficial effects.

However, it is understood that those landholdings where all the original forests have been cut down are not exempted from complying with the rules and shall have to reforest or encourage natural repopulation; and manage the pioneer or "purma" vegetation. It is thus that three cases, which impose different conditions on the fauna, may arise: small woodlands formed by climax or little changed forests, reforested woodlands, and woodlands formed by pioneer forest vegetation at different stages of development. Evidently, and for some two decades, the most common cases will be the first and especially the last one.

The small woodlands, as a function of the size of the land-holding, the way in which they are worked, and the manner in which the legal provisions are complied with, should cover areas ranging from 0.5 Has. up to several hectares or many dozen hectares. If these are small woodlands which have been maintained or established in compliance with the aforementioned article 81° of Decree Law 22175, they will be permanent, which guarantees the establishment and multiplication of diverse useful faunal species. On the other hand, if this is "purma" vegetation in the context of leaving the land fallow, it will be left alone for only 3 to 10 years maximum, which limits the number of species as well as the population of each. But, on the other hand, a growing forest may have some advantages over the climax forest in that it offers more food and protection to some given species. We must furthermore bear in mind that fauna in the aforementioned situations, (that is an area formed by a mosaic of climax forests, secondary forests, agricultural crops, pasture lands, and water courses), will enjoy a marked ecotone effect which will favor its multiplication. For example, rodents such as the "majaz" and the "anuje" (aguties), may feed on the planted areas or on the young "purmas" where domesticated plant species such as cassava root survive, while finding shelter in the climax forest or in the older "purmas."

The fauna which can be managed under the different conditions described are, in all cases, what are known as minor hunting species, either furred or feathered. The main useful species, adaptable to these habitats and which tolerate the presence of humans in the case of the Palcazu would be the following: Primates, armadillos, rabbits, hedgehogs, different rodents (*Cuniculus*, *Dinomys*, *Dasyprocta*), small predators such as the ocelot and the achuni; different species of wild turkeys, partridges, doves, parrots and other ornamental bird families, land turtles, ornamental frogs, different boas, iguanas, etc. That is to say that practically all small-sized species which are used locally for human consumption could be found in this forest area which, as has been shown by different studies, (Pierret and Dourojeanni, 1966, 1967: Rios *et al* 1973, Gaviria, 1981) supplies over 50% of the wild meat eaten in the Peruvian Amazon jungle. Under such conditions, species of interest as live animals both for biomedical research (monkeys and armadillos), and for pets and decoration (monkeys, parrots and other birds, frogs), animals with valuable pelts or hides (ocelots, boas, and iguanas), would also prosper.

The technologies to be applied will vary as a funtion of: the floristic characteristics of the forest; its natural or artificial nature; the degree to which it has been invaded; its age, its area, the crops and pasture lands which surround it and the manner in which it is managed, the availability of water and obviously, also, as a function of the faunal species present and their populations as well as of the purpose of the management. This management can be directed to the most valuable species such as primates for export or the production of wild meat in which case we should favor the development of rodent populations such as Dasyproctidae, or edentates such as Dasypodidae. In any case, the techniques to be applied may be included within the criterion of either extensive or intensive management.

For primates, for example, it would probably be profitable to apply intensive management if there was a single settler, or a group of them, within an area of several dozen hectares of forest. Censusing these animals is relatively easy and, furthermore, it is possible to increase their populations considerably if fruit trees are planted in adequate amounts and in the proper places. There is abundant information in this regard developed in Loreto (Helne et al, 1980, among others). To manage species for human consumption it could be quite appropriate to plant areas of climax forests with pioneer vegetation which develops in abandoned plots of land where tuberous or edible roots, especially cassava, were formerly cultivated.

The management of fauna in small woodlands in agro-livestock areas will undoubtedly cause some problems. These may be: 1) damage to agricultural crops by the wild animals subject to management; for example the Dasyproctidae eating cultivated cassava root; monkeys and parrots eating bananas, papayas, green corn or cocoa; 2) damage to crops caused by species of fauna not under management but which find refuge in the small woodlands as in the case of some rodents; 3) damage to livestock raising, especially poultry, caused by small predators under management such as the ocelot, or some not under management, such as the manco (Eira barbara L.), or different Didelphidae (Glironia, Marmosa, philander, Didelphis), or Nasua nasua and other Procyonidae; 4) damage to livestock through the dissemination of diseases for which wild fauna acts as a reservoir and/or due to vampire bat attacks (Desmodus rotundus). It must be pointed out that many of these problems could not be avoided even if fauna were not managed in the woodlands. This is due to the fact that the proliferation of certain harmful rodents and birds takes place, even without nearby forests, as a consequence of the enormous artificial availability of food offered by agriculture; the population of certain predators also increases which affects alternative prey such as poultry birds. On the other hand, in all Peruvian settlements there are many "purma" woodlands due to the migratory nature of agriculture. Even though there is very little doubt that the benefits will in general be much more important than the damages, it is important to study the risks in each case and to adopt whatever corrective measures may be necessary.

4.1.2 Management in Woods Under Forestry Ordinance

Forests which in the Palcazu may be assigned to forestry exploitation may obviously serve simultaneously for wildlife management and to obtain sustained crops from them and from their products. This is highly desirable to maximize the use of lands and thus to increase the economic profitability of investments, utilizing the compatibility and complementarity of both operations.

It must also be pointed out that contrary to what is usually believed, forestry ordinance may favor the development of the population of given faunal species, even though it could reduce the population of others. The ones that are most favored are usually major herbivores which are also more useful to man. Thus, the type of forestry ordinance adopted will determine the impact on the wild fauna.

If the ordinance to be applied in the forests of the Palcazu is, as may be supposed, based on the extraction of no more than 20 or 30% of the volume of standing commercial timber, in 50-year rotation, with natural regeneration accompanied by a reduced silvicultural intervention essentially in the form of planting native species at the trails, then we could predict that the productivity of wild fauna management will be the same or higher than that under natural conditions. Given the difficulties of performing a census it is suggested that extensive management (whose characteristics are detailed below) be practiced.

As regards the fauna itself, it is recommended that the process be started with a survey of the species as well as a comparative estimate of the populations as a function of forestry districts so as to determine the sector or sectors of the forest where populations are larger and which could become reserves. Subsequently, and on the basis of surveys on hunting and consumption of wild meat among the local population, it will be possible to estimate the number of specimens of each of the major species which have been hunted traditionally. Comparing the results of these surveys with the aforementioned comparative evaluation and also on the basis of interpreting questions of an eventual decrease in the number of specimens hunted year by year, we can define an annual quota applicable to one or several forestry districts as may be convenient. The initial quota or quotas must, obviously, be extremely conservative. Hunting throughout the year must be fully under control and be subject to permanent or seasonal bans, minimum sizes, sexes, types of weapons, as well as all other regulations suitable for each species, in keeping with existing experience. At the end of the year or of the hunting season, the success in meeting the quota will determine the accuracy of the estimate. If the quota turns out to be too large, there will be a need to reduce it considerably or perhaps to declare the species permanently banned. If the quota is rapidly covered, this perhaps indicates that it could be increased. Readjustments must be systematic and adequate for each zone. Hunting activities and the behavior of the hunters must be known by the specialists down to their finest detail because, only so, shall they be able to adequately interpret statistical data.

As regards the forest habitat, there are many recommendable alternatives. In the first place, ideally no less than 10%, of the forest must be kept intact with no forestry exploitation. This means that one or more areas strategically located, with abundant water and wild fauna must be left reserved. If the contemplated rotation is for 50 years, some 52 - 55 plots should be defined, depending on their size. It is not a question of reserving areas which have the characteristics of protection forests, as their productivity is usually lower. The funtion of these reserved zones is to serve as areas for the multiplication of fauna from which adjoining zones (i.e., hunting as well as shelter areas) may be repopulated should hunting pressure become excessive. In fact, another of its objectives is to provide guarantees in case any error is made in estimating the quotas. It would also be pertinent to maintain untouched forest strips between lumbered strips.

Mention has been made of strips 200 m. wide every 2,000 m., but this figure is only a reference. The advantage of this practice is to assure the conservation of all the floristic genetic material which, in turn, assures the survival of all of the faunal genetic patrimony, even of species not under management such as invertebrates and small vertebrates. Another aspect to be considered is maintaining untouched forests on the banks of rivulets and ravines to protect the hydrobiological resources on which species such as otters, "lobos del rio" and "caimans," among others depend, as well as to assure watering points for terrestrial fauna.

In any case, from the point of view of faunal productivity it is convenient to favor silvicultural methods involving natural regeneration over reforestation and to work with the broadest possible range of species and age groups. Forest species which also produce edible fruits should be chosen. However, reforestation over clearcut areas allows for the growth of wild grasses and this facilitates a major development of deer and other herbivores. This is an effect which is well known in African wet tropical forests where it can be noted not only in plantations but also in forest and lumbering roads as well as in the clearings left after selective exploitation of dominant trees. All of these forestry intervention effects must be analyzed and made use of.

It is very important to carefully define the terms under which culling will take place. If culling is carried out by settlers or by forestry workers individually, the control of hunting would be very difficult and the management plan would not be strict. For this reason, forestry workers must not be authorized to carry weapons during the "mateo" or inventory operation nor during logging or reforestation. They should be supplied food by the firm's management. Management of the fauna may be undertaken: a) by the lumbering firm, b) by the Ministry of Agriculture or some other pertinent governmental authority or, c) by some agency dedicated expressly to this activity. In all cases, culling must be carried out preferably by teams of specialized hunters. When there are strong pressures from the settlers to make use of the fauna, a joint formula may be adopted. This means that certain sectors could be left open to domestic hunting while others for commercial hunting only. This implies that domestic hunters would not be allowed to hunt for pelts or to capture live animals. To have their licenses renewed, commercial hunters would have to obey the rules and provide detailed information on the animals they hunt.

4.1.3 Management in Protection Forests

The establishment of protection forests does not have the management of wild fauna as its main objective but this objective can obviously be included and, furthermore, is desirable for it makes it possible to better determine the benefits provided by such areas. These benefits are not limited to conservation of soil, water and genetic resources but may also produce income through the non-destructive use of forestry or underbrush vegetation, through tourism and, as has already been said, through faunal management.

Faunal management in protected forests is little different, in general, from that which can be implemented in woods under forestry ordinance. The differences are imposed by the important handling of vegetation which occurs in ordinance forests as compared to the near intangibility in protected forests. For Palcazu conditions, management of fauna in such forests should also be extensive. The forest should be divided into zones on the basis of criteria such as physiography, availability of water and vegetation type. It is not a question of defining zones with equivalent populations but rather to correlate each forest area with certain characteristics of the fauna and their populations.

In performing this task the major difference between the fauna in production forests and protection forests becomes evident. In the latter, due to the broken nature of the topography, the thin layer of soil present, the high rainfall and greater humidity, the scarcity of year-round ravines, the productivity in terms of vertebrate biomass is considerably lower than in production forests. In fact, most of the important game species are quite rare or are absent from the San Matias or Yanachaga highlands. This is the case for pecaries, ronsoco, tapir, several primates, and the jaguar. On the other hand, there could be a greater abundance and diversity of birds. For these reasons management objectives could be considerably different between production and protection forests. The purpose of the latter is more to provide wild meat than to produce hides and pelts, but also for capturing live animals, among them certain primates and many ornamental birds.

Forestry administration must be charged with evaluating the fauna, zoning the area, determining the quotas as well as other hunting conditions, and controlling of the hunting itself. Commercial hunting activities may be carried out by native communities, the owners of neighboring farms or by any individual, on the basis of wild fauna collection contracts referred to under the legislation which stipulates that they must be granted for specific areas fixed period of time. The other types of hunting (subsistence, sports, sanitary and scientific) are allowed through licenses and preferably should not be carried out in areas included under wild fauna collection contracts.

4.1.4 Management in Pastures

Pastures are obviously set up to raise livestock but they offer good conditions for the development of populations of certain wild animals either on their boundaries with forests (as in the case of deer) or throughout the area (as in the case of ronsocos) provided there is water available.

In the Palcazu the process of wild animals becoming adapted to pastures has already taken place, (specifically as regards the ronsoco) as has occurred in other areas. The settlers consider it a dangerous competitor and try to eliminate it.

The ronsoco, however, is already managed on the Venezuelan plains jointly with livestock. It has been shown that at adequate densities it does not compete with cattle (Ojasti, 1973, Ojasti and Medina, 1972) and that, since it has the reproductive advantages of rodents as well as the feed efficiency of herbivores (Ojasti 1973, 1978), it is an excellent economic alternative. Chart 6 gives some idea of the zootechnical advantages of this animal as determined for Brazil.

CHART 6. HYPOTHETICAL COMPARISON DATA FOR THE USE OF RONSOCOS AND CATTLE UNDER MATTO GROSSO, BRAZIL, SWAMP CONDITIONS

SPECIES	INDIVIDUALS PER EVERY 3 HAS:	AGE AT CULLING	WEIGHT AT CULLING	AVERAGE LIVESTOCK WEIGHT (GR./DAY)	AVERAGE LIVE-STOCK WEIGHT FOR EACH 3 HAS. (GR./DAY)
Cattle	1	4.5	490	283	283
Ronsoco	18	1.5	35	63	1,134

Source: Negret (1979)

A preliminary study has been carried out for the Pichis Valley which infers the technical and economical feasibility of management of the ronsoco (Veliz and Chuquichaico, 1977).

This report shall not go into any great detail on the management of this species about which many references can be found (op.cit.). We shall only indicate what has to be done on livestock farms which could be authorized to manage the ronsoco if they accept the conditions imposed by forestry administration. This office should carry out the initial census, prepare the diagnosis and design the first management plan, with the participation of interested cattlemen and their staff. The plan's application should be strictly supervised by the authority but, gradually, the authority should be limited to a strictly controlling function. The costs of initial technical support through the Ministry of Agriculture should be paid by the interested parties from their first profits.

4.1.5 Management on Riverbanks and Water Surfaces

Many of the most valuable species of Palcazu wildlife live on the banks of rivers, lakes and gorges and on the water surfaces themselves. They are the otter, the "lobo del rio," the aforementioned ronsoco, the caiman, the "cuica," and the river turtle, among others. Thus, a careful treatment of these environments is important.

The main problems in the management of fauna associated with water environments are the increasing deterioration of the vegetation on the banks, water pollution, the constant disturbance caused by navigation and other human activities such as fishing, as well as the specific difficulty in controlling illegal hunting given the ease with which it can be carried out if boats are available. The greatest advantage in managing this fauna is the technical and economical feasibility of measuring the populations under management with a high degree of accuracy.

Even when the gorges or minor watercourses cross protected or productive forests, small woodlands in agro-livestock areas, or pasturelands, they merit special treatment for management of fauna; these species are, as has already been stated, more susceptible. This requires a special evaluation of the populations of the most important species and more conservative quotas while emphasizing maintenance of natural plant coverage on the riverbanks and prohibition of forestry extraction in forests under ordinance or clearcutting in agro-livestock areas.

Management of fauna for rivers and lakes requires special plans. Given the feasibility of carrying out a census, management may be intensive since other favorable environmental management is also possible. Thus, for example, we could delimit strictly protected beaches or areas for turtle or alligator egg-laying and provide control of natural enemies of the eggs and the young. In Brazil there is ample experience in this field with Podocnemis expansa (Brazil Ministry of Agriculture, 1973, Alfinito et al, 1976). Preliminary work has been done in Peru (Vasquez, 1981) on the caiman, and experience in other Amazon countries suggests diverse management alternatives.

It is obvious that we cannot pretend to manage simultaneously the fauna in all of the Palcazu's aquatic environments, hence we should emphasize the most appropriate sectors as much for their present population as for their ecological characteristics. The rest should be kept under absolute hunting ban. Since the species of these environments are so susceptible to commercial exploitation (easily traded pelts, hides, meat and eggs) it is advisable that they be exploited exclusively through extraction contracts which are easier to control than subsistence hunting licenses.

4.1.6 Management under Artificial or Semi-artificial Conditions

The Palcazu, like any other Amazon area, has good conditions for the production of wildlife on breeding farms, that is, under artificial conditions which presuppose a very intensive management of the environment of the species being raised. However, the Palcazu is less favorable than lower parts of the Amazon jungle for raising caimans, one of the most interesting species, due to the absence of "cochas" or natural lakes. In addition to the caiman, the breeding of primates may be carried out quite profitably. A feasibility study is needed to determine whether the breeding of species such as the ronsoco, which could also be managed intensively, is suitable.

4.2 Basic Conditions

4.2.1 Population Recovery

Even though exceptions apply for some species or given areas, in general the wildlife management plan should begin with a hunting ban which could last from 5 to 10 years (minimum and maximum periods, respectively). This should particularly be enforced for the most conspicuous land species such as monkeys, pecaries, deer, tapir, bears and felines and, above all, for aquatic species such as the river turtle, caiman, otter, and "lobo del rio." Similarly, the ban should be strictly applied to all species (of economic interest or not) which are rare or threatened by extinction in accordance with the list prepared by Brack (1981).

Subsistence hunting of species which can tolerate the proximity of humans such as agouties, armadillos of the Dasypus genus, ronsocos and some birds, may be allowed. It would be prudent to forbid settlers (especially new settlers) to hunt, and to authorize only the natives for whom this activity is a traditional source of food.

Once the populations have recovered (and in accordance with the type of agriculture, livestock or forestry development), the aforementioned different management alternatives could then be implemented. This in no way implies that one should wait for this period of time to elapse before initiating management plans. On the contrary, the ban period can be utilized to perform evaluations, diagnoses, zoning, and in general, to prepare all requirements for starting the culling which initially must be quite conservative and of an experimental nature.

4.2.2 Administration of the Faunal Resource

For practical reasons, management of the faunal resource cannot be completely separated from management of the general forestry resource. Additionally, those responsible for forestry management are the heads of the Forest Districts who implement by means of their staff specialists. As yet there has been no definition as to the number or the location of forestry districts which must be set up for better management of the present Puerto Bermudez-Oxapampa Forestry District area which includes the Palcazu Valley. However, it is possible that only two districts will be defined, one to the north and the other to the south of the valley. Furthermore, those responsible for conservation units, such as the one which is to be set up in the Yanachaga range, should have the rank and the authority of Forest District heads.

Ideally each Forest District should organize the management of fauna in sectors covering a maximum of 10,000 to 20,000 Has., each under a professional (forestry engineer or biologist) who would carry out basic studies, evaluations and diagnoses, corresponding management plans (technical tasks), dissemination and extension, overseeing and control (including statistics) and coordination with the Forestry police.

Brack's proposals (1981) for the location of administrative offices (Forest Districts and/or Forest Sectors), and those pertaining to Forest Police Posts are fully adequate. His proposals for an environmental education program are also quite appropriate.

Legal provisions for the conservation of wildlife are clearly set down in the Forestry and Wild Fauna Law (Decree Law No. 21147) and in the Flora and Wildlife Conservation Regulations (Supreme Decree No. 158-77-AG) and Conservation Unit Regulations (Supreme Decree No. 160-77-AG). The Ministry of Agriculture's local authority and the Executive Commission for the Pichis-Palcazu Special Project are empowered to define the guidelines necessary for a better ordering of hunting activities or conservation of fauna in general.

5. THE NATIONAL CONSERVATION UNIT SYSTEM AND THE ECOSYSTEMS AND SPECIES OF THE PALCAZU VALLEY AND THE CENTRAL JUNGLE

Peru has 4,285,499 Has. protected by 18 conservation units under the categories of National Parks, Reserves, Sanctuaries and Historical Sanctuaries, which cover 3.33 percent of its territory. It also has 2,506,739 Has. under Biosphere Reserve Status, three of which have been set up. Studies to set up 11 other conservation units which would cover 5 million additional hectares are underway. Thus, by the end of the century, it is expected that the country will protect over 7 percent of its territory under special conditions.

Of the 5 national parks (1,984,606 Ha.), 8 national reserves (2,218,000 Ha.), 2 national sanctuaries (11,315 Ha.) and 3 historical sanctuaries (35,392 Ha.), only 4 units involve ecosystems which Udvardy (1975) and Brack (1981) call the Yungas Province and which, in more general terms, is known in Peru as "Ceja de Selva" to which the Palcazu River Basin belongs. These are the Manu (1,532,806 Ha.), Tingo Maria (18,000 Ha.) and Cutervo

(2,500 Ha.) National Parks and the Historical Sanctuary of Machu Picchu (32,592 Ha.).

The Yungas Province in Peru covers 21,707,291 Ha. (16.9 percent of the territory), and, at present only 884,585 Ha. of this biogeographical province are protected (4.1 percent) of which over 90 percent is located in the upper Manu. On the other hand, both Tingo Mara and Cutervo are too small to ensure conservation of their biotas and have furthermore been deeply changed through forest exploitation and shifting agriculture. Stated differently, the Yungas Province is very poorly represented and hence, protected, within the National Conservation Units System. And this is the biogeographical province with the greatest biological diversity and the highest proportion of endemism in Peru.

On the other hand the Yungas or "Ceja de Selva" province is the one which is the most threatened by agricultural expansion, both planned as well as indiscriminate. Different studies (UNA, 1979, Dourojeanni, 1979) show that in the course of the next two decades, the forests of an additional 7 million hectares of this environment will be destroyed. This will raise the total figure for destruction of natural ecosystems to some 12 million hectares, which will mean that the loss of flora and fauna species will reach catastrophic levels. Thus the importance of limiting and effectively protecting representative samples of the "Ceja de Selva."

Three areas have been proposed in the Central Jungle for consideration as Conservation Units. The first is Cutibireni in the Vilcabamba Highlands (Drewes 1965), the second is Yanachaga (Brack, 1974, Smith, 1977) and the third is Sira-San Carlos (Dourojeanni 1981). Thus, as can be seen, the proposal to set up a protected area in Yanachaga in the Palcazu River Basin is not new. No one of these three projects competes with the others; they are quite complementary.

The main reason for this complementary nature is that the Yanachaga project corresponds to the Chanchamayo-Apurimac Pleistocene Refuge, the Sira-San Carlos project corresponds to the Pachitea-Ucayali Refuge, and the Cutibireni project partly corresponds to the Urubamba Refuge. These Pleistocene refuges and their corresponding centers of evolution are either areas of prolonged stability or areas of high endemism of species or geographic races of plants and animals which have been preliminarily determined, in the case of Peru, on the basis of birds and lepidoptera (Lamas, 1979). In pragmatic terms, conservation of representative samples of these areas would allow the preservation, at the least cost, of a major portion of the rich genetic inheritance of the "Ceja de Selva."

Brack (1981), for fauna, and other authors for flora, offer a preliminary idea of the great diversity and rarity of many of the species present in the Palcazu valley.

6. ESTABLISHMENT OF PROTECTED AREAS

The protected areas referred to in this chapter, in keeping with Peruvian legislation are: 1) conservation units (national parks, reserves and sanctuaries or historical sanctuaries), 2) protection forests, and 3) communal reserves and other categories of local interest.

6.1 Conservation Unit in the Yanachaga

6.1.1 Background

The original proposal to set up a national park or an ecological reserve in the Yanachaga range under the name Yanachaga- Chemellen was submitted to the Ministry of Agriculture in 1974 by Dr. Stefano Varese, a famous anthropologist concerned with the conditions of the Amuesha tribe. Dr. Antonio Brack submitted a report which supported Dr. Varese's proposal for scientific reasons and suggested that the category of national reserve would be the most appropriate.

The Varese and Brack proposals were not put into practice for they were outside of the priorities and possibilities of the Direccion General Forestal y de Fauna. Subsequently, the request was supported by Richard Smith (1977) who proposed the establishment of a national park which would be flanked on the east by a communal reserve dedicated to the Amuesha communities.

In 1981, within the framework of different development proposals for the Central Jungle and taking into account the new perspective of the present government towards this region, it was determined that this project was a national priority (Dourojeanni, 1981) although it was pointed out that the most pertinent category would be that of a national sanctuary.

6.1.2 General Description of the Environment

The environment of the conservation unit project is exactly that of the Yanachaga range which divides the valleys of the Palcazu River to the east, and the Huancabamba and Pozuzo Rivers to the west, and that, to the south, borders on the la Sal hills of the San Carlos Range which separates the Pachitea river basin from the Perene river basin. To the north the Yanachaga Range has its last spurs in the bend of the Pozuzo river itself.

It is very broken terrain, with altitudes ranging from 600 to some 3,800 m. above sea level at the Yanachaga peaks over the town of Huancabamba.

From its western slope, which is quite steep, torrentuous rivulets and gorges which feed the Pozuzo and Huancabamba Rivers from north to south are born. Very important rivers for the Palcazu river basin such as, from north to south, the Mairo, Lagarto, Comijachana, Chuchurras, Izcosacin and, at the southern end, the Bocaz, are born from the eastern slope which is much larger.

The climate in the Yanachaga range is pluvial, with abundant rain practically all year round (an annual rainfall of about 4,000 mm). Minimum temperatures are recorded from June to August and vary, of course, with altitude.

The soils of the range, without exception, belong to class VIII according to the major use capacity classification system. This is to say that they are not good for any type of agricultural, livestock or forestry exploitation and the area should be considered as a protection forest.

The Yanachaga range, in keeping with the life zone classification system devised by Holdridge (1947) and applied by ONERN (1976), covers the life zones known as Rain Forest-Tropical Montane in the highest part, Rain Forest-Low Tropical Montane, Rain Forest-Premontane and Wet Premontane forest. According to Brack (1981) it covers the Yungas province and the areas of this Province known as dwarf forest cloud forest and high jungle.

6.1.3 Present Uses and Their Implications

The Yanachaga range over 600 m. above sea level has already suffered from the severe effects of irrational forest exploitation, shifting agriculture, livestock raising and depredatory hunting. These impacts are more evident to the south and to the west from the roads which, from Villa Rica, enter the Palcazu valley by the Bocaz and Cacazu rivers at the south of the range and from the road which joins Oxapampa to Huancabamba and Pozuzo and which leads to the bend of the Pozuzo to the west.

To the south, destruction of forests and resources in general is enormous and in full operation. In the west, it is more serious in the areas surrounding Oxapampa, starting from the mouth of the Tunqui rivulet from where a road is planned to Chuchurras in the Palcazu, and starting from the area known as Seso, from which another projected road starts which will join Pozuzo with Pto. Mairo without going around the "codo" del Pozuzo. Similarly, damage is starting in areas neighboring the Pozuzo itself, both to the north and the south and in many other areas west of the road and trail between Oxapampa and the "codo" del Pozuzo.

Taking into account that the part of the Yanachaga range which should not be used for agriculture, livestock, or forestry in general starts over 1,000 m. above sea level, it can be estimated that over 30 percent of the environment which it would have been desirable to preserve has already been destroyed.

Obviously, forest exploitation and hunting, no matter how poorly carried out, per se do not cause such irreversible and serious damage to natural ecosystems as do agriculture and livestock raising, which radically destroys them. Forest exploitation in the Yanachaga, as well as in every other part of the Amazon jungle, is the entrance door to shifting agriculture which uses forestry roads for its own expansion.

Should these actions continue, it is to be expected that the Yanachaga range would lose all or nearly all of its protective value as well as its importance as an ecological sample, genetic reservoir, source of natural beauty and other attributes before 1995.

6.1.4 Justification for Setting Up a Conservation Unit

Scientific

Scientific justification is based on the unique nature of the floral and faunal genetic resources of the Yanachaga range which, as has already been pointed out, is an unprotected pleistocene refuge. It is probable that many of the species of flora and a major part of the invertebrates are unknown to science, but their extinction will be assured unless the environment is protected. It must be stressed that what has been stated as regards species in the Yanachaga is also valid for ecosystems.

Economic

Economic justification is quite important. On the one hand it is obvious that agriculture, livestock or forest exploitation of the Yanachaga range, given its environmental fragility, could only take place for a very short period of time and would be hopelessly destructive. On the other hand, its protection is the only guarantee that the Palcazu Valley as well as the Huancabamba and Pozuzo Valleys will receive abundant and good quality water for hydroenergy[1], urban consumption or eventual irrigation. It is also the best guarantee against avalanches, landslides, flooding and other catastrophes which occur as a consequence of soil erosion and high rainfall.

Any economic analysis would show that it would be more profitable for both valleys to protect the Yanachaga range for the purposes indicated above rather than to use it short term. Furthermore, it must be borne in mind that this range could be the basis for an important tourist industry given its qualities and its proximity to Lima.

1/ For example, a proposal has been made for the construction of an important hydroelectrical power station in the Pozuzo canyon whose feasibility will depend mostly on protecting this river's basin and especially the north-eastern part of the Yanachaga range. Similar proposals have been put forth to make use of rivers flowing down the western flank of the Yanachaga range.

Social

The Yanachaga range is an area of major importance for the Amuesha people (Smith, 1977) and deserves respect as such. Furthermore, the lower areas of the range could support forms of use compatible with the delicate ecological nature of the area, such as hunting and gathering, activities which traditionally have been properly carried out by the Amuesha.

Another social consideration is that the farms which could be established in the Yanachaga could in no way develop acceptable life conditions and, in the long run, would create a lower "caste" of peasants as can be seen under similar conditions in other parts of the upper Amazon of Peru.

Political

The destruction of the Yanachaga range, an area practically without any conventional economic value, within the framework of a project such as is being implemented by the Pichis-Palcazu Special Project Executive Commission would be convincing proof for skeptics regarding Peru's present Amazon development policy. Such skeptics claim that this policy involves an unacceptable risk for the environment, and consequently for man, and that the national legislation itself which provides for the protection of areas such as the one described is not being complied with.

Ethical

As Brack (1981) points out, the Yanachaga range has several rare species in danger of extinction. Peru, through its own legislation and through participation in several international treaties, agreements, and conventions, is obliged to protect them. In the Yanachaga range the presence of *Pudu mephistopheles*, *Tremarctos ornatus* and of several primates, among other threatened species, stand out.

Aesthetic

The Yanachaga is an environment of extraordinarily beautiful mountain and forest scenery which gives rise to a very large number of gorges, canyons and waterfalls to delight visitors in the area itself or in adjoining valleys. The flora is a major attraction while the fauna, although more difficult to appreciate, can be easily seen in its insects, especially butterflies, and in its birds.

6.1.5 Options for Category and Name

The Yanachaga range has been proposed as a park (Smith, 1977, Brack, 1981) as well as a reserve (Brack, 1974). The difference between these categories is quite marked. A national park is untouchable while a national reserve allows for the rational use of its fauna (Articles 16 and 17 of the Ley Forestal y de Fauna Silvestre). The idea of a national reserve was to give the Amuesha the possibility to practice traditional hunting and gathering within the Yanachaga environment. Nonetheless, it was later thought to be more appropriate to set up, around the national park, one or more communal reserves (Article 60 of the aforementioned law), in which these activities could be carried out while avoiding risks to the rarer species and providing a buffer area around the park which would also receive animal population surplusses from the park. Thus the idea of setting up a national reserve was discarded.

But there is also the possibility of setting up a national sanctuary instead of a national park. The main difference between these categories (Articles 16 and 18 of the aforementioned law) is that the second protects, as untouchable, a given species or community of plants or animals instead of the natural associations of flora and wildlife. In fact, since Yanachaga is going to protect ecosystems corresponding to several life zones, its category is that of a national park, even though its size is not very large.

Finally it must be pointed out that in keeping with the Ley Forestal y de Fauna Silvestre, the Yanachaga range could be a protection forest which is also untouchable (Article 12 of the law). However, its scientific, ethical and aesthetic peculiarities fully support its ranking it as a conservation unit.

The most obvious name for this new national park would be Yanachaga, its present name which is of Amuesha origin.

6.1.6 Proposed Boundaries

The boundaries proposed for the suggested Yanachaga National Park are outlined in the attached map. As can be seen, they include all of the highlands north of the Bocaz river valley excluding those areas extremely affected by agro-livestock and starting at an altitude or benchmark ranging between 1,000 and 1,500 m. above sea level to the east, and 500 and 1,000 m. above sea level to the west avoiding, as far as possible, agricultural and livestock invasions. As rightly suggested by Brack (1981) a zone of the so-called Amazon Province or Low Jungle is being included so as to assure the migration necessary for certain species and to increase the genetic diversity of the sample, including species which do not usually live over 1,000 m. above sea level, such as Priodontes giganteus (Geoff.), Cabassous, Atelocynus, microtis (Sclater), Speothos venaticus (Lund), Myrmecophaga tridactyla L., Leo onca L., etc. This zone has been located between the Mairo and Lagarto rivers, northeast of the range.

With such boundaries, the Yanachaga National Park would have an area of 225,500 Has.

6.1.7 General Guidelines for a Master Plan

Evaluation

The master plan must include a description of the area with physiography, geology, soils, climatology, flora, fauna, ecology, history, anthropology, and archaeology. Furthermore, it should include an evaluation of the present use of the resources and their status, taking into account land tenure (especially in boundary areas), existing population, agriculture, livestock raising, fishing, forest exploitation, mining, hunting, trade, access roads, etc. On the basis of this information, a diagnosis should be made to serve as the basis for the proposed development and management.

Development and Management

One of the major aspects to be considered under this section is the precise definition of boundaries and zoning. The latter must include a zone for recovery of all areas which have been degraded by agricultural, livestock and forestry activities; a special-use or services zone; an intensive-use zone where most of the visits would take place; an extensive-use zone, where visits for purposes of environmental education and recreation would be tolerated; a primitive zone with minimum public use, and an untouchable zone, where only scientific uses would be allowed (Miller, 1980). These zones are usually established in sections in keeping with the access to and shape of the unit.

Subsequently, a protection policy must be set up including the location of guard posts, definition of patrol routines, and procedures for inspection and action in the case of alerts. Similarly, a scientific research policy should be defined assigning priority to an understanding of the resources contained in the park as well as solutions to problems which might arise as regards the park's own conservation. A public use policy is another of the major items to be included. It is closely related to zoning and can basically be broken down into recreation and interpretation programs. Finally, a management policy which takes into account operations and logistics, management problems, maintenance and infrastructure for the aforementioned policies/management programs must be defined.

6.2 Protection Forests

Peru's Ley Forestal y de Fauna Silvestre defines (Article 12) protection forests which, due to their characteristics and location, serve basically to preserve soil and water; to protect agricultural land, roads other infrastructures, and populated centers; and to guarantee water supply for human, agricultural, and industrial consumption. It also stipulates that they are untouchable. This definition fits perfectly with the characteristics of the different sectors of the Palcazu river basin and hence, we are proposing two protection forests as stated below.

It should be pointed out that despite the fact that the aforementioned law has been in force since 1975, no protection forest has been set up in any part of the national territory.

6.2.1 San Matias Protection Forest

The San Matias range forms the eastern wall of the Palcazu watershed which it separates from the Pichis watershed. It and the Yanachaga range originate from the San Carlos range to the south. It is a narrow and long crest which reaches possibly under 2,000 m. above sea level and which has quite steep flanks.

The establishment of a protection forest in San Matias is an evident need and its untouchable nature must be enforced starting from 500 m. above sea level on both sides. To make the control and definition of boundaries easier, it is suggested that it start at the Chivis ravine in the south and run north beyond the Palcazu river cut to include the hills extending east of the Pozuzo river which are a continuation of the San Matias range. Thus, the San Matias protection forest would have an area of some 31,688 Has. (See attached map.)

Brack's recommendation (1981) of not opening roads between the Palcazu River and the range is pertinent. However, this forest could, in keeping with the law, be used for nondestructive applications such as hunting, collection of fruits, medicinal, ornamental and other plants; tourism and other forms of use compatible with its protected nature.

6.2.2 Other Protection Forests

Another protection forest must be set up on the upper section of the Palcazu watershed as regards the rivers which form it: the Bocaz, the Cacazu and the Pichinaz rivers as well as others of lesser importance which are located partly in the southern end of the Yanachaga and San Matias ranges and also in the San Carlos range, at the junction of the two previous ones. This protection forest could cover some 40,000 Has., which would have as its northern boundary the southern end of the Bocaz basin and the Chivis gorge.

6.3 Possibilities for Setting up Communal Reserves

Communal reserves, in keeping with the Ley Forestal y de Fauna Silvestre (Article 60), are established for conservation of wildlife to the benefit of neighboring populations for whom such a resource is a traditional source of food. Smith (1977) proposed, on the basis of this article, the creation of two groups of communal reserves in the Palcazu Valley. The first group, adjacent to the proposed national park at the west of the valley, and the second, adjacent to the San Carlos and San Matias ranges at the southeast of the valley.

Smith's proposals, even though fully justified by the ancestral rights of the Amuesha tribe and very convenient from the environmental point of view, have a low probability of acceptance due to the considerable area which would be involved under the heading of native community territories and communal reserves, especially if the latter are located under 500 to 1000 m. above sea level on the flank of the Yanachaga range and under 500 m. above sea level on the flanks of the San Carlos and San Matias ranges, respecting the most convenient boundaries for the proposed national park and for the protection forests.

Thus, it is the author's opinion that the possibilities of establishing a national park which could fully meet its objectives would be severely restricted if, concurrently, large communal reserves were proposed. Also, the use of soils suitable for forestry production would be limited, which would be a problem for regional development.

The natives and other valley inhabitants can largely supply their wild meat needs if they fully comply with the recommendations of this report as regards management of fauna.

7. GUIDELINES FOR PRESERVATION OF THE NATURAL INHERITANCE

Aside from what has already been stated as regards fauna, the establishment of a national park at Yanachaga, the establishment of the San Matias and other protection forests, the guidelines for conservation of the natural inheritance, especially flora and fauna, will be governed by the application of agricultural, livestock, and forestry technologies appropriate to the local ecology respecting stipulations in the Native Community and Agricultural Development Law for the Jungle and "Ceja de Selva" Regions (Decree Law 22175), the Forestry and Wildlife Law (Decree Law 21147), and the regulations for both.

These aspects are broadly dealt with in the discussion of agricultural and forest land use which is the subject of other reports. However, we summarize here some of their principles and alternatives.

In the first place it is important to note that rural settlements should be an organized establishment of individuals dedicated to the integrated and comprehensive exploitation of renewable natural resources through production systems which maximize social, economic, and ecological profit and ensure an adequate preparation of the area (Article 3 of Decree Law 22175). These rural settlements should integrate agro-livestock production, forestry, fisheries, and wildlife production or extraction, with industrialization as well as with transportation and marketing activities (Article 4 or Decree Law 22175).

Secondly, that same Decree Law in its articles 29 and 30, stipulates that the lands must be used strictly as a function of the major use capacity of the soils and that agro-livestock activities be restricted to the appropriate soils.

Thirdly, this Decree Law dedicates all of Title IV to the integral use of renewable natural resources by stipulating that: 1) the Ministry of Agriculture shall promote and oversee the application, in rural settlements, of production systems which take into account the use of technology adapted to the Jungle and "Ceja de Selva" ecological realities (Article 79); 2) the owners of lands dedicated to agriculture and livestock raising will maintain the original forest cover over 15 and 30 percent of such areas, respectively. These percentages must necessarily include the riverbanks, gorges, and slopes (article 81); 3) the obligation to make use of the lumber resulting from authorized forest clearing activities (Article 82); and, 4) the Ministry of

Agriculture shall rank the areas devastated by shifting agriculture for application of soil conservation, reforestation and/or basin management programs (Article 88).

The Forestry and Fauna Law and, especially its 6 regulations, including those pertaining to classification of soils, forestry ordinance, flora and fauna conservation, conservation units, extraction and transformation, and forestry police, offer another package of guidelines whose enforcement would ensure conservation of the Palcazu flora and fauna. We must also mention the General Water Law which provides the necessary instruments for protecting the banks of the water courses.

In summary, Peruvian legislation is very complete as regards instruments which would assure the conservation of flora, fauna and other renewable natural resources. The problem lies with the possibility of the state enforcing compliance, through education, extension, and control. It is assumed that within the scope of a project such as the Pichis-Palcazu this problem will be overcome.

8. CONCLUSIONS

8.1 Most of the major wildlife species of present and/or potential economic importance common to all the Amazon region exist in the Palcazu river basin.

8.2 The major species of local economic interest are those which produce wild meat, among them the rodents (*Dasyprocta*, *Cuniculus*, *Hydrochoeris*), the armadillos (*Dasypus*), the pecaries (*Tayassu*), the deer (*Mazama*) and various birds.

8.3 Among the species of greater economic interest are those producing hides (*Caiman*, *Tayassu*, *Mazama*, *Hydrochoeris*), pelts (*Felis*, *Leo*, *Lutra*, *Pteronura*, *Potos*, *Chironectes*), live animals for research and ornamentation (primates and parrots, among others), and hunting trophies.

8.4 The populations of practically all of the major species of economic interest and of many of the species of local economic interest are under rationally usable levels and hence, a ban should be set up covering all the fauna except the most common species used for subsistence purposes (Cuniculus, Dasyprocta, Dasypus, and others) especially by the natives.

8.5 Many species of Palcazu wildlife are, or could be, detrimental to man and his activities. Among them are those which are detrimental to crops, harvests, and pastures (Passeriforms, parrots and such, rodents), those which transmit livestock diseases (vampire bats), those which are reservoirs of human diseases (primates, birds, hedgehogs, edentates, bats, etc.), those which attack man (poisonous snakes), and those which attack domestic animals, livestock and poultry birds (felines, didelphids, mustelids, falconids, etc.)

8.6 In any case, the benefits to be derived from wildlife are greater than the eventual damages they might cause and whose magnitude shall depend, to a great extent, on the rationality of the rural development to be applied in the Palcazu.

8.7 The Palcazu fauna is manageable and it is expected that it will provide substantial advantages for the valley's social and economic development. The management levels to be applied (extensive, intensive and superintensive) and their characteristics would vary for small woodlands in agro-livestock areas, woods under forestry ordinance, protection forests, pasture lands, river banks and water surfaces, or artificial or semi-artificial conditions.

8.8 The management of fauna in small woodlands in agro-livestock areas will be feasible to the extent that the legislation which makes it mandatory to set them up is complied with, and shall vary as a function of the size and number of climax forests, secondary vegetation forests and artificial forests. In them, intensive (with census) or extensive (without census) management may be practiced for the production of wild meat or live animals.

8.9 The management of fauna in production forests under forestry ordinance and in protection forests, with the differences inherent to the characteristics of these forests and their management shall, in both cases, be of the extensive type for the production of wild meat, hides, pelts live animals and sports hunting.

8.10 It would be feasible to implement intensive management programs for some wild fauna species in the pasture lands of certain valley areas. The specific advantages of the ronsoco (Hydrochoerus hydrochaeris) to this end, are highlighted.

8.11 Since riverbank and water surface fauna are prodigious in valuable species such as Lutra, Pteronura and Chironectes (pelt) Caiman (hides), Hydrochoeris (hides and meat), Podocnemis (meat and eggs) and this fauna is easy to evaluate and manage, it is recommended that priority be given to protective measures to facilitate their management as soon as possible.

8.12 In the Palcazu, as in any other place, it is possible to raise wild animals, especially primates, with the advantage that this area is close to Lima. However, the area is not the best for alligators.

8.13 An organization based on Forest Districts and sectors, in the charge of professionals and covering 10 to 20 thousand hectares of area for the production of wild fauna is suggested for the management of the wildlife resource.

8.14 Despite the fact that Peru's national Conservation Unit system is quite broad and complete, it evidently is not representative of the ceja de selva or high jungle ecosystems of the central and northern areas of the country. On the other hand, the rate of destruction of natural forests in these areas of the country is so high that if urgent measures are not applied, its rich genetic inheritance will disappear before the end of this century.

8.15 The Yanachaga range, the western flank of the Palcazu river basin, is one of the areas proposed as a conservation unit in the central high jungle. The main justification for setting up this unit (as with Cutibireni and Sira-San Carlos), is that it corresponds to a pleistocene refuge and to a center of evolution, assuring the protection, at the least cost, of the maximum possible genetic diversity.

8.16 The Yanachaga range has been irreparably affected, perhaps up to 30 percent of its area, by agricultural and livestock activities and, to a greater extent, by forestry and hunting activities even though, in this case, the areas can be recovered. The most seriously affected areas are found to the south and southwest, but they extend to cover all of the western flank in the Oxapampa and Pozuzo valleys.

8.17 Justification for the establishment of a conservation unit at Yanachaga is scientific (the unique nature of the flora, fauna, and ecosystems, its great genetic wealth, mostly unknown to science); economic (impossbility to give this area any conventional economic use due to the fragility of its ecosystems; value of the area to prevent soil erosion, avalanches, landslides, and floods, and to produce water in sufficient quality and quantity for hydroelectric purposes or for urban and rural consumption and, finally, the possibility of developing an important tourist industry); social (meaning of the area for the Amuesha people, subhuman standard of living for the eventual farmers who could settle there); political (international image of the government and the country); ethical (presence of numerous species in the process of extinction which Peru must protect for moral reasons and in compliance with its own legislation and international treaties it has signed), and; aesthetic (to preserve an environment of extraordinary scenic beauty).

8.18 After analyzing national legislation, the category which corresponds to the Yanachaga conservation unit is that of a National Park. It is proposed that it be named after that mountain range. For reasons which are given, the proposed boundaries enclose a corridor in the low jungle covering an approximate area of 226,000 Has.

8.19 General guidelines are given for a master plan which should be the subject of a specialized study.

8.20 It is proposed that the San Matias Range, on the eastern flank of the Palcazu River Basin, be preserved untouched as protection forest in which, in keeping with legislation in force, activities which do not affect its protective nature for water and soils such as hunting, gathering and tourism could be carried out. The area would include some 32,000 Has.

8.21 Analysis of the possibilities of setting up communal reserves to benefit the Amuesha natives reveals that they are scarcely feasible, since they would limit either the quality of the proposed National Park or the possibilities which the natives or other valley inhabitants would have to supply themselves with fauna products on the basis of the aforementioned alternatives.

8.22 Complementing other reports and what has been stated here as regards fauna and the protected areas, other general guidelines are given for preserving the natural inheritance. Emphasis is made of the fact that the Native Community and Agrarian Development Law for the Jungle and "Ceja de Selva" Regions as well as the Forestry and Wildlife Law, and their regulations, meet or provide most of the requirements for an optimal use of renewable natural resources.

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APPENDIX F

BRIEF INVENTORY OF PLANT COMMUNITIES AND PLANT RESOURCES OF THE PALCAZU VALLEY, DEPATMENT OF PASCO, PERU

Robin B. Foster

CONTENTS

1. CONCLUSIONS

The most unusual feature of the Palcazu watershed is the extraordinary diversity of vegetation due to the unusual range of geological substrates. Of special scientific interest are the sand-ridge communities and the mixed species palm forests.

The Palcazu Valley contains between 5,000 and 10,000 different species of vascular plants. Anywhere between 100 and 1,000 of these species would probably become permanently extinct from the earth if this valley was completed cleared.

The native communities use hundreds of these non-domesticated species for medicine, household items, construction, etc.; and as minor food sources during normal years but major food resources during famine years. These plants are not uniformly distributed but are usually in patches and often remote from the native settlements.

About one-half or more of the plant genera seen in this valley are known to have species with medicinal use elsewhere in the neotropics. More than a thousand of the Palcazu species are likely to have chemicals with medicinal potential.

In addition to several valuable timber species on the valley floor, there are dozens of species with latex, resins, and oil -- with industrial commercial potential. Extensive plant specimen collection and ethnobotanical studies are needed in this valley before it is too late.

The communities and species of the mountain slopes are the most vulnerable to destruction and extinction. Most of the slopes are too steep for good timber. But without control, colonists and lumbermen <u>will</u> clear these areas.

Protecting the forest on the mountain slopes should be the first priority. Selective cutting is all that should be allowed on the gentlest lower slopes and most of the valley floor. A network of areas of all plant communities should be set aside as species reservoirs with strict protection. Colonists should only be encouraged to clear forest on the richer floodplain and such land is now only available in quantity at the very bottom of the Palcazu Valley and on down the Pachitea drainage. Native communities should be encouraged to enhance growth and abundance of valuable forest species, rather than to clear more forests. The short-term gains of forest clearing on most of the Palcazu drainage would be followed by dreadful impoverishment. Coca is probably the only crop that could do well over most of the watershed. The Palcuzu could easily become "Snow Valley." The beauty, biological interest, and proximity of Lima, make the Yanachaga and San Matias slopes ideal for tourists and vacationers.

2. EXTENT OF THE SURVEY

This preliminary survey of the plant communities of the Palcazu basin was done with just over two weeks of field work in July and August, 1981. It included: one general overflight of the valley and two partial overflights coming in and out; an unscheduled flight from San Ramon to Satipo over areas similar to Palcazu that have been colonized since the advent of the road to Satipo; a transect of the San Matias range from Loma Linda to the 1,000m divide to the Pichis Valley; a transect of the Yanachaga range in a 4 day walk over the Tunque divide (2,100m) down to the Chuchurras River; a one day walk along the southern Yanachaga ridge to Cerro Pajonal (3,000m); by car from Villa Rica down the Rio Cacazu to the current road construction at the lower Cacazu-Pichinaz divide; by boat from Chuchurras to Loma Linda; by foot from Loma Linda to Shiringamazu; and by foot from Iscozacin to Villa America -- with an intensive study in the forest half-way between.

3. EXISTING PLANT COMMUNITIES

I have made my own classification of the plant communities on the basis of what I think are the most useful distinctions in terms of the whole flora of this area -- not by a predetermined system. The topography and life-zones do play a major role in determining the floristic composition, but in the Palcazu Valley the enormous differences in geological substrate are often overriding as determinants of community composition and structure. For some communities such as the montane palm forests, factors determining their occurrence are not immediately obvious.

The above mentioned geological heterogeneity is one of the most striking features of this valley. The Central Selva of Peru is the most geologically diverse section of the east andean slope. The Palcazu drainage covers rock that ranges from late Paleozoic, Jurassic, and Triassic in the upper Yanachaga, down through extensive marine and continental sediments of Cretaceous age, to the low hills of Tertiary sediment and Quaternary alluvium on the valley floor. The low but steep San Matias ridge similarly exposes a wide range of Jurassic and Cretaceous sediment. The rock layers are far from uniform, and the intercalation of a wide variety of limestones, sandstones, etc., and the enormous variety of soil colors including gray, purple, pink, brown, yellow, and white -- often in rapid succession -- is indeed bewildering. The importance of the resulting soils to the plant communities is evident in the description below, but the correlations are only a very crude approximation of the real plant-community complexity of the Palcazu Valley.

A more complete list of the plants observed is found in Attachment I.

3.1. High Yanachaga: 3,000m - 4,000m

Not visited. The highest ridge southeast of Huancabamba is a spectacular row of jagged peaks all of about the same elevation, apparently near 4,000 meters. There are different rumors about what vegetation is to be found, some saying extensive deep beds of moss, other saying grassy pastures. Most of the flora is probably an extension and expansion of the shrubby and herbaceous species found on the pajonals and exposed ridges at lower elevations.

3.2. Upper Mountain Slopes and Ridges: 1,500m - 3,000m

The only major elevational break in floristic composition in the transect made down the Yanachaga occurred at approximately 1,500m, and was independent of changes in soil type. However, this transect followed a ridge and it would be best to assume that the floristic break would come higher in the mountain ravines -- perhaps at 1,800m. Above this break the following distinctions can be made:

3.2.1 Weinmannia forest

This is the characteristic forest of the upper mountains. The ridges are dominated by more than one species each of Weinmannia (Cunoniaceae), Hedyosmum (Chloranthaceae), Clusia (Guttiferae), and tree Melastomaceae, -- all about 10m tall. On the slopes many more tree genera join the canopy (20m) but none consistently. Conspicuous among these are Sapium (Euphorbiaceae), Hyeronima (Euph.), Rapanea (Myrsinaceae), Dendropanax (Araliaceae), and Saurauia (Dilleniaceae). Epiphytic shrubs growing from the main tree branches are mainly Oreopanax (Araliac.), Clusia, and Coussapoa (Moraceae). Smaller epiphytes are mainly the usual big four: orchids, bromeliads, aroids, and ferns, (apparently comprising several hundred species), and among others the conspicuous few species of pink and orange-flowered Ericaceae and Psittacanthus (Loranthaceae).

Beneath the canopy the stems are usually completely covered with moss and the understory woody plants are chiefly treeferns, Melastomaceae, Rubiaceae, and the bamboos Chusquea and Guadua. The herbaceous plants, many with colorful flowers, are mainly Araceae, Begonia, Centropogan (Campanulaceae), Gesneriacea, Fuchsia (Onagraceae), Bomarea (Amaryllidaceae), and several fern and Selaginella species.

Within this type of forest there are sharp changes in the substrate, usually sudden alternation between a soil of dark reddish color easy to walk on and a yellowish poorly draining clay (calcareous) that turns the trail into a slippery mudwallow. In addition, there are many intermediate or different colored soils. However, floristic differences in the vegetation on these soil types were not obvious as it is at lower elevations though an intensive study might be revealing. The forest on yellowish soil did seem to be in greater turmoil from frequent treefalls.

On the Tunque transect, the near complete absence of the important timber trees Podocarpus, Juglans, and Cedrela came as a surprise since they were readily spotted on the western slope and the southern end of the range. Though it is possible they have been cut out in the vicinity of this old trail, one would expect to see at least a few juveniles. If these genera are indeed absent over most of the great sweep of the Yanachaga slope then the commercial value of this forest is indeed low.

3.2.2. Quartz sand -- elfin forest and pajonal

The high mountain slopes and ridges of this region are mottled with patches of shrub thickets associated with quartz sandstones of early Meozoic origin. This substrate has given rise to a podzolic soil (sandy, extremely impoverished in nutrients, capped with a thick acid humus layer). The sandstorm outcrops are apparently more resistent to erosion than the other ancient sediments hence they tend to become exposed ridgetops. These characteristics combine to restrict the height of woody plants and allow the penetration of herbs such as grasses, sedges, composites, and terrestrial orchids and bromeliads. On the 3,000m Cerro Pajonal, the largest such area visited, 48 different species of terrestrial orchids were found without straying from the trail. In addition are numerous shrubby Ericaceae, and melastomes, a distinctive terrestrial Cyclanthaceae, and a dwarf but emergent palm. At lower elevations, sandy ridges result in more of an elfin forest like that one would expect at the "ceja" or timberline, and the species composition of these dwarf forests is dramatically different from that of the surrounding forest even when many of the genera at the same.

3.2.3. Palm forest

Throughout the upper mountain slopes one occasionally sees groups of individuals of a palm species emerging from the forest canopy. These palms usually do not constitute a significant portion of the forest. However, in some areas such as encountered on the Yanachaga transect between 1,500 and 1,700m, the forest is completely dominated by palms of many species. On the steeper slopes here, palms make up nearly 90 percent of the stems greater than the 10cm diameter, though on the flattest parts of the ridges they make up only about 50 percent of the stems. The most frequent of these palms is not yet identified but the other genera present in abundance are Welfia, Iriartea, Socratea, Wettinia, Euterpe, and Geonoma. These palm forests were of both red and yellow soil types.

3.3 Lower Mountain Slopes and Valley Floor: 350m - 1,500m

Below 1,500m the overall diversity of woody plants increases dramatically and there is relatively little overlap of species with the higher elevation forest. There is however considerable overlap of species and gradual change between the lower slopes and the valley floor and I have elected to treat this as all one zone. There is considerable floristic difference between the communities within the zone which are outlined below.

3.3.1. Cedrelinga forest

This forest type dominates the zone, from the reddish soils of the slopes to the tertiary red clay of the low hills on the valley floor. It also covers the whitish gravel-filled old alluvium, but not the more recent terraces near the rivers. Much of the forest above 1,000m on the Yanachaga side and on the upper 400m of the 1,000m San Matias ridge is shorter in stature (20-30m tall) and poorer in species than at lower elevations. But nearly all the species that do occur here also occur at the lower elevations.

Cedrelinga (Leguminosae) is the most conspicuous large tree (40-50m) found at low densities throughout -- up to 1,000m on all but the very steep ridges. The highest densities are apparently on the old alluvial fans at the base of the Yanachaga. Among the hundreds of tree species the genera Virola (Myristicaceae), Protium (Burseraceae), Pouteria (Sapotaceae), and Inga (Leguminosae) are the best represented. These genera, along with species of Lauraceae, Tachigalia-Sclerolobium and other legumes, Clarisia (Moraceae), Aspidosperma (Apocynaceae), Guarea (Meliaceae), Iryanthera (Myrist.), and Hevea (Euphorb.), make up the bulk of trees.

Previous forest maps of the Palcazu Valley recognize several subdivisions of this community. After comparison of these tree studies with each other and with my own observations it is obvious that the variance in species composition and the patchiness in species distribution is much too great to warrant such distinctions in most cases. Much of the supposed difference is in relative abundance of a few tree species. This in itself does not indicate significant community differences, especially when so many of the tree species are lumped under one species name (but with enormous difference in economic potential) such as in "moena" (anything in the Lauraceae), "caimito" or "caimitillo" (any Pouteria), "cumala" (almost any Myristicaceae), "copal" (any Protium), "pashaco" (any Acacia-like legume), "shimbillo" or "pacay" (for any Inga).

The commonest shrubs in the Cedrelinga forest are: Pithecellobium (Legum.); Mabea (Euphorb.); Faramea, Psychotria, Cephaelis, Palicourea (Rubiaceae); small Genomoid and Catoblastus palms; Bonafousia (Apocynaceae); Miconia, Maieta, Tococa, (Melastom.); various Myrtaceae; and Besleria (Gesneriaceae).

A detailed study of two adjacent 20 X 20m plots in tall "average" forest on old leached alluvium (trail from Isocozacin to Villa America) revealed the local diversity of species among different life forms:

	Plot 1	Plot 2	5 Adjacent Plots
	(number of species)		
Trees > 20cm diameter	6	10	32
Shrubs and treelets 1-20cm diameter	100	107	
Herbs and other low woody species	58	49	
Lianas	13	12	
High epiphytes	15	13	
Low epiphytes and trunk climbers	41	34	
Total species (eliminating duplication)	233	214	

Plots 1 and 2 together have 335 species, i.e., a doubling of the area increased the number of species by 44 percent. This rate of increase of course tapers off with increasing area.

3.3.2. Recent floodplain and calcareous slope forest

One would not predict that habitats as disparate as the alluvial terraces and the steep bands of rock on both ridge slopes would have such strong floristic similarity. This discontinuous plant community apparently results from the low acidity and high nutrient exchange capacity of both the limestone rock and the recent unconsolidated alluvium on the river floodplain. These soils are probably the valley's richest in nutrient availability and productivity. This does not mean these areas are the most suitable for tree production. The calcarious soils in particular have poor drainage properties and the higher average nutrient content of the plants makes them more subject to decay and insect attack, and they have a lower average life span.

Though there is certainly overlap with the flora of Cedrelinga forests, a number of species are distinctive. The huge emergent Ceiba pentandra is striking especially when it occurs up on the mountain slopes. Other particularly rich-soil trees include: Quararibea cordata, Quararibea rhombifolia, Ochroma pyramidale (Bombacaceae); Cordia alliodora (Boraginaceae); Jacaratia (Caricaceae); Erythrina ulei, Dipteryx (Legum.); Trichilia (Meliaceae); Sterculia ape, Ficus yoponensis, Poulsenia armata (Moraceae). Common diagnostic shrubs are Justicia appendiculata (Acanthaceae), Acalypha diversifolia (Euphorbiaceae), and high densities of Rinorea (Violaceae).

Most of the Palcazu floodplain forest has already been cut, but enough remnant individuals remain to infer its composition. Probably the first species to be removed was Cedrela odorata (Meliaceae), but juveniles are still in evidence.

There are a number of species common right along the river bank. The rocky shore dominant is Calliandra angustifolia (Legum.), and on recent deposition are occasional patches of Gynerium sagittatum (Gramineae), Cassia reticulata (Legum.), Vernonia patens (Comp.), Tessaria integrifolia (Comp.), and scattered trees of Ochroma, Guazuma crinita (Stercul.), Trema micrantha (Ulmaceae), Sapium, Guarea, Schizolobium parahybum (Legum.), Ficus insipida, Ficus maxima, and Cecropia. Common vines on the river edge are the bright orange flowers of Mucuna rostrata (Legum.), also Combretum fruticosum (Combretac.), Dioclea (Leguminosae), Ipomoea spp. (Convolvulaceae), Cissus sicyioides (Vitaceae), and Serjania spp. (Sapindaceae).

3.3.3. Sandy ridge scrub forest

On the one low quartz ridge visited on the San Matias slope, the extraordinary open-canopy elfin forest at only 600m. elevation contained several species otherwise known only from the high ridges and pajonales (e.g., a pink-leaved Clusia), some stunted individuals of species from the surrounding steep ridge forest, and many species not seen anywhere else. I encountered what seems to be a new species of Podocarpus, a rarely seen Sciaphyla (Triuridaceae), and numerous plants I did not recognize.

Where the soil is only partially sandy, the forest has a low (15-25m) canopy and a high density of straight small trees ("varillal").

3.3.4. Sandy floodplain

Some alluvial deposits on the valley floor have a very high component of quartz sand. One such area was briefly visited south of Shiringamazu. The most notable characteristic of this forest was the high density of rubber trees (Hevea), and the thick mat of roots on the soil surface.

3.3.5. Swamp forest

Between the Rio Chuchurras and Rio Lagartillo are areas that appear from aerial photos to be swamp forest. These are reported to be "aguajales" -- areas dominated by the swamp palm, Mauritia flexuosa. This type of community is extensive in the Ucayali floodplain.

4. PLANT UTILIZATION

The commercial timber resources of the valley bottom have been evaluated by ONERN and other and will not be considered in detail here. There is apparently no mahogany (Swietenia) in this valley, though it does occur in the Pichis Valley. Several other trees such as Eschweilera also occur in the Pichis but not apparently in the Palcazu.

The Amuesha make considerable use of forest plants. There homes are conveniently made without the use of sawed wood. The flooring is largely from the split trunks of the palm Socratea and the support posts are from Iriartea palm and the heartwood of several species including Tachigalia.

Roofing thatch comes entirely from leaves of a small palm, Geonoma, though some buildings have shingles from Cedrelinga trunks. Cordage for tying cross beams and roofing comes from the stems of trunk climbers: Marcgravia and/or Heteropsis. General purpose straps come from strips of Trema micrantha bark. Hevea rubber has mainly been used locally only for water-proofing treatment.

Some local products, such as Protium resin from lighting and Poulsenia armata inner bark for cloth, have been supplanted by commercial substitutes. This replacement is always influenced by price. The continued rising cost of "calamina" (corrugated metal roofing) means that palm thatch roofs will continue to be desirable and the Geonoma leaves much in demand.

For every pain, illness, or injury -- whether it be tooth decay or cancer -- there is often a different plant or combination of plants used to effect a cure, or alleviate the condition. In addition there are numerous plant species used as insect repellents, insecticides, barbascos, birth control, aphrodisiacs, and hallucinogens. The Amuesha apparently do not use curare arrow poison even though the two principal ingredients -- Strychnos toxifera or Chondrodendron tomentosum -- do occur in the valley. They use one species of Strychnos internally as a worming medicine. This points out that every native culture has a different set of knowledge about plants, even when surrounded by the same species. The curanderos are known to be reluctant, understandably, to reveal much of their knowledge of medicine to outsiders.

At the very least, 50 percent of the plant genera seen on this quick survey (see Attachment I), are known to be used as medicine or for other chemical effects by native peoples in other parts of the neotropics. More and more scientific evidence is accumulating that, in spite of initial skepticism, many of these plants are indeed effective medicines. In addition they are often much more readily available, less costly, and frequently more effective (when correctly used) than the treatment obtained at modern hospitals. At least 100 plant species are now used by the Amuesha, though one curandero estimates the number to be in the thousands.

Wild fruit trees provide variety to the native diet and are essential famine foods when climatic aberrations or other problems cause a crop failure. Like the production of sardines off the coast of Peru, the production of crops in the Amazon basin is subject to good and bad years. The diversity of the native crops and the availability of wild foods provide a buffer that is essential to the long-term survival of the Amuesha. Two normally wild small trees -- Lacmellea (Apocynacea) and Rheedia (Guttiferae) -- were found cultivated near Amuesha dwellings for their delicious fruit. This could be the starting step in the domestication of a fruit with commercial potential. One unidentified tree with small edible fruit was grown because of its attractiveness to birds, which could then be easily killed for food.

No native group ever fully learns all the potential uses of their local flora, and they are especially unlikely to be aware of the potential of plants for large scale agricultural or industrial use. The recent book by the U.S. National Academy of Sciences, entitled Underexploited Tropical Plants with Promising Economic Value, lists 36 plants, 13 of which occur wild in the Palcazu Valley: Calathea lutea, Mauritia flexuosa, Brosimum alicastrum, Jessenia polycarpa, Caryocar, Pourouma, Xanthosoma, Euterpe, Astrocaryum, Geonoma, Iriartea, Socratea, and Welfia.

The price of Hevea rubber is rapidly rising and this species (perhaps more than one) grows exceptionally well here. With genetic improvements in latex production and disease resistance, this could prove to be an important tree crop for the Palcazu. In addition this valley has numerous other plants with latex (in the families Moraceae, Sapotaceae, Guttiferae, Apocynaceae, and Euphorbiaceae) or resin (e.g., Hymenaea, and Copaifera -- known in Brazil to produce natural diesel fuel), all with potential for industrial chemical use.

The number of species with potential for medicinal chemicals is certainly over a thousand. In fact it would be almost easier to single out the species with no known medicinal potential. Species chemical potential cannot be dismissed easily, for in addition to cellulose and chlorophyll, most plants contain hundreds of complex reactive chemicals, and the techiques for isolating, identifying, and testing these compounds are often difficult and very time consuming. Also the rapid denaturation of many compounds means that although very active in a fresh plant, they may be wrongly ignored and dismissed when chemical tests fail to reveal activity, or clinical tests fail to reveal any effects.

4.1. Coca

There are at least 6 wild species of Erythoxylum in the Palcazu Valley, indicating that this is in general a very suitable habitat for that genus. Erythroxylum coca is cultivated at several of the Amuesha communities on a limited scale for local mastication. The plants looked healthy, through productivity is likely to be better on the cooler slopes. This species is extremely versatile in the variety of habitats in which it can thrive, especially with the help of a little genetic selection. It will grow on steep eroded slopes on which almost no other plants can survive. There is every reason to believe that 90 percent of the Palcazu watershed is suitable for production of coca if commercial incentive remains high.

5. ENDANGERED PLANT COMMUNITIES AND SPECIES

The east slope of the Andes has the highest concentration of plant species in the continent. This is primarily because the elevational gradient from the Puna to the Amazon plain includes such a wide range of environmental conditions in a small area, and because historically it has been a wet refuge when much of the Amazon Basin was dry. In Peru, the small department of Pasco probably contains nearly as many species as the huge department of Loreto. In the Central Selva region, the additional great diversity of geological substrates enhances the variety of plant habitats. I would expect the Central Selva region of Peru to have the highest species diversity of any similar sized area in the neotropics, but there is insufficient information to make that conclusion now.

All the Palcazu plant communities and the great majority of its species are in decline throughout the neotropics. The entire east slope of the Andes from Columbia to Argentina is rapidly being cleared, temporarily farmed, or grazed, and then abandoned to erosion. Natural forest recovery of these eroded slopes will take more than a thousand years even if the original species are still available for colonization -- which is unlikely.

The forest communities of the Andean slope are poorly known at present and it is difficult to be definite about their relative endangerment. The quartz sandstone vegetation at all altitudes in the Palcazu, though widespread in patches or bands throughout the Central Selva, is relatively rare elsewhere. The species do not seem consistent from patch to patch and there may be much local endemism. Nowhere is this community officially protected and it is extremely vulnerable to fire. Its only protection is its complete worthlessness for agriculture.

I have not seen or heard of anything like the dense mixed-species palm forests anywhere else in the Andean slope, though they may exist. Certainly it seems to be an endangered community even if all the species in it should prove to be individually abundant elsewhere.

The Weinmannia forest, or something similar, though widespread throughout the steep Andean slopes is subject to increasingly intensive pressure from above, i.e., the people of the altiplano, now that the inter-andean valleys have been denuded of trees for lumberwood. Already, the lumber roads over the Yanachaga pose a threat to this forest quite apart from the main road the government is building into the valley.

The narrow floodplain forest is already cleared along most of the Rio Palcazu and its principal tributaries, as it has been through most of the Amazonia. With seed sources available, it could regenerate in 300-500 years to something approximating its mature condition. Similar forest is protected along the Rio Manu, Pacaya-Samiria, and in Von Humboldt National Forest.

Currently, Cedrelinga forest, or something similar, probably covers more area than the other communities. It can tolerate selective cutting of timber and small-scale short-term shifting agriculture on the flatter areas. But once clearcut for pasture, it is not likely to completely recover for over a thousand years. Some forest like this is protected in Von Humboldt National Forest and in the Manu National Park.

In the intensive study of the Cedrelinga forest near Iscozacin, a 20 X 100m sample of trees (greater than 20cm diameter) has 45 percent more species of trees than would be found on an area the same size in lowland Panama (Barro Colorado). If all vascular plants are considered in addition to trees, a 20 X 40m plot has 47 percent more species in Palcazu than it would in Panama. In the lowland forest of the whole Panama Canal Area -- nearly equal in size in the valley floor of the Palcazu (800-1,000km^2) -- there are approximately 2,600 species of vascular plants. It would not be unreasonable to project that the heterogeneous Palcazu Valley floor should have at least 47 percent more -- or 3,800 species . But since the whole Palcazu watershed of 3,000km^2 includes in addition to all the high mountain flora and all the other species characteristic of different soil types, one can feel confident in stating that the flora of the entire Palcazu basin may be double that of the valley floor and thus between 5,000 and 10,000 species.

Taking what may be a conservative figure, 5-10 percent (250-1,000) of the species in the flora probably have not yet been named and described (i.e, not known to science). There is no way of knowing right now how many of these species are endemic to this valley and would become immediately extinct if the valley was cleared. Nor is it known how many of the valley's species already known to science are now restricted to this valley or are in other ways threatened or in imminent danger of extinction. The number is probably over a thousand.

Even if a given species is not in danger of extinction, the genetic differentiation within species is large and any area such as the Palcazu has its own species races with different genes or arrangements of genes. This means that, for any of the valuable timber species and the hundreds of other species with commercial potential, local extinction would mean loss of important genetic material even if the species survived elsewhere.

6. EFFECTS OF ROAD CONSTRUCTION

The road by itself would cause some decline in the native plant communities and would increase runoff and erosion to a limited extent thus effecting the floodplain communities. But it is fair to say that the single road, separately from what is brings with it, is not likely to cause major endangerment to the plant communities in the valley. It is likely that at least a couple of very rare species will go to extinction in the path of the road, but it is impossible to predict in advance which species these would be. The loss of these species is only insignficant in comparison to the loss from forest clearing. Additional roads branching from the main one present progressively more serious problems.

7. EFFECTS OF NEW SETTLERS FOLLOWING THE ROAD

7.1. Slopes

New colonists and uncontrolled lumbering are the greatest threats to the plant communities, and also to the continued productivity of the settlers on the valley floor. Quite simply, the slopes of the Yanachaga and San Matias, though listed as "protection forest" on all the planning maps, are almost certainly not going to be protected unless an extra-ordinary effort is made.

Clearing these forests would make a temporary increase in the availability of lumber and other wood products, and it would make agriculture possible on these slopes for a couple of years. But the long-term effects are disastrous. It would cause complete destruction of virtually all the plant communities, leaving only a degraded weedy scrub on the eroded slopes. It would certainly wipe out nearly all threatened or endangered species. It would eliminate numerous plant species currently used by the native communities, and the wild animals used as food sources by these people. The ensuing increase in periodic flash floods would make the floodplain a high risk area for both cultivation and cattle ranching. The record 1978 flood that destroyed so many cattle, followed the clearing of the upper Cacazu and Bocaz Valleys.

7.2 Valley floor

The area of the valley floor not occupied by present settlers and native communities, and now designated for colonization is mostly Cedrelinga forest. If colonization is not severely restricted, the productive use of this land will be ruined in a very few years. Any large scale and long-term clearing would cause permanent soil damage after several years and would also remove the possibilities of reimmigration of species after local extinction. Regeneration of forest would be drastically slowed by the remoteness of natural seed sources. Only very small-scale shifting cultivation or tree-farming, very small-scale and low-density cattle raising, or selective timber cutting would be possible without major risk to the long term survival of both the plant species and the resources of humans.

Due to the patchiness of plant resources, the native Amuesha often find their resources on land that is not within their designated boundaries. Even without competition for space with colonists, their own population pressure is forcing them to go further and further afield to obtain the appropriate palms for construction and roofing. The addition of significant numbers of colonists would soon precipitate a crisis in these and other basic resources.

8. RECOMMENDATIONS FOR PROTECTION OF PLANT COMMUNITIES AND SPECIES

1) The A.I.D. commitment for the Palcazu Valley could best serve Peru, its people, and its resources, by being entirely allocated to the restriction

of management of colonization in the valley floor and strict protection of the forested slopes -- rather than allocated to the road itself.

2) The government should restrict the movement of settlers down the new main road until management plans are in effect.

3) It should be certain that the bulk if not all of the colonization of new settlers is at the less inhabited bottom of the valley and down the Pachitea Valley. The land in the upper part of the valley (south of Rio Lagarto) is already saturated with people, especially on the alluvial fans at the base of the Yanachaga, and the Palcazu floodplain. These are the only habitats capable of tolerating sustained intensive agriculture.

4) The active lumber road going down into the Palcazu drainage at the 3,000m La Esperanza gap east of Oxapampa should be immediately blocked at at the top of the divide.

5) The road and red-pepper growers moving up the Tunque pass northeast of Huancanbamba should be halted before they go over the divide.

6) Cerro Pajonal and other sand savannahs should be protected from fire.

7) There should be a concentrated effort to identify at the species level the plants of the area. This can only be done by extensive collection and museum work. It is the only way to find out which species are truly unique to this valley, and which are most in need of protection.

8) There should be a thorough study of plant utilization by native Amuesha and Campa people -- ideally an ethnobotanical study throughout the east slope of the Peruvian Andes. The same plants are not used by each native group even when surrounded by similar plant communities.

9) The native communities should be given incentives to make commercial use of forest resources such as by cultivating or incresing the density of valuable timber or fruit species, rather than incentives to clear the land as is now the case.

10) The Yanachaga and San Matias slopes should be declared a National Forest.

11) Non-intensive lumbering and tree-farming of selected species should be allowed only on the valley floor and the few more gradual slopes and ravines of the mountains. Logging roads should be minimized.

12) Some large areas of all forest types should be declared species reserve, protected from all cutting and hunting. These would provide plant seed and animals for recolonization when species are selectively reduced to extinction in the rest of the valley and in other parts of Peru. To protect some of the floodplain forest will require immediate action in the lower part of the valley.

13) The species reserves should also be accessible and attractive to tourists. There is a tremendous demand for wilderness areas easily accessible from Lima. The Yanachaga slope provides a marvelous educational, scientific, and aesthetic attraction in some of the most diverse and fascinating biological communities on earth. This attraction could easily be made a source of economic importance in the area. The native Amuesha communities would be a valuable human resource as expert guides. A trail to the very top of the Yanachaga and a maintained trail network down the slopes and through forests of the valley floor would be sufficient attraction if combined with improved campsites and a few small lodges.

ATTACHMENT I

VASCULAR PLANTS RECOGNIZED DURING
PRELIMINARY SURVEY BY R. FOSTER, JULY - AUGUST, 1981

Part 1: Lower Mountain Slopes and Valley Floor (350 - 1500m); (including San Matias and Yanachaga)

Acanthaceae

* Hansteinia
* Justicia appendiculata
* Justicia 5 sp.
Mendoncia 2 sp.
Odontonema
Pachystachys
Razisea
* Ruellia tarapotana
* Ruellia thyrsostachya
Ruellia 2 sp.
Sanchezia 3 sp.
Suessenguthia
Other: 6 sp.

Amaryllidaceae

Eucharis

Anacardiaceae

* Spondias mombin

Annonaceae

* Guatteria 2 sp.
Unonopsis
* Xylopia 3 sp.
Other: 6 sp.

Apocynaceae

* Aspidosperma 4 sp.
* Bonofousia sananho
* Bonafousia sp.
* Couma macrocarpa
Lacmellea
Odontadenia
Prestonia
* Tabernaemontana

Araceae

Anthurium clavigerum
Anthurium gracile
* Anthurium 6 sp.
Caladium
* Dieffenbachia 4 sp.
* Dracontium
* Heteropsis
* Monstera 2 sp.
* Philodendron lechlerianum
* Philodendron 13 sp.
Spathiphyllum 4 sp.

Araliaceae

* Dendropanax arboreus
Didymopanax morototoni
Oreopanax 2 sp.

Begoniaceae

* Begonia 5 sp.

Bignoniaceae

* Jacaranda copaia
Paragonia pyramidata
* Tabebuia
Other: 8 sp.

Bixaceae

* Bixa

Bombacaceae

* Ceiba pentandra
Ceiba samauma
Chorisia
Huberodendron
Ochroma pyramidale
Quararibea cordata
Quararibea rhombifolia
Quararibea 2 sp.

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* Indicates genera with species known to be used medicinally elsewhere in the neotropics.

Cyclanthaceae

Asplundia 2 sp.
Carludovica palmata
Cyclanthus bipartitus
Other: 5 sp.

Cyperaceae

* Cyperus
* Scleria 2 sp.
* Scirpus
Other: 2 sp.

Dichapetalaceae

Tapura

Dilleniaceae

Doliocarpus
* Saurauia
* Tetracera

Dioscoreaceae

* Dioscorea

Ebanaceae

* Diospyros

Elaeocarpaceae

Sloanea fragrans
Sloanea guianensis
Sloanea 3 sp.

Ericaceae

1 sp.

Erythroxylaceae

* Erythroxylum 6 sp.

Euphorbiaceae

* Acalypha diversifolia
* Acalypha macrostachya
* Acalypha sp.
* Alchornea
Hevea
Hyeronima
Mabea 2 sp.
Pausandra trianae
* Sapium 2 sp.
Other: 9 sp.

Flacourtiaceae

Banara
* Casearia 2 sp.
Laetia procera
Lunania parviflora
Mayna longifolia
* Ryania
Tetrathylacium macrophyllum

Gentianaceae

* Chelonanthus alatus
Tachia
Voyria 2 sp.

Gesneriaceae

* Besleria 6 sp.
Codonanthe
* Columnea 2 sp.
Drymonia
Other: 11 sp.

Gnetaceae

* Gnetum

Gramineae

Chusquea 2 sp.
Guadua
Gynerium
Olyra
Pariana 2 sp.
Streptochaeta
Streptogyne
Other: 20 sp.

Boraginaceae

* Cordia alliodora
* Cordia nodosa
* Cordia 4 sp.

Bromeliaceae

Aechmea magdalenae
Billbergia
Guzmania
Pitcairnea
* Tillandsia
Other: 5 sp.

Brunelliaceae

Brunellia

Burseraceae

* Protium 9 sp.
Trattinnickia
Other: 2 sp.

Campanulaceae

Centropogan cornutus

Capparidaceae

* Capparis 3 sp.

Caricaceae

* Carica heterophylla
* Jacaratia

Caryocaraceae

Anthodiscus
* Caryocar

Chrysobalanaceae

Couepia sp.
Hirtella 3 sp.
Licania 4 sp.
Other: 2 sp.

Clerthraceae

Clerthra

Combretaceae

* Combretum fruticosum
* Terminalia oblonga
* Terminalia sp.

Commelinaceae

* Dichorisandra
Floscopa
Geogenanthus

Compositae

* Clibadium
* Erechtites hieracifolia
* Mikania
* Pseudoelephantopus
* Tessaria integrifolia
* Vernonia patens
* Vernonia
Wulffia baccata
Other: 7 sp.

Connaraceae

Connarus
* Rourea

Convolvulaceae

* Convolvulus
* Ipomoea alba
* Ipomoea quamoclit
* Iopmoea 2 sp.

Cucurbitaceae

* Cayaponia
* Gurania eriantha
* Gurania sp.
Siolmatra

Guttiferae

* Calophyllum brasiliensis
  Chrysochlamys ulei
  Chrysochlamys sp.
* Clusia 2 sp.
  Havetiopsis
  Marila
* Rheedia 3 sp.
* Symphonia globulifera
  Tovomita stylosa
  Tovomita 3 sp.
* Vismia 3 sp.

Hippocrateaceae

Cheiloclinium 2 sp.
Other: 2 sp.

Lacistemaceae

Lacistema aggregatum
Lozania

Lauraceae

18 sp.

Lecythidaceae

Cariniana
Couratarti
Grias
Other: 1 sp.

Leguminosae

* Acacia
  Andira
* Bauhinia 4 sp.
  Calapogonium coerulium
* Calliandra amazonica
* Cassia fruticosa
* Cassia reticulata
* Cassia 4 sp.
  Cedrelinga catenaeformis
  Centrolobium
* Copaifera
* Dalbergia
  Dioclea
* Dipteryx
* Enterolobium
* Erythrina ulei
  Hymenolobium
* Hymenaea
  Inga 25 sp.
* Lonchocarpus
* Machaerium
  Macrolobium 2 sp.
* Mucuna rostrata
* Ormosia coccinea
* Ormosia 2 sp.
* Parkia
* Phaseolus
* Piptadenia
* Pithecellobium macrophyllum
* Pithecellobium 3 sp.
* Platymiscium
* Pueraria phaseoloides
* Rhynchosia
  Schizolobium parahybum
* Stryphnodendron
  Swartzia
* Tachigalia 4 sp.
  Vatairea
  Other: 13 sp.

Loganiaceae

* Potalia amara
* Strychnos tarapotensis
* Strychnos toxifera
* Strychnos 2 sp.

Loranthaceae

* Psittacanthus
Other: 2 sp.

Lythraceae

Adenaria floribund
* Cuphea

Malpighiaceae

* Bunchosia
Stigmaphyllon
* Tetrapteris

Malvaceae

* Malvaviscus
* Sida

Marantaceae

* Calathea contamanensis
* Calathea altissima
* Calathea lutea
* Calathea micans
* Calathea 5 sp.
Hyleanthe
Ischnosiphon 5 sp.
Monotagma 5 sp.
Saranthe 1 sp.

Marcgravaceae

Marcgravia
Souroubea
Other: 1 sp.

Melastomaceae

Adelobotrys
* Arthrostema
Clidemia 7 sp.
Leandra
Maieta
Miconia aulocalyx

Melastomaceae, cont.

Miconia nervosa
Miconia paleacea
Miconia 15 sp.
Mouriri myrtilloides
Mouriri
* Tibouchina
Tococa 4 sp.
Topobea
Other: 20 sp.

Meliaceae

* Cabralea
* Cedrela
* Guarea pterorachis
* Guarea 6 sp.
* Trichilia 7 sp.

Menispermaceae

Anomospermum 2 sp.
* Chondodendron tomentosum
* Cissampelos
Other: 6 sp.

Monimiaceae

* Siparuna 4 sp.

Moraceae

* Brosimum alicastrum
* Brosimum 2 sp.
* Castilla
* Cecropia sciadophylla
* Cecropia 3 sp.
* Chlorophora tinctoria
Coussapoa
Ficus insipida
Ficus maxima
Ficus paraensis
* Ficus yoponensis
* Ficus 8 sp.
Narcleopsis 2 sp.
* Perebea 2 sp.
* Poulsenia armata
Pourouma minor
Pourouma 3 sp.
Sorocea
Other: 2 sp.

Musaceae

* Heliconia 3 sp.

Myristicaceae

* Dialyanthera otoba
* Iryanthera 2 sp.
* Virola sebifera
* Virola 7 sp.

Myrsinaceae

* Ardisia
Parathesis
Rapanea
Stylogyne
Other: 3 sp.

Myrtaceae

Calyptranthes 2 sp.
* Eugenia 2 sp.
Myrciaria 2 sp.
Other: 18 sp.

Nyctaginaceae

* Neea 3 sp.

Ochnaceae

Cespedezia 2 sp.
Ouratea 2 sp.

Olacaceae

* Heisteria

Onagraceae

Ludwigia 2 sp.

Orchidaceae

Phrygmipedium
Scaphyglottis
Other: 15 sp.

Oxalidaceae

* Oxalis

Palmae

Asterogyne
Astrocaryum
Bactris 2 sp.
Catoblastus drudei
Desmoncus
Euterpe
* Geonoma 7 sp.
Iriartea
Jessenia polycarpa
Mauritia flexuosa
Socratea
Synechanthus
Wettinia
Other: 2 sp.

Passifloraceae

* Passiflora coccinea
* Passiflora 2 sp.

Phytolaccaceae

* Phytolacca rivinoides

Piperaceae

* Peperomia 4 sp.
* Piper 15 sp.
* Pothomorphe

Podocarpaceae

Podocarpus

Polygalaceae

* Polygala 2 sp.
* Securidaca

Polygonaceae

* Coccoloba
Triplaris

Quiinaceae

Quiina

Rhamnaceae

* Gouania lupuloides

Rubiaceae

Alibertia 2 sp.
Alseis
Bertiera
Calycophyllum
* Cephaelis dolichophylla
* Cephaelis flaviflora
* Cephaelis tomentosa
* Cephaelis 4 sp.
* Condaminea
* Coussarea 2 sp.
* Faramea harmsiana
* Faramea occidentalis
* Faramea 3 sp.
* Genipa americana
* Geophila 3 sp.
* Hamelia patens
Isertia alba
Ixora
Macrocnemum roseum
* Palicourea guianensis
* Palicourea 2 sp.
* Pentagonia
Posoqueria
* Psychotria longifolia
Psychotria racemosa
* Psychotria 15 sp.
* Randia aculeata
* Randia sp.
Retinophyllum
* Sickingia
* Uncaria
* Warscewiczia
Other: 22 sp.

Rutaceae

* Zanthoxylum

Sapindaceae

* Allophyllus
* Cupania 3 sp.
* Paullinia 5 sp.
* Talisia

Sapotaceae

* Chrysophyllum
* Pouteria 15 sp.

Scrophulariaceae

* Lindernia

Simaroubaceae

* Picramnia
* Simarouba amara

Solanaceae

* Cestrum
Cyphomandra 2 sp.
Markea
* Physalis
* Solanum argentum
* Solanum 5 sp.

Staphyleaceae

* Turpinia

Sterculiaceae

* Byttneria
* Guazuma crinita
* Sterculia apetula
* Sterculia sp.
* Theobroma speciosum
* Theobroma sp.

Theophrastaceae

* Clavija

Tiliaceae

* Apeiba membranacea

Triuridaceae

Sciaphila

Ulmaceae

* Trema micrantha

Urticaceae

Boehmeria
* Urera baccifera
* Urera sp.

Verbenaceae

* Aegiphila 3 sp.
* Lantana camara
Petrea
* Vitex

Violaceae

Rinorea 3 sp.

Vitaceae

* Cissus sicyoides

Vochysiaceae

2 sp.

Zingiberaceae

* Costus scaber
* Costus 4 sp.
Dimerocostus
* Renealmia 4 sp.

Selaginellaceae

* Selaginella exaltata
Selaginella 5 sp.

* Ferns

* Adiantum 6 sp.
Asplenium 4 sp.
Dicranoglossum
Dicranopteris
Diplazium
Elaphoglossum 3 sp.
Gleichenia 6 sp.
Hymenophyllum
Metaxya
Pityrogramma
Polypodium 5 sp.
Saccoloma
Schizaea
Tectaria
Thelyptris
"Tree ferns" 2 sp.
Trichomanes 10 sp.
Vittaria
Other: 3 sp.

Part 2: Upper Mountain Slopes and Ridges (above 1500m)

Acanthaceae

* * Justicia
* Ruellia 2 sp.
* Other: 2 sp.

Amaryllidaceae

* * Bomarea 5 sp.

Annonaceae

* Guatteria
* Other: 1 sp.

Araceae

* * Anthurium 4 sp.
* * Heteropsis
* * Philodendron
* Spathiphyllum
* * Xanthosoma
* Other: 6 sp.

Araliaceae

* * Dendropanax
* Oreopanax 5 sp.

Aristolochiaceae

* * Aristolochia

Balanophoraceae

* 1 sp.

Begoniaceae

* * Begonia 8 sp.

Bromeliaceae

* Aechmea
* * Pitcairnea
* Other: 10 sp.

Burseraceae

* * Protium 2 sp.

Campanulaceae

* Burmeistra
* Centropogon 7 sp.

Caprifoliaceae

* * Sambucus

Capparidaceae

* 1 sp.

Chloranthaceae

* * Hedyosmum 3 sp.

Combretaceae

* Buchenhavia

Compositae

* * Gynura
* * Mikania
* * Senecio
* * Vernonia
* Other: 15 sp.

Coriariaceae

* * Coriaria thymifolia

Cunoniaceae

* * Weinmannia 3 sp.

Cyclanthaceae

* Asplundia 2 sp.
* Carludovica

Melastomaceae

Bellucia
Conostegia
Leandra
Miconia 21 sp.
Monochaetum
Other: 10 sp.

Meliaceae

* Guarea 2 sp.

Menispermaceae

* Abuta

Monimiaceae

* Siparuna

Moraceae

* Cecropia 4 sp.
Coussapoa
* Ficus 2 sp.
Pourouma minor
Pourouma sp.
Other: 2 sp.

Musaceae

* Heliconia 2 sp.

Myricaceae

* Myrica

Myrsinaceae

* Ardisia
* Rapanea
Other: 1 sp.

Myrtaceae

4 sp.

Onagraceae

Fuchsia 4 sp.

Orchidaceae

55 sp.

Oxalidaceae

* Oxalis

Palmae

Bactris
Euterpe 2 sp.
* Geonoma 3 sp.
Iriartia
Socratea
Welfia
Wettinia
Other: 5 sp.

Papaveraceae

* Bocconia

Passifloraceae

* Passiflora 3 sp.

Phytolaccaceae

* Phytolacca rivinoides

Piperaceae

* Peperomia 3 sp.
* Piper 7 sp.

Podocarpaceae

Podocarpus 2 sp.

Polygalaceae

* Monnina
* Polygala

Cyperaceae

2 sp.

Elaeocarpaceae

Sloanea

Ericaceae

Cavendishia
* Gaultheria
* Macleania
* Pernettya
* Vaccinium

Eriocaulaceae

1 sp.

Euphorbiaceae

* Croton
Hevea
Hyeronima
Mabea
* Sapium
Other: 6 sp.

Flacourtiaceae

* Casearia
* Ryania

Gentianaceae

Tachia
Other: 1 sp.

Gesneriaceae

* Besleria 2 sp.
Columnea
Other: 9 sp.

Gramineae

Chusquea 3 sp.
Guadua
Other: 8 sp.

Gunneraceae

* Gunnera

Guttiferae

* Clusia 4 sp.
Tovomita 2 sp.
* Vismia
Other: 1 sp.

Juglandaceae

* Juglans

Lauraceae

* 2 sp.

Leguminosae

* Cassia
* Desmodium 2 sp.
Inga 2 sp.
* Pithecellobium

Loranthaceae

* Psittacanthus

Magnoliaceae

* Talauma

Malvaceae

* Pavonia
Other: 1 sp.

Marantaceae

2 sp.

Marcgraviaceae

Norantea
Other: 1 sp.

Rosaceae

Rubus

Rubiaceae

Alibertia
* Cephaelis
* Conchona 2 sp.
* Coccocypselum
* Condaminea
* Coussarea 2 sp.
* Faramea 2 sp.
Hoffmannia
Nertera
* Palicourea
* Psychotria 5 sp.
Other: 6 sp.

Sapindaceae

* Allophyllus
* Cupania

Sauraniaceae

* Saurauia 4 sp.

Scrophulariaceae

* Calceolaria
* Castilleja

Smilacaceae

* Simlax

Solanaceae

* Cestrum
* Solanum 7 sp.

Sterculiaceae

* Guazuma crinita

Theaceae

Freziera
Other: 1 sp.

Ulmaceae

* Trema micrantha

Umbelliferae

* Hydrocotyle
Other: 2 sp.

Urticaceae

* Pilea 3 sp.
Pouzolzia
* Urera baccifera
* Urera caracasana

Violaceae

* Viola

Vitaceae

* Cissus

Vochysiaceae

1 sp.

Zingiberaceae

* Costus 3 sp.
* Renealmia 2 sp.

Equisetaceae

* Equisetum

Selaginellaceae

* Selaginella 3 sp.

* Ferns

Tree ferns 6 sp.
Other: 20 sp.

APPENDIX G

FORESTRY POTENTIAL IN THE PALCAZU VALLEY, PERU

Dr. Gary S. Hartshorn

CONTENTS

1. SUMMARY

The forestry specialist evaluated the forestry potentials of the Palcazu valley for USAID during a three week visit to Peru in July - August, 1981. Recent, independent forest inventories by ONERN and La Molina indicate average timber volume of 91-97 m^3/ha. La Molina's estimate of 30-40% commercial timber is thought to be more reliable than ONERN's 60% estimate. The field identification of tree species is particularly weak, hence it will require substantial improvement in order to maximize the appropriate utilization of the many local tree species, as well as ecologically sound forest management. The forest types defined in both inventories are based strictly on physiography.

The La Molina and PEPP forest management plans are still too incomplete for evaluation. PEPP's initial efforts toward development of a forest colonization program seem to be well-conceived and realistic. La Molina's brief contract period may not permit them to adequately consider and evaluate non-traditional forest management possibilities. However, La Molina does have considerable cost and value data that will permit the necessary economic analysis of forest management and exploitation proposals.

Deforestation of the Palcazu valley for pasture establishment is currently the most serious environmental impact. Virtually all of the timber is cut and burned during the conversion to pasture. Even the Amuesha are participating in cattle ranching as the majority no longer practice shifting cultivation. The attempts to establish pasture on unsuitable lands are causing serious site degradation such as erosion and loss of fertility.

The development of production forestry based on management for sustained yield will have some environmental impacts, particularly on shade-tolerant forest species; however, the impacts will not be nearly as severe as those associated with forest conversion to agriculture or pasture.

Recommendations for natural forest management include selection system for the most restrictive production forest sites, agroforestry on the best production forestry sites, and clear-cut system on the intermediate production forest sites. Essentially all of the Cordillera de Yanachaga and the San Matias escarpment should be kept as protection forests. The selection system should be used on the white sand soils to favor stand improvement of rubber and tornillo trees and also on the steep slopes of the high hills. The production forest system recommended for the steep, but low hills, is a rotational series of narrow, clear-cut strips with natural regeneration.

2. INTRODUCTION

The Pichis-Palcazu Special Project (PEPP) was created in 1980 by President Fernando Belaunde to develop the "Selva Central". Because of its proximity to Lima (300 km of all-weather road over the Andes), the Selva Central is often spoken of as the bread-basket for Lima. Indeed, large quantities of fruits such as citrus, papaya, avocado and pineapple are trucked to Lima from the Chanchamayo valley. The more easterly valleys of the Palcazu and Pichis rivers lack road communication with the exterior. PEPP's primary objective is to stimulate development of the Pichis, Palcazu and the more northerly Pachitea valleys.

Road building is the primary mechanism for developing these valleys. The principal road from Villa Rica through Puerto Bermudez to its junction with the Pucallpa-Tingo María highway at Km 86 will form part of the marginal highway-- President Belaunde's 30-year dream of a north-south highway in the Peruvian Amazon. Primary and secondary penetration roads will open up these valleys to colonization and "advance the agricultural frontier".

USAID has chosen the small Palcazu valley for a possible development assistance loan that would finance the construction of a spur road the entire length of the Palcazu valley. Congressional regulation 216 stipulates that the environmental consequences of AID-financed activities are to be identified and considered by AID and the host country. AID has contracted a team of environmental specialists to conduct an environmental assessment (EA) of the Palcazu component of PEPP, as well as assist the local AID mission with project design. This individual report is but one of many that will be synthesized into the EA.

3. TERMS OF REFERENCE

The purpose of an EA is to provide AID and host country decision makers with a full discussion of significant environmental effects of the project. The EA should include alternatives that would avoid or minimize adverse effects or enhance environmental quality so that the expected benefits of development objectives can be weighed against any adverse impacts upon the human environment or any irretrievable commitment of resources. In addition to the general purpose of an EA, specific terms of reference for the forestry specialist are:

a) Evaluate existing forest inventories

b) Evaluate forest management proposals

c) Predict environmental impacts, particularly on threatened or endangered species and biotic communities, of production forestry development.

d) Recommend production forestry methods that will ensure sustained yield production and environmental protection.

e) Make recommendations for reforestation, if and where advisable.

In the interval between preparation of the initial scope of work for the EA and implementation of the EA, PEPP contracted major forestry components to the National Agrarian University (La Molina). Since the La Molina report is not due until the end of September, it is not possible to evaluate here the La Molina conclusions and recommendations for forestry in the Palcazu valley. Nevertheless, Ing. Jorge Malleux graciously reviewed for this consultant the La Molina work and permitted use of some preliminary data and maps.

4. CONSULTANT ACTIVITIES

The forestry specialist was in Peru from 21 July to 11 August, 1981, for a total of eighteen workdays. A brief listing of activities follows:

July	21	International travel to Lima
	22-23	Lima: preparatory meetings with AID, PEPP, ONERN, EA team
	24	Travel to San Ramón
	25	Travel to Villa Rica with EA naturalists
	26	Ecological inspection along road to Km 61
	27	Ecological inspection of Cordillera de Yanachaga via Muller logging road
	28	Map interpretation in Oxapampa, travel to San Ramón
	30	Travel to Lima; meetings with EA team, PEPP, IGM
	31	Lima: meetings with AID, La Molina, EA team
Aug.	1	Travel to Iscozacín
	2-6	Inspect forests, chacras, soils in Iscozacín region
	7-8	Travel to San Ramón and Lima; report preparation
	9	Complete report
	10	Meetings with AID, PEPP, INFOR, EA team
	11	Departure from Peru

5. FOREST INVENTORIES

Two useful inventories of the Pichis-Palcazu valleys are or soon will be available: the National Office for the Evaluation of Natural Resources (ONERN) completed in 1980 a semi-detailed timber inventory (0.34%) and forest typing; with funding from the Ministry of Agriculture for a national forest inventory, La Molina's forestry department recently completed an independent inventory (0.25%) of the Pichis-Palcazu forests. In both the ONERN and La Molina inventories, forest types are defined strictly on the basis of physiography, with percent slope as the primary criterion. Lower terrace, upper terrace, low hills, medium hills and high hills are the physiographic units recognized for the valley floor; the flanks of the Cordillera de Yanachaga and San Matías escarpment are classified as protection forests. ONERN labeled each physiographic unit by the common names of the three most abundant tree groups.

The ONERN and La Molina inventories are fairly similar in the totals given for alluvial terraces and low hills-- the two most abundant physiographic units in the Palcazu valley. Both inventories excluded the rugged Cordillera de Yanachaga and the San Matias escarpment.

Although the two independent inventories are remarkably close in the average volume of timber in the Palcazu valley (91 and 97 m^3/ha), there are appreciable differences in the volume rankings of tree names.

Considering the top ten tree names in each forest type, there is only 60% similarity between the two inventories of lower terraces, upper terraces and low hills. Five La Molina tree names listed in the top three per forest type do not appear in ONERN's top ten tree names; similarly, four of ONERN's top three tree names do not occur in La Molina's top ten tree names.

Most of the differences in rankings between the ONERN and La Molina inventories are probably due to poor and sloppy identification of trees by local tree finders (materos). The forestry specialist could not find a local matero in the Iscozacín region who could name even the common trees. That the ONERN inventory of the Palcazu valley lists a total of 129 tree names (of which 21 were unknown) is indicative of the meager local knowledge of trees. The broad, generic use of common names contributes to the low number of tree names listed; only 35% of the 23 names that comprise the top ten lists refer to a single species (e.g. tornillo = Cedrelinga catenaeformis). Many common names such as cumala, machimango, mashonaste, réquia, and shimbillo refer to several species in one genus or in two closely-related genera. Some common names like caimitillo, moena and pashaco are used at the family level. The common name pashaco is applied to four genera in the Mimosaceae and to one genus in the Caesalpiniaceae.

The slopy application and lack of specificity of common names masks considerable heterogeneity in wood quality. The forestry specialist concurs with both inventories indicating the abundance of shimbillo (Inga spp.) in the Palcazu forests, yet he saw few Inga spp that attain canopy size and have quality wood. The absence of tangarana de altura (Tachigalia spp. and Sclerolobium spp) from the top ten lists raises the question if the local materos lumped these abundant trees with shimbillo? In the opinion of the forestry specialist, the preponderance of broad tree groups such as caimitillo, moena and shimbillo in the inventory data makes the evaluation and assignment of potential wood uses largely an academic exercise.

6. FOREST MANAGEMENT

Written proposals for forest management do not yet exist. ONERN's report on the Palcazu forests is limited to timber inventory and forest types. PEPP is in the process of developing a forest colonization program for the southern part of the von Humboldt National Forest in the Pachitea valley. At this preliminary design stage it is envisioned by PEPP that a colonist will be assigned a rather sizeable block of forest to exploit and manage on a sustained-yield basis. Because of the low volume of quality timber and the lack of adequate infrastructure, PEPP is initially considering 250 ha will be needed to support a colonist family of six. PEPP is quite aware that infrastructure, forest management and timber market improvements can contribute to a substantial reduction in the per family requirement for land. The important point is that PEPP has started with a realistically conservative estimate of 250 Ha/family and is exploring various ways to lower the size of unit area required.

As part of the PEPP contract, the La Molina forestry department is to develop a forest management and exploitation plan for the Pichis-Palcazu region. According to Ing. Malleux, La Molina will evaluate the types of forest industries suitable for the region and plan the orderly exploitation of the forest resources. Both Ing. del Aguila, executive director of PEPP, and Ing. Malleux assured the forestry specialist that La Molina is considering many traditional and non-traditional forest management systems in order to assure a sustained yield of forest products from the region. Several bits of information suggest to the forestry specialist that the final report from La Molina will recommend traditional exploitation and management systems for the region. The rapidly approaching deadline (September 30) on the PEPP-La Molina contract will probably not permit the evaluation and development of non-traditional management systems for the Palcazu forests. Several logging companies are purported to hold large timber concessions in the Palcazu valley. Oxapampa loggers are already planning and pushing logging roads over the Cordillera de Yanachaga into the Palcazu valley.

La Molina has collected considerable cost data on logging, transport and processing for stratified wood uses such as sawn lumber, parquet, decorative paneling, etc. When available, the yield, cost and value data should be adquate for an economic analysis of forest exploitation, forest colonization, sustained yield forestry, etc. in the Palcazu valley. The La Molina projection of a 40-year rotation for natural forest management is probably conservative, but in the absence of data it is difficult to be more precise. ONERN's estimate (60%) of Palcazu timber presently commercial is nearly twice that of La Molina. The forestry specialist feels that the La Molina estimate of 25-35 m^3/ha of commercial timber is the more realistic of the two.

7. ENVIRONMENTAL IMPACTS

The increasing conversion of forest to pasture now occurring in the Palcazu valley is causing the wholesale loss of forest ecosystems. Actual and projected losses of species and communities are addressed separately by EA naturalists. Because of inaccessibility to markets, most of the timber is burned in the process of pasture establishment. Even such quality woods as Brazilian rosewood (Darlbergia aff. tucurrensis) and tornillo are cut and burned to make way for pastures on land that is only suitable for production forestry. The removal of forest and conversion to pasture of the steep slopes on the low hills is already causing considerable environmental degradation. These soils are particularly low in fertility and quite susceptible to erosion. Slumping of soils and surface runoff are quite prevalent in the overgrazed pastures in the central valley. A modest, dry-season rain of less than 20 mm turned the crystal-clear Rio Iscozacin to muddy brown.

Widespread deforestation of the Palcazu valley will significantly alter the hydrologic regime of the valley's rivers. Conversion from forest to non-forest reduces the moisture retention capacity of the soil, hence dry-season river flow will be less. During the rainy season, increased and more rapid runoff from deforested slopes will cause higher and more devastating floods of the lower terraces. In addition to the obvious risks to settlements and agricultural crops, increased flooding may also have a negative impact on the local fish resources (see the separate report by Peter Bayley).

The predilection to rapidly expand pastures at the expense of the forest also reaches the native Amuesha communities. The Amuesha in

Buenos Aires and Villa America told the forestry specialist they no longer practice shifting cultivation; they now prefer to convert their yuca fields to pasture rather than abandon them to secondary vegetation. The very serious consequence of the conversion of poor soils from forest to pasture is the deterioration of these sites to the point where they are no longer an economically-renewable resource. It is highly doubtful that degraded pastures can be economically converted to permanent crops; they may not even be suitable for commercial tree plantations.

The rapid conversion of forest to pasture by Palcazu residents, whether they be second-generation German immigrants or native Amuesha coupled with substantial influx of colonists, may significantly deplete the forest resources of the Palcazu valley-- even before the loggers have their chance. Effective mechanisms are urgently needed to protect the forest ecosystems on the flanks of the Cordillera de Yanachaga and to exploit the Palcazu valley in a rational and sustainable manner.

The development of production forestry based on management for sustained yield will also have some environmental impact that increases with the severity of the management system. A selective logging system will have insignificant environmental impacts. A forest management system based on clear-cutting and natural regeneration will have much more substantial impacts on the forest communities. Natural regeneration in clear cuts will maintain an appreciable percentage of the shade-intolerant tree species; however, most shade-tolerant tree species will have their population severely reduced. Technically sound production forestry based on natural forests should permit the persistence of adequate, albeit low population levels of native forest species. That is certainly more than can be said for the conversion of forest to agriculture or pasture.

8. RECOMMENDATIONS FOR FOREST MANAGEMENT

Prior to recommending specific, ecologically-sound management systems for the production forests of the Palcazu valley, it is necessary to comment upon the classification of production forests. It is the firm opinion of the forestry specialist that both ONERN and La Molina have considerably overestimated the agricultural capability of the Palcazu valley. The ONERN and La Molina land-use capability maps are being evaluated by other members of the EA team, hence it is not necessary to detail here the discrepancies. A few examples will suffice: (A) Some of the low but steep hills between Iscozacín and Buenos Aires are classified by ONERN as suitable for permanent crops (C2s) whereas La Molina classifies them for agroforestry. In the opinion of the forestry specialist, their maximum sustainable use is in production forestry (B) On the partially-dissected upper terrace between Villa America and the colonist-clearing halfway to Iscozacín, ONERN classifies it as C2s and La Molina calls it agricultural land. The area is actually a mosaic of level white sand soils and sloping red clay. The former is extremely deficient in nutrients and must remain in forestry if even the slightest productivity is to be sustained. The latter appears to be suitable for agroforestry or permanent crops, but only if the conversion is direct.

8.1. Selection System

The selective felling of a small percentage of the standing volume is most appropriate on fragile sites such as on the steep slopes of the high hills or the white sand soils on the upper terrace or found occasionally as flat, poorly-drained areas among the low hills. This forest management system should be specifically applied to the natural stands high in rubber trees, such as west of Villa America and south of Shiringamazú. Since tornillo is also fairly abundant on these poor soils, the selective cutting of undesirable species should be done to favor the natural regeneration of rubber and tornillo, or other desired species. PEPP should place a tropical silviculturist in the Palcazu valley to work with the native communities in developing the appropriate selection system for rubber and tornillo.

At the other topographic extreme, on the steep slopes of the Cordillera de Yamachaga, silvicultural experiments should be conducted to develop an ecologically-sound selection system to favor natural regeneration of nogal (*Juglans neotropica*) and other valuable tree species. It is highly probable that cable logging may be the only environmentally-sound means of timber extraction form such rugged terrain.

8.2. Agroforestry System

In the opinion of the forestry consultant, permanent crops or agroforestry may be suitable land-use of the clayey red soils on the dissected upper terrace. Because of the surfeit of timber and lack of crop experience in the valley, agroforestry is the most difficult and uncertain system to recommend. The most likely tree candidate for agroforestry is tornillo; however, little is known about its silvics and even less about its compatibility with crops. Nitrogen-fixing leguminous trees would be particularly desirable in view of the generally low soil fertility. Nitrogen-fixing leguminous trees (e.g. *Erythrina*) should be considered in the pastures.

8.3. Clear Cut System

A forest management system of small, rectangular clear- cuts should be the most ecologically-sound and economically feasible means of sustained production forestry on the steep-sloped low and medium hills. This system is adaptable to concessionary forestry or forest colonization. In either case it is highly dependent on good infrastructure and diversified markets such that the maximum amount of wood can be harvested per unit area. Since the Peruvian government and AID are interested in colonization of the Palcazu valley, particular emphasis should be given to the potentials of forest colonization based on a sustained yield of forest products. The La Molina economic data can be used to estimate the annual cost necessary to sustain a colonist family. Prorating the annual cut to a 30-40 year rotation will give a rough estimate of the appropriate land holding per colonist family. It will also be necessary to include sufficient land for the colonist to practice subsistence agriculture.

Inspection of clear-cuts in mature forest indicates there is very good natural regeneration of many timber species, such as Cedrelinga , Caryocar, Laetia, Virola, Terminalia, Simarouba, etc. Natural regeneration is much better in unburned clear-cuts than in burned clear-cuts or in abandoned fields. At this time, it is recommended that the clear-cut management system should not permit burning or cropping in the clear-cuts; however, research in natural forest management should be initiated as soon as possible to verify or modify these recommendations. The production forestry system based on natural forest management should be carefully designed to ensure adequate natural regeneration. Adequate seed supply into the narrow clear-cut from adjoining mature forest is best obtained by leaving wider strips of mature forest between successive clear-cuts. Ideally, a rectangular clear-cut of width "X" will be initially buffered by mature forest "3" in width. After the colonist has completed the first set of annual clear-cut strips (in preferably not less than 8-10 years), he returns for a second set of x-wide clear-cuts from the center portion of the 3X of mature forest.

The clear-cut system of natural forest management maximizes the recuperative and productive capacity of the forest, while minimizing the costs of obtaining a second harvest. If the colonist desires to favor the growth of preferred species, the competitive balance in the regenerating forest can be adjusted by silvicultural treatments. It is important that any silvicultural treatments be delayed until the natural regeneration of trees has formed a closed canopy that has eliminated weeds. Usually the elimination of vines and undesirable trees can be done about three years after clear-cutting.

Natural forest management in the Palcazu valley will require major up-grading of local dendrology (= tree identification) capability. A major program in dendrology is fundamental to improving the knowledge of potential use of the wood, forest management and silviculture.

9. RECOMMENDATIONS FOR REFORESTATION

Degraded pastures on steep slopes should be reforested, but the surfeit of timber in the Palcazu valley makes it highly unlikely any private land owner will carry out significant reforestation. At the present time there are no economic incentives or reasons for commercial plantation forestry in the Palcazu valley. Degraded soils could be rehabilitated much more cheaply by simply abandoning them to secondary vegetation.

CONTENTS

1. SUMMARY CONCLUSIONS AND RECOMMENDATIONS FOR BASELINE HEALTH ASSESSMENT OF THE PALCAZU VALLEY

The Palcazu valley is faced with a severe shortage of basic health services. The serious health problems affecting the Palcazu include respiratory disease and enteritis, parasitic diseases, and hepatitis. The Ministry of Health is responsible for providing health care to the majority of the population; however, the centers are based primarily in urban areas. The outcome of this distribution is that the Palcazu, due to population density and accessibility, receive a marginal level of services, inadequate to meet the needs of the valley. Although the department of Junin, which includes the Palcazu, has 196 physicians, each providing care to approximately 4,457 patients, not one physician is presently providing care in the Palcazu.

The Palcazu valley is serviced by seven health posts, each staffed by a minimumly trained health promoter. Traditional health care is provided by curanderos and empirically trained midwives.

The Palcazu valley lacks:

- Sterile medical facilities
- Medication
- Skilled health personnel
- Basic sanitary facilities for potable water and disposal of human wastes
- Maternal and infant care
- Community education

- Training and supervision of health promoters
- System for identification and recording of health indicators

The Palcazu population is composed of three separate and unique populations: large ranchers of European descent, native Amuesha, and colonists from the Sierra and Coast. Each of these groups has its own specific type of health needs and mechanism for obtaining health services. The design of health services for the Palcazu must build upon existing service structures in order to guarantee community compliance in the practice of health promotion, disease prevention, and medical care.

The ranchers use the hospitals and physicians outside the valley for medical care and delivery of infants. They utilize the private airline SASA to transport them in and out of the valley. The native Amuesha communities use the health post system, in addition to curanderos and midwives. Because the colonist groups do not have well defined communities or a particular system for health provision, they rely on the health posts, curanderos, and self medication.

The rancher group uses modern health care for the majority of its needs. This group requires more immediate access to care provided by a well equipped and staffed facility in the valley. Such a facility would also benefit the native Amuesha and colonist groups. Historically, however, services provided by many of the health practitioners trained in modern concepts are not used by native groups. The reasons for this include:

- Alienation to providers
- Fear of modern medical practices
- Failure to understand concepts of modern medicine
- Conflict with traditional medical practices
- Inconsistency with cultural native beliefs.

Therefore, to encourage the native Amuesha to accept the modern facilities, the design and implementation of health care systems should involve the communities as much as possible, while also training curanderos and midwives (who presently hold the trust of the Amuesha) in modern medical practice.

In 1979, AID presented a number of recommendations for the implementation of a project for the Extension of Integrated Primary Health Care to Rural Areas of Peru. This comprehensive project incorporates program components which are extremely appropriate to the needs of the Palcazu valley. However, due to limited resources and to population density of jungle communities, such as the Palcazu, these recommendations were not adopted in this region. With the present plans for development and proposed colonization effort in this region, however, it is highly recommended that the extension program be expanded to include the Palcazu region.

The first phase of the Palcazu development will be construction of the road. Road construction personnel are exposed to and precipitate a number of health problems, including leishmaniasis, yellow fever, malaria, venereal diseases, alcoholism, accidents, and violence. It is, therefore, recommended that provision of health care for construction personnel should include: emergency medical care, screening and treatment for several diseases, immunization against yellow fever, and provision of prophylactic medication against malaria.

Colonization of the Palcazu entails the risk of the following:

- Introduction of diseases, such as bartenollosis, chagas disease, through infected individuals and/or infested belongings and animals

- Exacerbation of health problems associated with poor sanitation and lack of hygienic practices, such as parasitosis, hepatitis, and typhoid

- Aggravation of dormant conditions, such as tuberculosis and respiratory infections by the climate of Selva

- Development of malaria and yellow fever by removal of ecological controls on mosquito vectors while providing access to humans in non-screened dwellings.

Recommendations for control and prevention of disease in new colonists include:

- Screening and treatment of all colonists entering the area

- Immunization of colonists entering the area

- Spraying of belongings and animals to kill off vermin

- Treatment or destruction of infected animals

- Provision of health services to treat this new population

- Assistance in construction of latrines and potable water systems for areas of proposed development

- Education of colonists in hygienic practices

2. INTRODUCTION

The health of the Palcazu is not static; it is a condition affected by human and environmental factors and the balance between these factors over time. Factors specific to the Palcazu Valley and its purposed development include:

- Demographic characteristics of present and incoming populations
- Endemic diseases of the Ceja de Selva
- Endemic disease of the Sierra and Coastal Regions
- Disease Factors of the Ceja de Selva
- Reservoirs of disease
- Health resources of the Palcazu
- Sentinel Health Reporting Mechanisms

This report is presented in three sections:

- Baseline Health Status Assessment
- Factors introduced by development
- Recommendations

3. BASELINE HEALTH STATUS ASSESSMENT

The health of the various Palcazu communities is a reflection of the balance between human and environmental factors and the evolution of controls which either mitigate or exacerbate disease in these populations. Nutrition, sanitation, endemic disease vectors and reservoir, and physical and human health resources are the factors which shall be used to describe the baseline health status of the Palcazu.

3.1. Nutrition

The Palcazu communities are composed of three specific groups: large ranchers, native Amuesha, and colonists.

The nutritional status of the rancher population is good. The diet of this group is high in protein, consisting of dairy products in the form of cheese, milk and butter. Other protein sources include fish, beef, chicken, pork, and meat from non-domestic animals. Carbohydrate sources include rice yuca, plantain, breads, noodles, sugar, and potatoes. This diet is supplemented with salad, vegetables and fruits. The sources of these foods are their own ranches, the selva, the native Amuesha, and imports from Lima, Chanchamayo, and Tarma (Miller, etc.al., 1981).

The diet of the Amuesha is high in carbohydrates including yuca plantain, rice, and bananas. The protein intake is limited to available fish and non-domestic animals. Rarely does the diet include domestic stock or canned fish. The consumption of dairy products is limited to canned milk; other dairy products, such as cheese and butter, are not included in the diet. The result of this diet is a considerable rate of low grade malnutrition. Two separate reports by student nurses from the Hospital at La Merced in 1978 and 1979 which examined the various communities serviced by the health post sanitario, noted malnutrition to be a major problem within the native communities. As part of the 1979 report, and evaluation of 120 children ages one to six years found fifty percent to have normal nutritional status, forty percent to have low grade malnutrition, and ten percent have medium grade malnutrition. Miller and Martinez state in their study of the Palcazu that the "most significant causes of death were diseases related to malnutrit..on" (Miller et.al., 1981). From interviews at health posts in Loma Linda, Puerto Mairo, and Iscozacín, malnutrition was determined to be a priority problem.

Dietary practices of Amuesha communities of the Adventist faith have contributed to the problem of malnutrition and the increase of diseases such as tuberculosis. Dr. Karl Pandus, of the Clinica Cahuapana (medical post on the River Pichis) stated that Amuesha from the communities of Loma Linda and Laguna, two Adventist Communities, came to his clinic for treatment and were diagnosed as having tuberculosis.

The nutritional status of the colonist population from the Sierra and Coast in the Palcazu is related to their economical status. Colonists with capital can afford to buy a great deal of their food from stores such as those at Iscozacín and Puerto Mairo and from the Amuesha. They supplement their diet with fish from the river and occasional chicken. Cattle are raised specifically for market. The nutritional status of the less prosperous colonist is lower than that found among the Amuesha. This is due in part to their preference for the food of the Sierra and their limited access to these foods (Martinez, 1969), as well as their non-preparedness to cultivate, collect, and prepare the foods of the Selva. Dr. Pandus estimated that approximately ten percent of the population of the Pichis suffered from varying severities of malnutrition, and that colonists constituted the greatest proportion of these cases.

Health post activities of the Palcazu include developing a plan for working with the school system to improve nutritional status within the valley. However, this program is still not fully defined or effective in dealing with the problem of availability.

SUMMARY

Malnutrition is a multifold problem. Problems caused by malnutrition include:

- Physical debilitation
- Anemia

- Increased susceptibility to disease
- Complications from less manifest diseases, such as measles, chicken pox, and common colds
- Maternal and infant morbidity and mortality in the pregnant mother and prenatal infant, including impaired mental development
- Aggravation of tuberculosis and pneumonia into epidemics in weakened populations (Goodland et. al, 1975).

In conclusion, it can be stated that the level of malnutrition within the Palcazu ranges from good for the large ranchers, prosperous colonists, and native communities in areas with good game reserves, to poor for the ill-equipped colonists who produce or collect little of their food and lack the economic capacity to purchase adequate amounts of protein and other food stuffs to maintain a healthy level of nutrition.

As development of the valley increases, game and fish will decrease, resulting in a greater dependency on the market economy among the Amuesha (Miller et. al, 1981). This reduction in the available protein supply will intensify the problem of malnutrition and the associated health consequence within the existing communities.

3.2. Sanitation

Sanitation is a major problem in the Palcazu. Few latrines or areas are designated for sewage disposal, and there are few sources of potable drinking water. Basic hygienic practices are absent.

Waste Disposal

Urban Iscozacín, the most developed area in the valley, has latrines for approximately 40 percent of the population. With the exception of ranches, such facilities are rare or completely absent outside this area.

Garbage disposal in and around the homesite and village areas provides a breeding ground for flies and other transmission vectors. Wastes from animals around homesites are a reservoir for a spread of leptospirosis (conversation with Dr. K. Sultzer). Other resulting conditions from inadequate waste disposal include typhoid, hepatities, gastroenteritis, and shigellosis.

Potable Water

In the Palcazu, potable water is not readily available for drinking and/or washing clothes. Water is rarely boiled. Sources of water contamination include: latrines which empty directly into the river, flushing of wastes from slaughter houses, garbage and defecation along the river banks. These conditions are exacerbated during the dry season, resulting in periodic outbreaks of typhoid in various communities.

Hygienic Practice

The rancher population uses hygienic practices to a greater extent than the colonist or native groups. They have systems for sewage disposal, showers, and they boil water for drinking and washing.

The native Amuesha bathe and wash their clothing in the rivers. Latrines are rare, with the exception of those constructed by the village promoters. Boiling water and washing hands are not common practices. This lack of sanitation contributes to the endemic levels of parasitosis and gastrointestinal disorders. Present health conditions among the Amuesha are directly associated with their recent practice of living in nucleated communities to meet the requirement of the Peruvian Education System and land titling. Before this, the Amuesha practiced a dispersed lifestyle, which entailed none of the problems of potable water and sewage disposal present in more concentrated communities. The health problems of the Amuesha will increase in proportion to growth of the village population, further adding to the problem of the reinfection and distribution of disease.

Colonists from the Sierra maintain hygienic practices which are non-adaptive to the Selva. These include:

- lack of personal hygiene, such as bathing or washing clothes
- wearing the heavy clothes of the Sierra
- indiscriminate disposal of excrement in and around housing sites

These practices cause high rates of skin disorders, scabies, hepatitis, and typhoid within the group (Dr. Pandus)

SUMMARY

The communities in the Palcazu are severely lacking in systems for disposal of human wastes, garbage, and animal wastes. Sources of potable drinking water are unavailable, and hygienic practices are limited. These conditions are the causes of hyper-endemic levels of parasitosis, hepatitis, gastroenteritis, leptospirosis, as well as periodic epidemics of typhoid. These diseases are the main contributors to the high rates of anemia, malnutrition, infant morbidity and mortality, and premature death in the population of the Palcazu.

3.3. Endemic Disease Vectors and Reservoirs

A great number of diseases are endemic or have a great potential for development and distribution throughout the Pichis and Palcazu valleys. Table 1 lists these diseases, infectious agents, reservoirs and modes of transmission, and presence within the area. Table 2 is an abstract of 10,050 patient consults treated at the health post in Iscozacín. The most prevalent disease in the Palcazu is parasitosis, which is perpetuated by the lack of sanitary conditions described in the previous section.

Parasitosis

Occurs in 100 percent of the Palcazu population. An analysis of records at the health post of Iscozacín found that 25 percent of all consults, 45 percent of all hospitalizations, and 50 percent of the deaths reported were from parasitosis and associated complications.

Tuberculosis

Is the second most prevalent disease. Dr. Pandus stated that from an examination of 2,000 patients, a large proportion of which lived in the lower Palcazu valley, 45 cases of tuberculosis were confirmed. Alberto Robalino, sanitario at the health post at Iscozacín, estimated that there were at least 50 cases of untreated T. B. in the communities surrounding his post.

Leishmanaisis

Is common in the Palcazu with an estimated incidence rate of two to five percent in the current population.

Measles

Is a problem in both the Pichis and Palcazu, with periodic outbreaks occuring throughout the valley. In 1980, a measles epidemic in the Pichis resulted in 50 reported deaths in both infant and adult groups.

German measles

Was recently introduced into the Pichis by the children of a teacher from the Sierra. This disease causes severe birth defects in infants whose mothers are exposed during the first three months of their pregnancy. An epidemic of German measles would have a disastrous effect on the population of the Palcazu where a high proportion of the population are pregnant.

TABLE 1

Principal communicable diseases of Palcazu

Disease	Infectious agent	Mode of Transmission	Reservoir	Presence within area
Amebiasis	Entamoeba (Protozoan)	Oral; fecal-oral	Human	Common
Ancylostomiasis (hookworm)	Necator and Ancylostoma (Nematodes)	Fecal contact	Human	Abundant
Ascariasis	Ascaris (Nematode)	Fecal contact	Human	Common
Encephalitis	Arbovirus	Arthropod (?)	?	Rare
Leishmaniasis (Cutaneous)	Leishmania (Protozoan)	Lutzomyia (Sandfly)	Wild Animals	Common
Leprosy	Mycobacterium leprae (bacterium)	Direct contact	Human	Common
Malaria	Plasmodium (Protozoan)	Anopheles (Mosquito)	Human; monkeys	Occasional
Pneumonia	Diplococcus (Bacterium)	Oral contact	Human	Common
Rabies	Virus	Bite of mammal	Mammals	Unreported
Strongyloidiais	Strongyloides (Nematode)	Fecal/Indirect	Human; dogs	Common
Syphillis	Treponema (Bacterium, Spirochaete)	Venereal contact	Human	Increasing
Trypanosomiasis (American) ("Chagas Disease")	Trypanosoma (Protozoan)	Reduviid (Bug)	Human; animals	Unreported
Tuberculosis	Mycobacterium tuberculosis (bacterium)	Airborne/oral	Human	Common
Viral Fevers	Arbovirus	Arthropod (?)	?	Widespread
Yellow Fever	Arbovirus	Haemagogus (Mosquito), Aedes	Monkeys (Mosquito)	Occasional
Bartosellosis	Bartosella bacilliformis	Lutzomyia	Human	Unreported

(Source of Data: Control of communicable Disease in Man, Benenson, 1975)

TABLE 2

ABSTRACT OF ONE THOUSAND FIFTY PATIENT CONSULTS AND EMERGENCY TREATMENT OF THE ISCOZACIN HEALTH POST

June to December 1980

1.	Parasitosis	172
2.	Gastrointestinal distress	79
3.	Control of child health	67
4.	Bronchitis	65
5.	Foot infections	51
6.	Colds	26
7.	Asthma	24
8.	Urinary tract infections	23
9.	Rheumatism	21
10.	Suturing of wounds, treatment of infected wounds	21
11.	Fractures, disarticulations, and muscle strain	20
12.	Prenatal care	19
13.	Pharyngitis	18
14.	Inflammation of the ear	18
15.	Tonsilitis	16
16.	Stomach ulcers	14
17.	Diseases gums	13
18.	Measles	13
19.	Colic	12
20.	Conjuntivitis	11
21.	DC/TBC	11
22.	Vaginitis	10
23.	Allergic Dermatitis	9
24.	Birth control	9
25.	Herpes	7
26.	Hypertension	6
27.	Amenorrhea	6
28.	Anxiety	6

Whooping Cough

Occurs frequently in the two valleys. A recent epidemic in the Pichis infected five villages and an estimated 1000 people. Due to lack of treatment and pre-existing conditions, many of the cases persisted for six months or longer, causing malnutrition, anemias, and decreased resistance to other complicating diseases (Dr. Pandus).

Viral Hepitatis

Is highly endemic in the region.

Rabies

Has been determined as the cause of death of cattle in both valleys. However, to date no case of rabies in humans has been reported. Reservoir of the disease is the rabid bat population.

Malaria

Was not reported in either the Pichis or Palcazu. However, there were reports of outbreaks in the region around Chanchamayo. This area is the region through which the majority of the colonists will enter the Palcazu.

Yellow Fever

Is not presently apparent in the Palcazu, apparently as the result of a 1977 immunization campaign against yellow fever. The next campaign is scheduled for 1982. Currently in the Chanchamayo region, an outbreak of yellow fever has prompted an effort to immunize all persons entering the area.

Venereal Disease

Is becoming an increasing problem. The identified source of infection is merchants, lumbermen, and workmen from the Coast and Sierra. Miller reported that girls who left their communities for work in San Ramon, Lima and Villa Rica returned with venereal disease and spread it in their communities (Miller et. al, , 1981). Similar cases were reported in the Pichis and down river near Puerto Mairo.

Bartenellosis

Is an endemic disease of the Ceja de Selva in Peru. The mode of transmission is the same as that for Leishmanaisis: bite of the sandfly, <u>Lutzomyia</u> . To date, this disease is unreported in the Pichis and Palcazu, which may be due to inadequate diagnosis and reporting system. Bartonellosis may be introduced by incoming colonial groups.

SUMMARY

Findings of a preliminary examination of available records and interview with health promoters, doctors, and people within communities of the Pichis and Palcazu are:

- Parasitosis, tuberculosis, and hepatitis are prevalent
- Measles and whooping cough epidemics periodically occur, resulting in death from complications
- Malaria and yellow fever, even though not present, have a high potential, for development due to environmental factors, influx of individuals from infected regions, and a large non-immunized native and colonist population.
- Rabis is endemic in the bat population
- Venereal disease is becoming a problem with a great number of untreated cases and increased incidence, with the source of infection being merchants, workmen, and timber workers from outside the region

- German measles, chicken pox, colds, and influenza are presently entering the region with debilitating effects on indigenous populations.

CONCLUSION

Disease in both the Pichis and Palcazu valley is often unreported. The reasons for this include:

- Inaccessibility to medical care
- No equipment or personnel trained to perform diagnostic laboratory tests
- Non-utilization of available services
- Non-reporting of deaths
- Mis-diagnosis of disease

There is a great danger that epidemics will be brought in from regions outside the Palcazu, as in the case of venereal disease, measles, and whooping cough. The increase of indigenous populations, including ranchers, native Amuesha, and colonists, will place greater pressure on the valley's resources, removing natural controls on disease vectors while providing conditions which facilitate the development and distribution of disease.

3.4. Physical and Human Health Resources

There are 33 communities in the Palcazu valley: 15 native Amuesha communities with approximately 2,500 persons and 18 colonist communities with approximately 5,000 persons. (See Table 3). The native communities receive their care from eight health posts. Table 4 describes by age and sex the eight communities serviced by the health post at Iscozacín. Health posts are staffed by promotores (health promoters) from the community and are supervised by Señorita Patel in Huancayo. The colonial communities, which are less centralized and more dispersed, use the health post at Iscozacín.

TABLE 3

BREAKDOWN OF PALCAZU HEALTH POST RESOURCES BY COMMUNITY AND POPULATION

Native Communities	Population Data		Health Posts
	Families	Indiv.	
1. Yeullas- Yuncullas	20	123	-
2. San Pedro de Pichanas	43	182	1
3. Macha Bocas	12	60	-
4. Sta.Rosa de Pichanas	12	55	
5. Loma Linda	61	348	1
6. Puerto Laguna	21	120	-
7. Shiringamazu	63	249	1
8. Alto Iscozacín	26	130	-
9. Buenos Aires	30	174	-
10. Santa Rosa	21	98	-
11. 7 de Junio	104	522	1 (*)
12. Nueva Esperanza	37	177	-
13. Alto Lagarto	19	76	
14. Enock	18	101	-
15. Hauswald	11	52	-
Colonist Communities			
1. Caneco	30	150	-
2. Iscozacín	75	235	1
3. Chuchunas	25	125	-
4. Comparachimas	60	300	-
5. Río Palcazu	30	150	-
6. MazuHuaco	90	450	-
7. Ishpihuacazo	70	350	-
8. Isla Rota	30	150	-
9. San Juan	25	125	-
10. Esmeralda	50	250	-
11. Pto. Mairo	80	400	(*)
12. San Cristobal	80	400	-
13. Lagarto	50	250	-
14. Río Mairo	100	500	-
15. San Pedro	50	250	-
16. Huampumayo	50	250	-
17. Flor de un Día	20	100	-
18. Alto Lagarto	50	250	-

(*) Facility present but not operating

(Source of data: Miller et al, 1981, data from community census of Palcazu communities)

TABLE 4

AGE AND SEX BREAKDOWN (COLONIST AND AMUESHA) FOR EIGHT PALCAZU COMMUNITIES

	M	F	T	71	1	2	3	4	5	6-14	m	c	45-69	65+
Iscozacin	72	74	146	7	4	9	4	8	5	49	25	26	8	1
Iscozacin	61	42	103	4	4	8	2	3	3	23	22	17	14	3
Alto Iscozacin	64	56	120	8	3	7	3	4	3	22	29	14	12	5
Caneco	29	29	58	1	2	1	2	1	1	20	15	11	4	0
Buenos Aires	102	100	202	7	13	9	8	7	7	55	43	42	9	2
Sheringamazu	108	98	206	8	7	8	7	11	8	66	42	31	18	0
Laguna	65	61	126	7	4	9	8	4	6	41	24	22	5	0
Loma Linda	134	125	259	13	16	10	16	9	9	75	54	47	9	1
	635	585	1220	55	53	57	50	47	41	351	364	210	79	12

Source:
Records of Health Post at Iscozacin

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Health Services

Services provided by health posts include:

- Immunizations
- Cleaning and dressing of infections
- Suturing of minor wounds
- Setting fractures
- Pulling teeth
- Providing medications and vitamins
- Referral to the hospital at La Merced

All services are provided on a fee for service basis.

Promotores

Promotores for the seven operating health posts were given two years of technical training six years ago. Training provided did not include basic theory on human body systems, disease processes, and general health practices. Since their training six years ago, the promoters have not received additional training.

Physical Plant

Health post facilities at Iscozacín consist of an examination room, a store room, one bed for hospitalization, and a lavatory. This is the best-equipped of all the posts and serves as a coordination center for the other posts. The other posts visited had only one room, no running water, and a nearby latrine. All health posts lacked sterile conditions. Health posts are without refrigeration for storage of blood, plasma, or perishable medications. In communities with no health post, medical care is provided by untrained Patrones (ranchers) or curanderos. One

Patron near Puerto Mairo described treating his son for uta (Leishmanaisis) and performing surgery on a native for syphyllis. His source of information on diagnosis and treatment was a 1955 Medical Manual. He discussed his problem and that of the surrounding areas of access to medical care and his dependence on SASA (private air service) for access to care.

Maternal and Infant Care

Births are performed at home without the aid of the promotores. In 1980, out of 14 births registered at Iscozacín, only two uti ized the health post. The reasons given for this were lack of access, economic reasons, and education. Miller states that "the women are reticent to use health posts for obstetric and gynecological services because of embarrasment of being treated by men". (Miller et. al, 1981). This situation poses a greater problem for those communities in the case of venereal disease. One sanitario stated that in such cases he requires a nurse to provide diagnosis and treatment.

Prenatal Care

Prenatal care is not available in any Palcazu community. Miller states that the women of rancher families go to either La Merced or Lima for medical care or to give birth.

Immunization

Many immunization campaigns have been carried out in the Palcazu in recent years in communities served by health posts. In 1977 and 1978 yellow fever, typhoid, and BCG vaccinations were given to curb outbreaks in the communities. At that time, approximately 90 percent of the population in the area in and around Iscozacin received immunization, while only 70 percent of the population of the other health posts were immunized. The reasons given for non-compliance were fear and unfamiliarity of the people with the practice.

Children less than five receive immunizations against whooping cough, measles and polio. Compliance for vaccinating children is dependent on the discretion of the parent. In 1982, another yellow fever and BCG campaign is being scheduled, because of the limited five-year protection of the vaccines used. Immunization in the other 25 communities is completely absent with the exception of Puerto Mairo, where periodically student nurses provide care as part of their training. For the last seven months, this area has been without health care.

Other Health Care

The community at Iscozacín has a half-completed hospital. Construction has stopped due to problems between ranchers and Amuesha.

SUMMARY

The Palcazu is severely underserved in the provision of health care services, including :

- Skilled medical practitioners
- Physical plants for the provision of basic services
- Availability of medication
- Programs and facilities to provide basic hygienic services, nutritional, and prenatal services
- Diagnostic facilities
- Adequate immunization measures

- Access to medical care
- Sterile operating conditions
- Systems for reporting morbidity, mortality, and birth data
- Facilities for treatment of severe trauma

4. FACTORS INTRODUCED BY DEVELOPMENT

4.1. Road Construction

Development concentrates change in a designated area. The first phase of development begins with deforestation for the purpose of tree harvesting and the construction of a road to open up the area for development. Deforestation removes the habitats of predators, which act as controls of rodent and insect populations. Deforestation also provides food and a breeding environment for hematophageous insects (Goodland et.al., 1975). The acute outcome of this process are outbreaks of malaria and yellow fever within the road construction and tree harvesters population. (Dr. A. Sultzer, PAHO Epidemiological Bulletin).

Malaria and yellow fever may be brought into the area by infected individuals of the construction crew or by squatter groups who enter the area as it is opened. These individuals act as reservoir for the distribution of disease throughout both developers and indigenous native and rancher populations.

Other health problems of the road construction population include: venereal diseases, accidents, violence, alcoholism, malaria, yellow fever, leishmanaisis, and parasitosis (Dr. Finkleman, Center for Health and Human Ecology PAHO).

4.2. Colonization

The second phase of development, illustrated in Figure 1, involves more extensive deforestation and construction of housing by colonists. Trypanosomiasis (Chagas Disease), a disease endemic in many regions of the Sierra, Coast, and Selva, may be brought into the Palcazu by infected colonists, and/or infested livestock, dogs, or belongings. The mud, thatch and wood dwellings of new colonial groups provide an environment in which the reduvid bugs (mode of transmission) thrives (Conversation with Dr. Manuel Moro - PAHO) (Goodland and et.al., 1975).

Agricultural practices of the Coast and Sierra further aggravate disease conditions in the Selva by creating breeding zones for insect and rodent vectors.

Incoming colonial populations are reservoirs for measles, whooping cough, influenza, German measles, and tuberculosis. The present population of the Palcazu has limited protection against these diseases with only eight of the 33 communities participating in immunization campaigns, which do not include vaccination against German measles or influenza.

Poor hygienic practices, lack of sanitary facilities, or lack of potable water sources will create conditions which may lead to epidemics of typhoid, leptospirosis, and hepatitis (Conversation Dr. Finkleman, Dr. K. Sultzer, Dr. Pandus , Martínez 1969).

Pre-existing conditions of colonists, such as tuberculosis or upper respiratory infections, will be exacerbated in the climate of Selva.

SUMMARY

Development is a two-phase process involving road construction and agricultural development. Acute conditions promoted by road construction

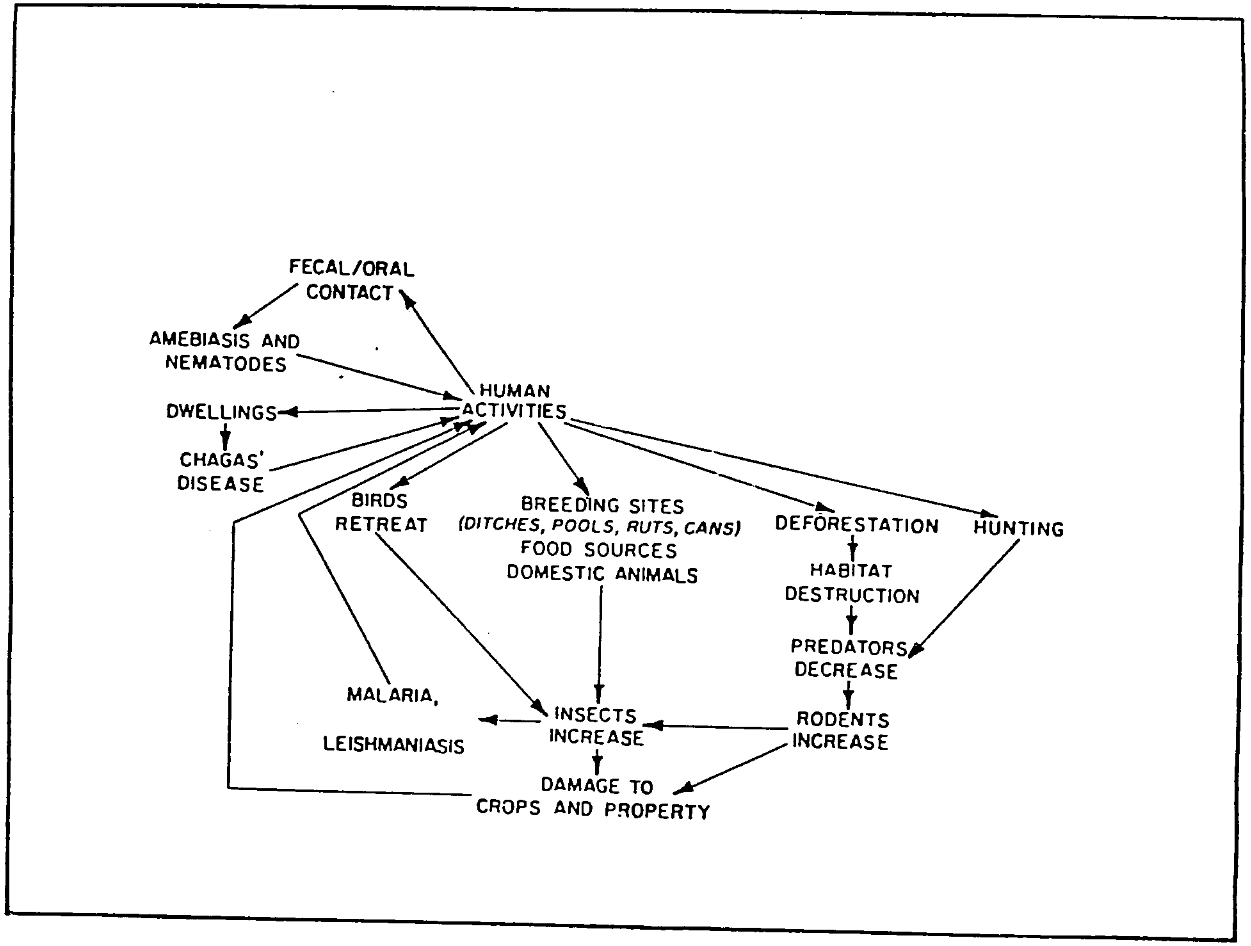

Figure 1.-
The effects of deforestation and colonization on the development of disease in the Ceja de Selva

(Adapted from Goodland et al, 1975)

personnel include: malaria, yellow fever, venereal diseases, alcoholism, and violence. Colonial development further exacerbates disease problems by greater removal of habitats which control disease vectors, while also introducing a broad range of communicable diseases to the non-immune indigenous communities. Poor sanitary practices will contribute to the development of typhoid, parasitosis, and hepatitis.

Diseases contracted in the Sierra and Coast will be exacerbated by the climate of the Selva.

Present health care within the Palcazu is already extremely limited, and will not be able to cope with these additional problems associated with incoming populations.

5. RECOMMENDATIONS

Changes in health conditions associated with development of the Palcazu will be precipitated by and will impact upon present populations, road construction personnel, and incoming colonial groups. The following section presents the problems associated with each group and corresponding recommendations.

5.1. Present Population

Problem

Absence of skilled medical personnel and facilities to provide adequate health care.

Recom : Complete medical facility at Iscozacín and staff with a physician and professionally trained auxiliary staff.

Problem

Absence of minimum health services in 25 of the 33 communities.

Recom: Use medical facility as a training center for continual education of promotores.

Problem

Lack of access to specialized medical care.

Recom: Use Iscozacín staff and promoters to visit communities on a regular basis to examine, treat, take specimens for analysis, and transport emergency cases to Iscozacín.

Problem

Absence of diagnostic facilities to identify and treat diseases.

Recom: Use SASA to transport specimens to a laboratory in Lima for analysis.

Problem

Lack of compliance in communities to immunization efforts and use of hygienic practices.

Recom: Involve community in health promotion activities, including using established community organizations:

- education of communities in basic health practices
- construction of latrines for disposal of human wastes
- construction of enclosures to segregated animals from housing areas
- designation of communal garbage disposal areas

Problem

Reluctance of women to have male sanitarios perform gynecologic and obstetric care.

Recom: Train midwives in the communities to assist promotores in prenatal care, obstetric and gynecological services.

Problem

Hyper endemic levels of tuberculosis, parasitosis, hepatities, etc. which are not identified and treated throughout the Palcazu.

Recom: Use communities to locate infirm for referral, diagnosis, and treatment to reduce the prevalence and incidence of these diseases.

Problem

Influx of venereal disease in native communities.

Recom: Use community spokesmen in coordination with health promotores, midwives, and curanderos to:

- Educate about the dangers of V.D. and the outside sources
- Educate individuals to identify V. D. symtomology and refer themselves to health promotores services.

5.2. Road Construction Personnel

Establish health services for road construction crews to carry out the following activities:

Problem

Outbreaks of malaria and yellow fever in road construction crews.

Recom: Immunize personnel to yellow fever

- Screen and treat workers for malaria and yellow fever
- Enforce treatment by removal of employment

Problem

Venereal disease transmitted from worker population to indigenous groups.

Recom: Periodically screen and treat V.D.

5.3. Incoming Colonists and Present Population

Problem

Influx and exacerbation of disease brought in by colonist populations.

Recom: Require screening and treatment of colonist groups including:

- Immunize individuals
- Treat disease
- Deinfest individuals, their belongings, and livestock

Problem

Development of disease from infestation of colonial dwelling areas.

Recom: Construct dwellings which do not provide breeding grounds for vermin.

- Screen up dwellings
- Provide insect netting for all dwellings
- Periodically spray dwelling areas

Problem

Development of disease related to lack of hygienic practice and availability of potable water source.

Recom: Educate colonists on hygienic practices as a requirement for access to land.

- construct potable water systems for the community to facilitate the colonists' implementation of hygienic practices.

Problem

Parasitosis from indiscriminate disposal of human waste and garbage.

Recom: Provide technical assistance in the mandatory construction of basic sewage disposal facilities before areas are occupied.

Problem   Malnutrition associated with parasitosis.

Recom: Eliminate parasitosis through education, and construction of latrines and potable water systems.

Problem   Malnutrition associated with diet.

Recom: Encourage cultivation of native food supplies in native groups.

- Educate colonist groups in agricultural practice adaptive to the selva.
- Educate the Palcazu population on the importance of proper diet in pregnant mothers, infants, and children. This program could be incorporated into schools in association with the communities health post.

Problem

Proliferation of disease-carrying vectors resulting from non-adaptive agricultural practices.

Recom: Use alternative forest colonization techniques with controlled cultivation of natural resources.

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APPENDIX I

ANALYSIS OF GOVERNMENTAL INSTITUTIONS INVOLVED IN DEVELOPMENT OF THE PALCAZU VALLEY

Dennis McCaffrey

CONTENTS

1. SUMMARY OF CONCLUSIONS

1) There is an ample framework of laws for environmental protection, ecologically sound land use, protection of native communities, and titling land holdings in the Palcazu Valley. Some of these matters have constitutional status under the Peruvian Constitution of 1979.

2) The Pichis-Palcazu Special Project, PEPP, expressly designed to carry out development of the Palcazu valley, is well organized and well financed. Its powers and duties embrace all aspects of development, thereby avoiding fragmentation of effort among several agencies. It appears to be working efficiently with good mechanisms for cooperation with other government agencies and a minimum of bureaucracy.

3) Sound development of the Palcazu valley, ecologically and socially, will require institutional support that is well informed, dedicated, and well financed. Applied development should include control of deforestation and forest harvesting, policing of protected lands, and extension services and incentives for good land use on production lands.

2. SUMMARY OF RECOMMENDATIONS

1) Mark the boundaries of protection lands as soon as possible. Prevent incursion into these lands by patrolling and policing.
2) Construct a forest police station in the upper Palcazu valley and staff it as soon as possible.
3) Mark the boundaries of lands not suited to pasture or cultivation and prevent deforestation of those lands.
4) Complete titling and platting of native communities and other occupied lands as soon as possible. Protect owners of those lands from trespass.
5) Control extraction of forest products from forest production lands so as to protect these lands and forests from damage.
6) Develop extension services for crops and livestock and make them available to as many people as possible.
7) Protect fish and game resources from overharvesting and from habitat destruction.
8) Develop a program of incentives to encourage good land use.
9) Establish field stations to obtain meteorological data and other useful information.
10) Provide basic social services to Palcazu residents.
11) Continue education and training of PEPP staff.
12) Continue to finance PEPP well.

3. ACKNOWLEDGEMENTS

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I especially thank Ing. Edmundo del Aguila Morote, Executive Director of PEPP, for his attentiveness and willingness to provide information and explains things. Ing. Chuyuki Saito Okochi, Adjunct Director of PEPP, has made available maps, documents and countless items of information. Dr. Emilio Gonzalez, lawyer attached to PEPP, and Dr. Gabriel Millares Borja, lawyer knowledgeable in natural resources law, have assisted me in locating and understanding legal materials.

4. INTRODUCTION

This report describes the legal background against which the Palcazu valley will be developed and the government institution charged with carrying out that development. It also comments on how sound development might be accomplished.

The description of the legal background touches only on those items which are of most direct application, knowing that literally hundreds of unmentioned laws and rulings have some bearing on the subject.

The description of PEPP, Proyecto Especial Pichis-Palcazu, was drawn from numerous interviews with PEPP officials and from a number of documents by and about PEPP. The dates of the documents concerning PEPP have been stated to show how quickly it was formed and started work.

The comments on sound development are synthesized from diffuse sources. Because this report was written after most of the other reports in the study for AID by JRB Associates were completed, those other reports, and the personal communications of their authors, were important sources for comments on sound development.

The section on sources in this report lists only sources specifically cited in the report and not the diffuse sources which were also relied upon.

5. LEGAL FRAMEWORK

5.1. Constitution of 1979

The Peruvian Constitution of 1979 contains a number of provisions which bear on development of the Selva. Title II of the Constitution deals with the economic regime of the state. Within this title, chapter 2 is concerned with natural resources, Chapter 7 treats the agrarian regime, and Chapter 8 has to do with native communities. Salient points within these Chapters are:

Article 118 which states that lands, forests, and natural resources in general belong to the state. Their utilization is subject to conditions established by law.

Article 119 which guarantees that the state will evaluate and preserve natural resources and promote their rational use.

Article 120 which provides that the state will urge development of Amazonia, authorizing special rules for that development when necessary.

Article 123 which promises the people of Peru the right to a healthy environment in which there is ecological balance and in which scenery and wildlife are preserved. The state is obliged to control and prevent environmental contamination.

Article 159 (4) which empowers the state, by way of agrarian reform, to dictate the special norms required to maintain the ecologic equilibrium of Amazonia in order to develop its agrarian potential.

Article 161 which recognizes the legal status of native communities and guarantees their protection by the state.

Article 163 which protects native community lands from seizure or prescription and restricts their alienation.

5.2. Laws which Predate the 1979 Constitution

A number of laws which predate the 1979 constitution have direct application to development and environmental protection of the Palcazu Valley. The most important of these is Law Decree No. 22175, Law of Native Communities and of Agrarian Development of the Selva and Ceja de Selva.

Each of the provisions of the new constitution which pertain to native communities has antecedents in Law No. 22175. In addition, under this law, the territorial integrity of native communities is guaranteed. The state is required to survey the territory of each native community and grant title over the territory to the community. The territory of each community is to be large enough to meet the needs of the community's population. Native communities have preference in obtaining forestry contracts. Public officials have a special responsibility to investigate complaints by native communities regarding violations of the laws and rules which protect them.

Law No. 22175 classifies land by use capability into lands suitable for crops, livestock, and forestry. Agriculture and livestock raising are restricted to those lands classified as suited to those uses.

One title of Law No. 22175 deals with the subject of integrated utilization of renewable natural resources. Under this title production systems in the Selva and Ceja de Selva should employ technology which is ecologically apt for those zones. Forest cover of 15 percent of the land area is to be maintained on agricultural lands and 30 percent on grazing lands. River and stream banks and upper slopes are to remain forested. Utilization of wood from lands being cleared is promoted as is extraction of forest products from forest lands. The Ministry of Agriculture is supposed to apply soil conservation, reforestation, and watershed management programs to areas which have been devastated by shifting agriculture.

Most of the rest of Law 22175 is concerned with the process for establishing title to lands. The law also states maximum and minimum sizes for farms and ranches and provides for agrarian promotion and credit.

Another significant law is Law Decree No. 21147, The Law of Forestry and Wildlife. This law states that forest and fauna resources are part of the public domain. It also declares that lands whose best use is forestry may not be used for agriculture or grazing. Under the law all timber extraction is controlled by the Ministry of Agriculture by way of extraction contracts. Timber extraction in native communities may only be carried out by the community.

The exploitation of wildlife is controlled by provisions similar to those for forestry. Further control is provided by prohibiting hunting or capturing endangered species.

The law establishes a number of infractions. Among them are trespass in reserve forests, unauthorized conversion of forests to agriculture or grazing, hunting or capturing protected wildlife and failure to comply with the provisions of an extraction contract.

The principal means of punishing infractions is the fine. Other sanctions are rescission of extraction contracts and seizure of illegally obtained products.

A forestry police force is established by the law to control infractions.

Among other laws predating the 1979 Constitution which concern environmental protection applicable to the Palcazu are laws prohibiting dynamiting of fish and protecting the white cayman and other endangered species.

A number of national parks and various kinds of natural reserves are established by law. Also there are general laws controlling air pollution and water pollution.

Most of these laws are still in effect under the new constitution.

5.3. Laws Enacted Under the 1979 Constitution

The Law of Agrarian Promotion and Development, Legislative Decree No. 2, was recently promulgated to meet the purposes stated in its title. It contains a number of new provisions on agriculture and forestry and also some amendments to both the native communities law and the forestry and wildlife law. It is designed to increase productivity, improve markets and promote agro-industry. These goals are to be accomplished by technical assistance from the Ministry of Agriculture, state credit, and tax breaks for farmers. Details for these programs will be established by rule by the Ministry of Agriculture and by supreme decree.

The agrarian promotion law includes silviculture and the extraction of wood and forest products in its definition of agrarian activities. In its description of activities for expansion of the agricultural frontier it cites deforestation and conversion of wooded lands, and also reforestation, as examples. However, management of natural forests is not mentioned.

Article 67 of the law states that agriculture and livestock promotion will be given priority over forest exploitation and extraction.

This law retreats from the strong commitment in earlier laws to land classification according to ecological suitability. None of the environmental protection provisions of the earlier laws are actually repealed, however. The tenor of the law is not well suited to the Palcazu Valley whose best development potential appears to lie in natural forest management because of the valley's limited capacity for expanded agriculture or livestock production.

The Law of the Executive Branch, Legislative Decree No. 217, does a number of things which relate to the Palcazu Valley. It sets out the procedures for exercise of legislative authority by the executive branch and it describes the function of each ministry.

The Ministry of Agriculture is charged with conservation and rational use of natural resources, specifically water, soil, forests, and wildlife. Other functions of the Ministry are agrarian reform and increasing agricultural, forestry, and livestock productivity.

The ministers which head each ministry collectively form the Council of Ministers which is presided over by a president. The President of the Council of Ministers coordinates the activities of the various ministries. His office has charge of executive special, multisectoral, development projects commissioned by the President of the Republic. One of these special projects, the Proyecto Especial Pichis-Palcazu, PEPP, has been formed to promote development of the Palcazu river valley and also the Pichis and Pachitea valleys nearby.

There is also a new law covering the entire ambit of agriculture more broadly than ever. It is the Organic Law of the Agrarian Sector, Legislative Decree No. 21 . This law describes the functions of the Ministry of Agriculture and organizes the ministry into various subdivisions. The most significant part of the law probably is the breadth with which it describes the agrarian sector. The agrarian sector includes everything relating to crops and livestock and land for those uses plus everything relating to forest lands, forests and wildlife, all watersheds, rivers and aquifers and the water in them, and everything concerned with agricultural production and industrialization.

In the Palcazu, this vast subject matter will not be controlled directly by the Ministry of Agriculture but by PEPP.

6. PROYECTO ESPECIAL PICHIS-PALCAZU, PEPP

6.1. Establishment and Authority

PEPP began with establishment of the Executive Commission for the Pichis Palcazu Project by Supreme Decree No. 137-80-AA dated October 10, 1980. The executive commission was composed of the Minister of Agriculture and Nutrition, a delegate of the Ministry of Transport and Communications, and a delegate of the President of the Council of Ministers. The purpose of the commission is to implement, as soon as possible, a development project for the Pichis,Palcazu, and Pachitea Valleys.

By Supreme Decree No. 178-80-AA of December 23, 1980, the executive commission was expanded to include the Technical Director of the National Institute of Planning.

On November 25, 1980, the Executive Director of PEPP, Ing. Edmundo del Aguila Morote, was appointed by Ministerial Resolution No. 0111-80-PCM-DA-1. The functions of the executive directorate and the powers of the executive director were set out in Ministerial Resolution No. 0119-80-PCM-DA-1 dated December 16, 1980. The principal powers of the executive director include the power to enter into agreements and contracts, to approve projects, to maintain accounts, and to approve payment of expenses.

This resolution also described the geographic reach of PEPP to include the watersheds of the Pichis, Palcazu and Pachitea rivers plus the area of influence of the marginal highway of the Selva from San Alejandro to Puerto Bermudez.

The geographic reach of PEPP was expanded by Ministerial Resolution No. 0087-81-PCM of May 15, 1981 to include five districts, Villa Rica, Oxapampa, Chontabamba, Huancabamba, and Pozuzo in the Province of Oxapampa, Department of Pasco. These districts lie in the highlands and highland valleys south and west of the Palcazu Valley.

By Supreme Decree No. 125-81/AG, August 12, 1981, 74,200 hectares of the Von Humboldt National Forest along the marginal highway between San Alejandro and Puerto Inca were excluded from the national forest and transferred to the jurisdiction of PEPP. The purpose of this transfer was to enable PEPP to carry out plans for silvo-agropecuarial settlement. The decree also states that forest products obtained by opening the marginal highway may be sold by PEPP and the proceeds used by it.

On August 26, 1981 a new Council of Directors of Special Projects for Integrated Development of the Selva and High Selva was formed by Supreme Decree No. 036-81-PCM. The Council includes the Minister of Agriculture, who presides over the council, the Secretary General of the Office of the President of the Council of Ministers, the Vice-Minister of Education, Vice-Minister of Health, Vice-Minister of Agriculture, Vice-Minister of Housing, Vice-Minister of Transport and Communications and the Technical Director of the National Institute of Planning. The Council of Directors is to meet at least once a month to direct and coordinate the several special projects in the country.

The powers to grant title to agricultural and grazing lands, to grant concessions to forest lands, to maintain plats and registries of rural land ownership and to control extraction of forest products are all held by the Ministry of Agriculture. All of these powers are exercised by PEPP, however, on the lands over which it has jurisdiction. PEPP anticipates that its exercise of these powers will soon be formalized by Supreme Decree. A draft of such a decree is under discussion.

6.2. Structure and Functions

There are six offices of PEPP which report to the executive director. They are the offices of audits, communications and technical training, administration, technical assistance, law, and planning and evaluation.

The office of audits is presently vacant. The office of communications and technical training publicizes PEPP. Day to day operations are the responsibility of the office of administration.

The office of technical assessment develops projects and technical agreements and assesses technical data. Legal advice, especially on contracts and on PEPP's duties and powers under its enabling legislation, is provided by the legal office. The office of planning and evaluation is currently employed mostly in urban planning for Iscozacín, Puerto Bermudez and other centers in the project area.

All of these offices are housed with the executive directorate in Lima. The PEPP organigram shows the Lima staff consisting of 43 people: 16 professionals, five technicians, nine auxiliaries, five secretaries, two draftsmen, three drivers, two watchmen and a janitor.

PEPP also operates a technical directorate with headquarters in Oxapampa. The technical directorate supervises four rural development centers located in Von Humboldt, Iscozacin, Puerto Inca and Puerto Bermudez. PEPP anticipates having at least two substations of the Iscozacín center in the Palcazu valleys. These substations are planned for Puerto Mairo and in the upper Pichanaz Valley along the existing road from Villa Rica at a place called Cooperativa.

According to the PEPP organigram the technical directorate employs 52 people: 16 professionals, ten technicians, ten auxiliaries, one driver, and 15 laborers. Of these, three work at Oxapampa, 19 at Von Humboldt, 16 at Iscozacín, 10 at Puerto Inca and three at Puerto Bermudez.

6.3. Project Development

6.3.1. Goals

The overall goals of the Pichis-Palcazu project for the entire area are:

- to penetrate the area with roads;
- tap its forest resources;
- greatly expand its agricultural and livestock production;
- and greatly increase its population by attracting settlers from other parts of Peru.

These goals are drawn from the assumptions that the region has great agricultural and livestock potential which has gone undeveloped for lack of access and low population.

These general goals and assumptions are expressed in the annexes to the Grant Agreement between USAID and Peru entered into on September 26, 1980 to design the Pichis-Palcazu project for agricultural and rural development. They are also expressed in a paper produced by PEPP for the President of the Council of Ministers entitled Projections and Scope of the Pichis-Palcazu Special Project, dated January 22, 1981.

Specific goals of the project in the Palcazu valley are stated in the PEPP report, Trimestral Report January - March of April, 1981. These goals include:

- construction of a road from Pichanaz past Iscozacín to Puerto Mairo;
- evaluation of natural resources;
- land platting and topographic mapping;
- titling native communities and lands of established colonists;
- starting agriculture, livestock and forestry extension programs;
- bringing basic social services to the people of the valley;
- studying hydroelectric potential;
- opening a rural development center in Iscozacín with a substation at Pichanaz;
- installing a forest police encampment at Pichanaz.

A further refined statement of goals for the Palcazu is found in PEPP's Project Progress Report through July 31, 1981. In that report the penetration road is still a central feature. However, the potential for development has shifted emphasis from agriculture and livestock to forestry which is more in keeping with the capacity of the lands. Also, the expectation of large scale new settlement of the valley has been reduced. Projects are more geared toward serving the existing population than toward new colonists. Greater emphasis is placed on conserving the resource base and on ecologically sound land management than in earlier reports.

6.3.2. Operations

PEPP has amassed a large amount of information on the Palcazu going back at least to 1966. The material includes aerial photographs, maps, resources inventories, and projections of land use capacities. The quality of this information is variable and some of it gives rise to unrealistically high expectations for development of the Palcazu valley.

PEPP is updating this information with new aerial photography and a forest inventory now in progress by the National Agrarian University at La Molina.

Some investigative work is planned by PEPP itself as well as direct efforts to meet its goals. Examples are the PEPP field station at Iscozacín where a cacao nursery is started. Much more in the way of crop and livestock demonstrations are planned there. PEPP has also marked the boundaries of titled native communities in the Palcazu by clearing the boundary lines on the ground.

Many of PEPP's plans will not be accomplished directly by it, however. The principal way in which the Palcazu project is going forward is by agreements between PEPP and other government agencies. One example of this is the agreement between PEPP and the Ministry of Agriculture for land platting and titling in the Palcazu valley. Under this agreement PEPP will finance, supervise and approve work which is to be done by several branches of the Ministry of Agriculture. The result should be maps showing the location of lands which qualify for title with their boundaries and areas. The owners of these lands will receive documents of title and their titles will be registered.

Another example is PEPP's intention to finance construction of a field station for forest police in Pichanaz. The station will be manned by the Peruvian police force, but operating costs will be paid by PEPP.

PEPP's ample budget is its greatest asset in getting things accomplished. On September 17, 1981 PEPP entered into a contract with the Ministry of Transport and Communications whereby it released 800,000,000 Soles, nearly two million dollars, for road construction in the Palcazu. The Ministry of Transport and Communications will use the money to hire private road construction contractors to build approximately eight kilometers of road. The road will begin at km. 58 on the Villa Rica Road and descend the Cacazu River, then cross the Palcazu on a new bridge and start down its left bank. The work should be completed by December, 1981.

The source for the road construction financing is Public Law 480 money. PEPP has also used this source for road design work for the whole Palcazu road.

PEPP expects to be able to have the Palcazu road constructed to final design standards all the way to Puerto Mairo by the end of fiscal year 1983.

PEPP anticipates financing some development of the Palcazu from international sources. Outside financing is being sought both for road construction and for subsequent development projects.

7. SOUND DEVELOPMENT OF THE PALCAZU VALLEY

7.1. Objectives of Sound Development

In broad terms, the objectives of sound development of the Palcazu valley appear to be these:

1) Match land use to land capability.
2) Protect flora and fauna from destructive exploitation.
3) Insure that native communities and other members of the current population benefit from development and are not damaged by it.
4) Insure that new colonists to the valley prosper and do not cause social or environmental damage.

7.2. Legal Support for Objectives

The legal framework described above gives ample support for the objectives of sound development of the Palcazu. Under the laws, land use in accordance with land use capability is required. Land uses that exceed the land's capacity are prohibited. Application of these laws will satisfy the first objective of development and will go a long way toward satisfying the third and fourth objectives as well.

The second objective is supported by the laws protecting particular species and authorizing the government to control hunting and forest extraction. These laws should be applied and their application will meet the second objective and partially meet the first, third and fourth objectives.

Native communities should receive the full benefit of the laws that protect their land and give them preference in forest extraction. Other members of the current population should benefit from application of the laws on securing land title, promoting agriculture, and governing forest extraction.

Sound application of all of the noted laws will result in meeting the fourth objective for new settlers.

7.3. Institutional Support for Objectives

7.3.1. Leadership

Leadership in sound development of the Palcazu means figuring out what kind of development is appropriate, figuring out how to do that development, and doing that development in a way that attracts support of the people who are affected by the development.

Development of the Palcazu has been entrusted to PEPP and PEPP does seem to be asserting leadership in development. The Executive Director of PEPP, Ing. Edmundo del Aguila Morote, is well informed about the Palcazu. He has started a program of obtaining yet more information. His expectations for the zone appear realistic and he is aware that development carries high risks, especially if it is done improperly.

The other people working at PEPP also seem to be well informed, open-minded, dedicated, and conscientious.

The PEPP people seem to be well received in the Palcazu Valley and there seems to be general support there for development of the valley.

7.3.2. Information

PEPP is off to a good start in collecting existing information on the Palcazu. The acquisition of new aerial photographs will be very useful. Most useful of all will be plat maps showing which lands are occupied and which are not and land use capability maps.

Establishment of field stations to collect meteorological data would be a good idea. So would periodic aerial photographs which PEPP has said it intends to have taken. Permanent inventory plots on lands with various land use capacities might also be useful. The other reports in the study of the Palcazu contracted by USAID from JRB Associates contain numerous other suggestions for information collection.

7.3.3. Application of Information

Information about the Palcazu valley should be applied by PEPP in two stages. The first stage is immediate application of information needed right away for sound development. The second stage is gradual application of other useful information.

In the first stage, identification in the field of lands which must be maintained in protection forest is urgently needed. The boundaries of these lands should be marked, people should be informed of them, and the lands should be patrolled.

Nearly as urgent is field identification of the boundaries of lands not suited to agriculture or pasture. The purpose of this identification is to prevent deforestation of these lands, again by marking the boundaries, advising people of where they are, and patrolling the lands.

Next in urgency is controlling extraction of forest products from lands on which extraction is within the capacity of the land. The purpose of this control is to prevent loss of valuable wood by wastage and to prevent soil damage by improper road building and improper harvesting.

The second stage of application of information begins with identification of pasture and crop lands followed by dissemination of facts on best use of particular kinds of these lands. This stage also includes identifying any excessive pressures on game and fish and taking measures to protect the game and fish resources.

7.3.4. Land Titling

Title for native communities and current residents in the Palcazu should be regularized and recorded as soon as possible and platted so everyone can see who owns what. PEPP should assist those with title in defending their lands from invasion and also assist newcomers in finding and securing open lands.

Part of this is occurring under the agreement between PEPP and the Ministry of Agriculture. However, with the road under construction serving as an invitation to new settlement, it is important that it be completed accurately and quickly.

7.3.5. Education

Sound development of the Palcazu will take education both of the promoters of development and of the people affected by it.

The PEPP staff seems to be well informed now. It is important to stay well informed and assimilate new information.

The main thrust of education is toward those affected by development as people succeed better when they understand what they are doing and why. Among the principal points of education for sound development are:

- Land cannot sustain a use unless it has the capacity to sustain it.
- Attempting improper land use destroys land.
- Destruction of forests on lands whose capability is protection forest or production forest will destroy those lands and will have adverse effects on other lands and resources as well.
- Fish and game are important sources of protein which could be lost if they are not conserved.

Education on how to use land for uses it is suited is also very valuable. PEPP has an incipient demonstration and extension program. Plans to expand that program are commendable. PEPP's intentions are to have numerous demonstrations scattered throughout the valley. That seems a good way to reach a lot of people. Finally, both the public and PEPP staff should have a good knowledge of the nation's laws on natural resources.

7.3.6. Incentives

Good land use and conservation of natural resources can be encouraged by incentives. Examples are extension of credit, grants of money or tools or stock, extension of contracts,enlargement of title holdings and so on. Wise selection of incentives could go a long way toward encouraging good land use.

Similarly, disincentives, the reserve of the things mentioned as incentives, could have some effect in discouraging bad land use.

7.3.7. Policing

Certain aspects of sound development, such as prevention of incursion in protection forests and enforcement of restrictions on hunting and fishing, probably cannot be accomplished without policing.

Rapid completion and staffing of the proposed forest police station in the Pichanaz Valley is essential. Road construction has already begun through fragile lands. The police should be there so people know that PEPP is serious about protecting land that needs protection and so protection can be attained.

7.3.8. Social Services

At present educational facilities in the Palcazu are poor. Health services are poor also and sanitation could use a lot of improvement.

All of these services should be improved for the existing population. They must be expanded if any increased population of the valley is to live at a decent standard.

7.3.9. Financing

The Peruvian government has committed a great deal of money to building roads into the Palcazu and other parts of the selva and high selva. It has also funded PEPP well for its first year.

It is going to take a lot more money for many more years to develop the Palcazu soundly and avoid the failures that have occurred in other parts of the country where roads were built and then people made spontaneous settlements with no support.

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APPENDIX J

THE CLIMATE AND HYDROLOGY OF THE PALCAZU WATERSHED, AND IMPACTS OF AGRICULTURAL DEVELOPMENT

Gregory L. Morris, Ph.D.

CONTENTS

FIGURES

I. INTRODUCTION

1.1. Scope and Purpose

This report briefly describes the climate and hydrology of the Palcazu watershed, upstream from its confluence with Río Pozuzo. This watershed is located on the eastern slopes of the Peruvian Andes between approximately 300 m and 1500 m elevation. Potential impacts to the hydrologic system are identified which will proceed from road construction and resultant colonization, deforestation, and agricultural development. Recommendations are developed which-- if implemented --will help reduce the adverse environmental effects within the Palcazu watershed and on downstream areas. Some types and levels of adverse effects are inevitable and are so noted.

The overall purpose of this report is to identify the most severe consequences to the hydrologic system, and to outline strategies for avoiding them. High rainfall, steep slopes, fragile and relatively infertile soils, the lack of sanitation measures for water supply and waste disposal, and the dependence of natives and colonists alike on riverine fisheries are all factors which enhance the need for organizing development activities to conform with environmental and social constraints. Failing at this, ill-conceived and uncontrolled development could convert the Palcazu watershed into a "rural slum", leaving its increased population to scratch a subsistence living from a degraded environment of reduced productivity.

1.2. Sources of Information

All climatological and hydrologic data has been obtained from SENAHMI (Servicio Nacional de Hidrología y Meteorología, Lima). The author spent seven days in the Palcazu valley which included boat trips from Puerto Mayro to Loma Linda for the purpose of examining land use along the river terraces. Hikes inland from the river were undertaken at Shiringamazu and Puerto Mayro, and the trail from Iscozacín to Villa América was also hiked. The entire valley was also observed from the air.

2. CLIMATE

There are no climatic stations within the Palcazu Valley. Climatic conditions have been estimated based on extrapolation from other stations and from the life zone map which was developed based on vegetation (Bolaños and Watson, 1981).

2.1. Atmospheric Circulation

Surface pressure maps for one year were examined at the SENAHMI office. These maps indicated that there is characteristically a surface high pressure system over the upper Amazon watershed in eastern Peru, and a low pressure system is generally developed over the Peruvian Andes. The anticyclonic air movement around the Amazon high pressure system results in a continental air mass movement from north to south along the eastern slopes of the Andes.

Data from the meteorological station at Puerto Bermudez reports no air movement in the mornings or evenings, but an average wind speed of approximately 4 m/sec (14 km/hour, or 9 miles/hour from the north at 1 pm. No seasonal variation in wind direction or velocity is reported at Puerto Bermudez.

Residents of the Palcazu area reported that there is virtually no breeze at any time of the year, except for occasional strong winds associated with thunderstorms.

2.2. Precipitation

The circulation of the continental air mass carries moist air from north to south across eastern Andean slopes, resulting in orographic precipitation as the moist air mass is forced aloft when it strikes mountain ranges.

Superimposed on this generalized circulation pattern are localized convection systems which develop into thunderstorms.

Despite the importance of orographic effects on the eastern Andean slopes, there are a variety of localized topographical and meteorological factors which also have a strong influence on precipitation at any one point. As a result, the relationship between average annual rainfall and elevation exhibits considerable scatter and is of little value in estimating the precipitation within the Palcazu Valley.

2.2.1. Precipitation estimated from vegetation mapping

The precipitation within the Palcazu Valley has been estimated on the basis of the Life Zone system of vegetation mapping developed by Holdridge. In applying this system, Bolaños and Watson (1981) concluded that:

> "The annual precipitation estimated for the valley floor ranges from 3,000 to 4,500 mm per year, with rainfall generally increasing from Puerto Mayro to Loma Linda (north to south), and from the San Matías Mountains toward the Yanachaga Mountains. (east to west). Nevertheless, in the southern portion

of the Palzacu watershed, at middle elevations, there are several small areas which are shadowed from rainfall. One such is the Cacazu Valley, which is estimated to receive an average precipitation of somewhat more than 2,000 mm/year."

2.2.2. Precipitation at nearby stations

There are no precipitation measurements within the Palcazu Valley. Perhaps the most representative meteorological stations in the area which might be representative of the Palcazu valley are at Puerto Bermudez (3314 mm/year) and at Tingo María (3096 mm/year). Nearby stations to the east (e.g. Villa Rica, Pozuzo) are at considerably higher elevations and have less rainfall than is expected within the Palcazu Valley. The station at Puerto Victoria (1983 mm/year) is probably much drier than the Palcazu Valley. 1/

Differences in precipitation (such as the large change from Puerto Victoria to Puerto Bermudez) are related to localized topography and the rain shadow effect. Puerto Victoria has no adjacent mountain ranges to promote orographic precipitation. The relatively drier Cacazu Valley at the southern limit of the Palcazu watershed is protected by a ridge to the north which appears to create extremely high rainfall in the Loma Linda area and less rainfall at the Cacazu Valley.

2.2.3. Rainfall map

The location of isoheytel lines of equal annual rainfall is estimated in Fig. 1, based on the vegetation mapping by Bolaños and

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1/ Bolaños and Watson visited Puerto Victoria as well as the Palcazu Valley, and reported that the natural vegetation in Pto. Victoria area reflected much drier conditions than the Palcazu Valley.

Watson, and the interpretation of generalized circulation patterns, topography, and data from other stations. It is felt that the Palcazu Valley rainfall regime mimics that of the Huallaga Upper Huallaga valley, where rainfall increases as one moves toward higher elevations in the watershed. (i.e. moves south from Campanilla toward Tingo María). Moist air probably enters the Palcazu valley from a generally northerly direction and precipitation on the valley floor increases as the air mass moves south and is forced aloft.

2.2.4. Seasonal distribution of precipitation

Average monthly precipitation is shown in Fig. 2 at Puerto Bermudez and Puerto Victoria. With 12 years of date, the maximum 24-hour precipitation reported at Puerto Bermudez was 198 mm/24 hour. The most severe rainstorms occur in the wettest months, and particularly in December and January.

2.3. Temperature and Solar Radiation

Solar radiation data is not available within the Pichis-Palcazu area. Tingo María has been selected as a representative station and the average hours of sunlight per day, by month is shown in Fig. 3A. The annual distribution of sunlight within the Palcazu Valley probably follows a similar pattern; the rainfall seasonality in Tingo María and Puerto Bermudez are quite similar, and the same meteorological and orographic factors are probably present.

The temperature varies principally as a function of elevation, with a lapse rate of approximately 6.8 degrees centigrade per 1000 m of elevation (Johnson, 1976). Monthly temperature patterns at Puerto Bermudez (elev. 300 m) are summarized in Fig. 3B. The temperature regime

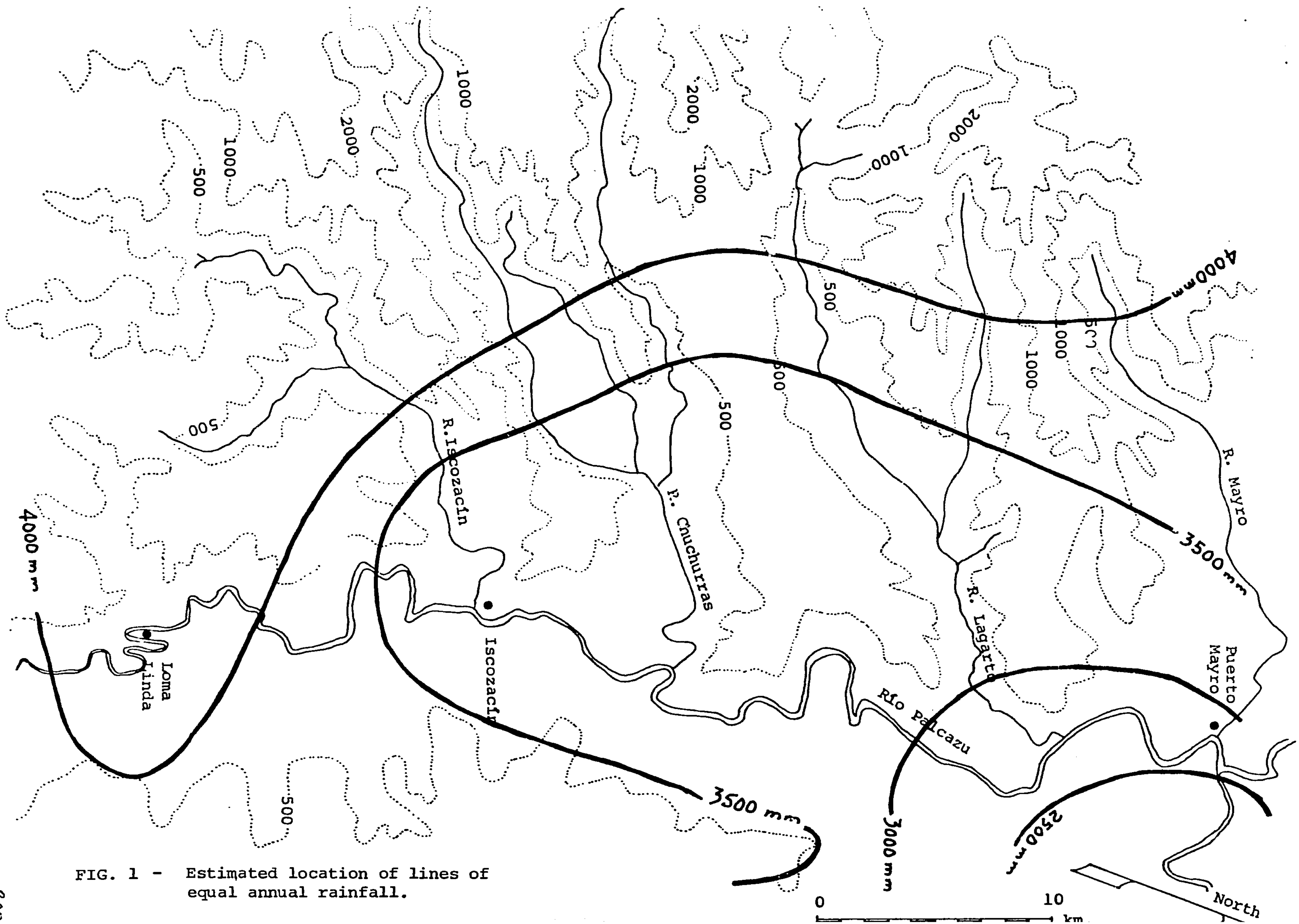


FIG. 1 - Estimated location of lines of equal annual rainfall.

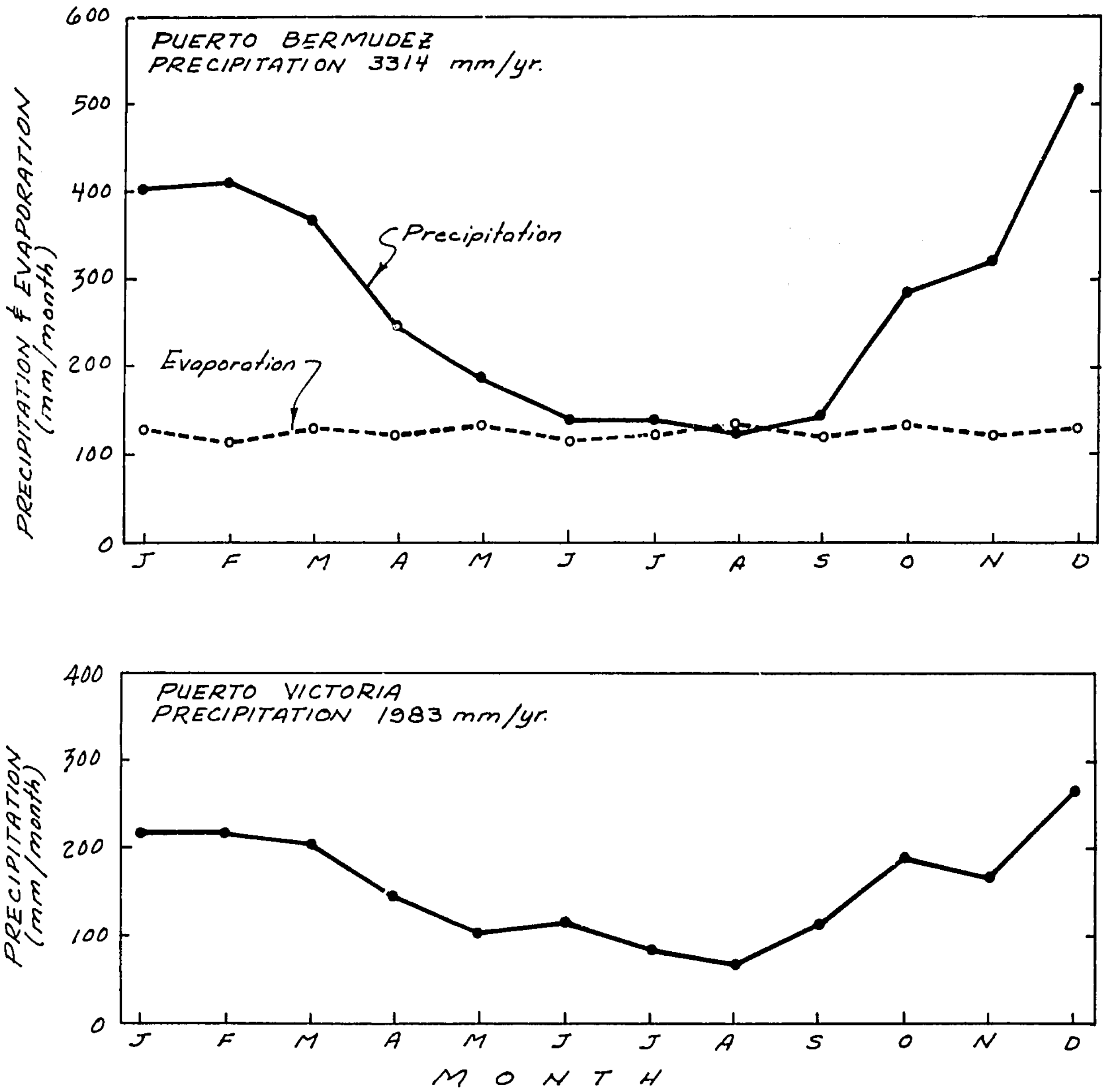


Fig. 2 - Monthly rainfall at Puerto Bermudez and Puerto Victoria. Monthly evapotranspiration at Puerto Bermudez is estimated based on temperature using the Life Zone System.

within the Palcazu Valley should be very similar, with an appropriate correction for differences in elevation. The temperature is nearly uniform year-around, with the dirunal temperature variation being much greater than the seasonal variation. Both the coolest and the warmest temperatures occur in the southern hemisphere "winter". The hottest days occur due to the prolongued absence of cloud cover during this season, and the coolest nights appear to occur when a daytime overcast (limited heating of the earth) is followed by a clear night (facilitating re-radiation of heat).

2.4. Evaporation

There is no reliable source of evaporation data within the study area, and evaporation data from Puerto Bermudez is so low that it appears to be incorrect. (The piche evaporation at Puerto Bermudez averages approximately 440 mm/year, which is estimated to be approximately equivalent to an annual pan evaporation of 700-850 mm/year. This conversion is based on simultaneously-recorded evaporation data for one year at Tarapoto using a Class A pan and piches at three different heights).

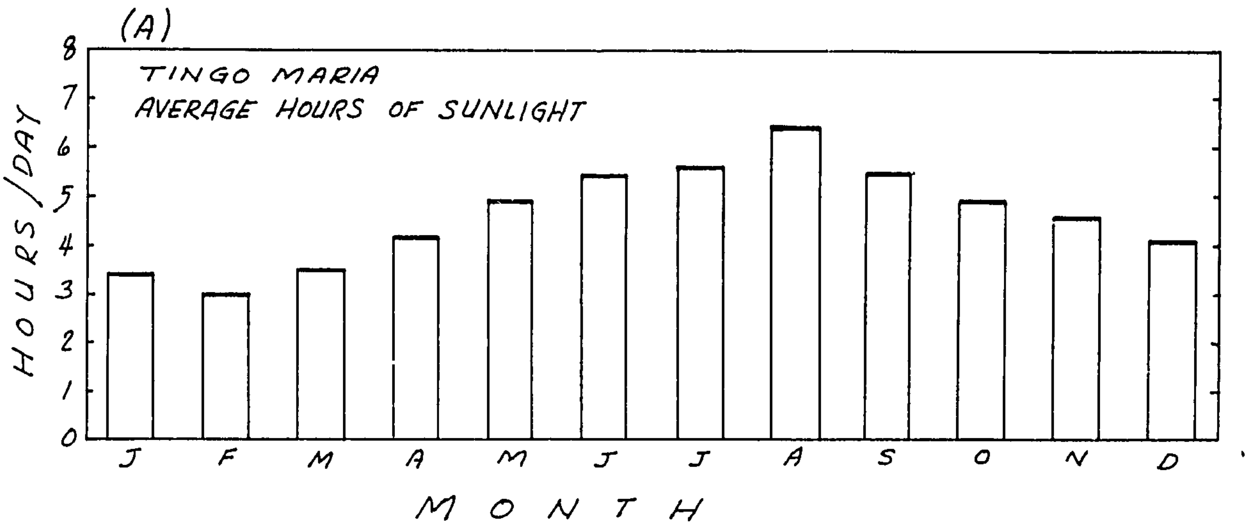
Evaporation is estimated to be approximately 1,500 mm/year,calculated on the basis of biotemperature using the Holdridge life zone system. Monthly evaporation at Puerto Bermudez estimated by this method was shown in Fig. 2.

3. RIVER CHARACTERISTICS

There is no data available on river flows, sediment yield, or other characteristics of the fluvial regime.

3.1. Flooding

The maximum river flow will occur in the months of highest rainfall and flooding will be most probable during December and January. Valley



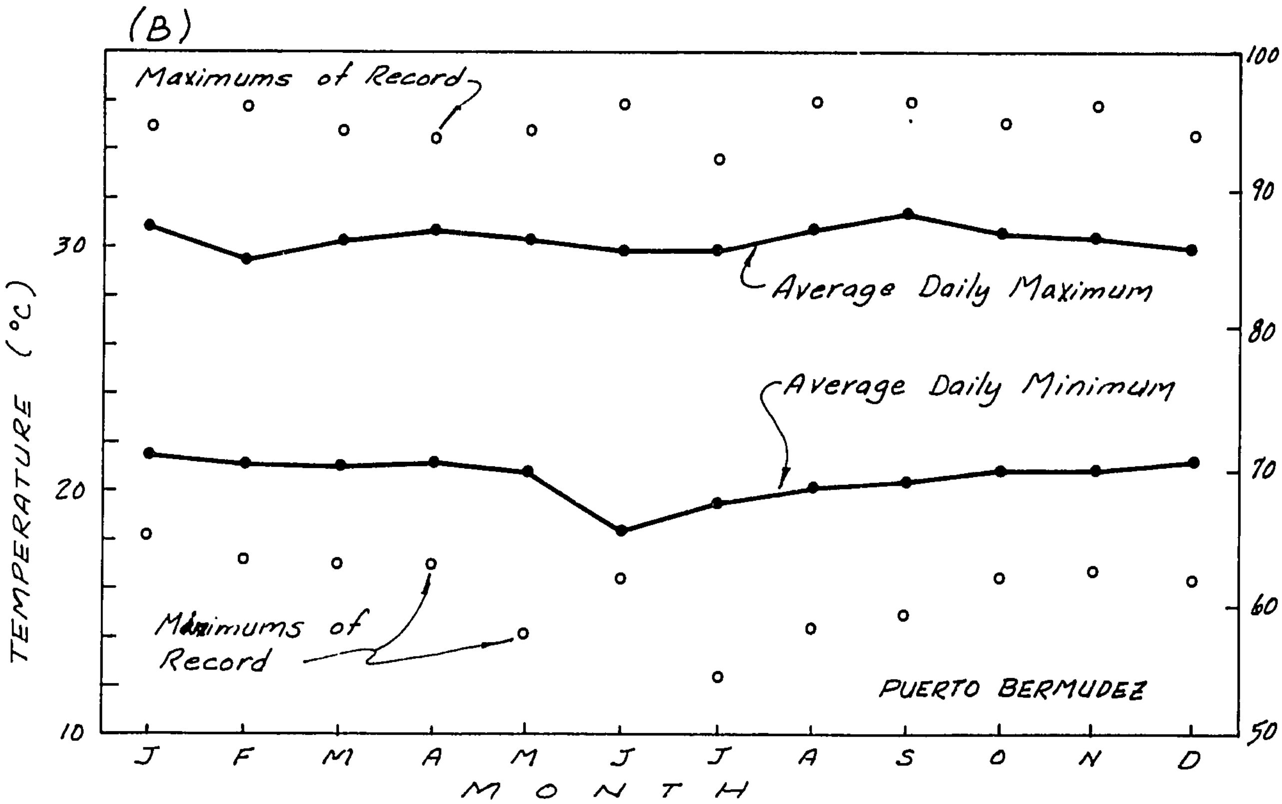


FIG. 3 - (A) Average hours of sunlight per day at Tingo María, by month
(B) Temperature regime at Puerto Bermudez, by month.

residents have reported that large floods (having a return interval of approximately once 10-20 years) will reach or exceed a stage of approximately 6 meters above the low flow level of the Palcazu River.

3.2. Sediments

The amount of sediment delivered to rivers and carried downstream increases dramatically during flood periods; the heavy rainfalls which are associated with flooding have high erosive power. Visual observation of the Palcazu gravel beds indicated that they were fairly well sorted, and are not subjected to heavy sediment loading. This is in dramatic contrast to the neighboring Chanchamayo valley, where heavy development pressure, including cropping on the steepest slopes, has generated severe erosion. Streams throughout the Chanchamayo valley have become braided with sediments in response to the heavy erosional load.

3.3. Navigation

The Rio Palcazu is navigable in a light dugout with an outboard motor as far upstream as Loma Linda. During the dry season, however, the boat must be pulled across numerous rapids between Iscozacín and Loma Linda, as is also the case if any of the tributaries are to be ascended (e.g. Mayro, Lagarto, Chchurras and Iscozacín Rivers). During the dry season a 50 ft. dugout (5 ton cargo capacity) equipped with an outboard can reach Iscozacín, but only with extreme difficulty inasmuch as the boat must be unloaded and the cargo portaged across several rapids upstream of Puerto Mayro. Dry season travel time from Puerto Mayro to Iscozacín in a light dugout is approximately 4 hours, whereas a cargo canoe will require approximately two days. Travel time from Pucallpa to Puerto Mayro is approximately three days. River freight rates from

Pucallpa to Isoozación is S/.100/kilo, whereas air freight from San Ramon to Isoozación is only S/.60/kilo. The reason for the high cost is attributed to the need to use an outboard motor; cheaper inboard diesel motors can be used only as far upriver as Puerto Inca.

River freight from Pucallpa is the major form of freight movement to Puerto Mayro, whereas the use of air freight predominates further upstream in the valley. Similarly, cattle in the northern (downstream) end of the Palcazu valley tend to be exported via the river, whereas in the southern (upstream) portions of the valley most beef is exported by air to San Ramón.

River freight is used in the Palcazu Valley for lack of any other transport facilities. Freighting on the river is difficult and costly, and will be replaced by overland freight when road links are completed.

3.4. Hydropower Potential

Considerable hydropower potential is expected to exist in the Yanachaga mountains, but no work has been undertaken to identify potential hydropower sites.

4. WATER SUPPLY AND SANITATION

All Palcazu residents draw their drinking water from rivers, streams, and shallow groundwater seeps. Boiling is the only treatment used and appears not to be a widespread practice. While there is no data available on the bacteriological quality of water supplies within the region, in view of the existing sanitary practices it is certain that the major streams are contaminated. However, the area is replete with small creeks and seeps which drain uncontaminated forested areas, and in several areas these supplies are used for community water supply. There are reportedly no wells within the valley, nor has there been any real effort to dig wells due to the availability of surface water supplies.

The construction of latrines, the boiling of drinking water, and general concepts of hygiene are being promoted through the area through a system of "Postas Sanitarias", each operated by a sanitary technician with limited training. The sanitarians report that some progress is being made in improvement of hygiene, and also report that there appears to be a decreasing incidence of hygiene-related diseases. Nonetheless, considerable work remains to be done within the communities which have Sanitary Posts. The problems in the communities not having Sanitary Posts, and among the rural population, can be expected to be more severe. David Tolliday (OXFAM, Shiringamazu) estimated that perhaps 20% of the Amuesha utilize latrines, and that even basic hygiene concepts are largely absent. There is no sanitary post at Shiringamazu. No community within the area has an improved potable water system, although some systems are being developed at this time.

A wide variety of gastro-intestinal and waterborne infectious diseases occur within the area, and 100% of the school-age children are reported to be infected by parasites (Marks, 1981). The combination of proper waste disposal and the provision of uncontaminated water supplies will provide the most effective single impediment to disease transmission. Nonetheless, even with these improvements other important modes of disease transmission will still remain due to the lack of sanitary practices in the preparation of foods, plus contamination from domesticated and other animals.

5. POTENTIAL PROJECT IMPACTS

5.1. Proposed Project Activities

The basic objective of the proposed Palcazu Project is to colonize and integrate this high jungle valley into the national/commercial economy of Peru by extracting forest resources and producing agricultural products, principally livestock. Colonization and economic integration will be promoted by road construction, providing transportation links to Villa Rica and thence to other areas of the sierra and coast. The Palcazu area is now serviced only by single-engine aircraft operating from grassed airstrips, and by outboard-powered canoes.

The environmental effect of road construction will be very small--"or even negligible"-- compared to the impact created by the colonists and commercial interests which will follow the road into the area. The creation of access through road construction is anticipated to result in two broad types of major impacts on the hydrologic system:

1. The influx of colonists will increase the demand for drinking water supplies while simultaneously increasing waste discharges to the environment.
2. Large areas of lands will be cleared and converted to croplands or pasture, with resultant increase in runoff and erosion.

Principal adverse impacts which are anticipated include:

1. Increased contamination from human and livestock wastes (adverse impacts on water supply and human health).
2. Increased erosion and increased sediment load carried by streams (adverse impacts on fisheries, navigation and loss of soil fertility.)

3. Reduced low flows in streams (adverse impacts on fisheries, water supply, and navigation).

4. Increased flood flow (adverse impact on fisheries, damage to structures, and loss of livestock).

5.2. Water Supply Contamination and Health

5.2.1. Problem description

The residents of Palcazu rely on surface waters or shallow groundwater seeps for drinking water. Although these water supplies are readily subjected to contamination, most individuals and communities are able to obtain water from relatively uncontaminated streams which have watersheds protected by forest cover.

Intensive land clearing, colonization, and livestock production will compromise the integrity of existing water supplies. The forests in water-supply watersheds will be cut and replaced by sources of contamination: dwellings, domesticated animals, and herbicides. New colonists will seek water supplies near their dwellings, and with increasing deforestation it will become infeasible to obtain water supplies from streams which are not contaminated. There is a clear danger that colonization will thus exacerbate existing health problems in the area.

5.2.2. Recommendations for water supply

Simple water supply systems using public fountains should be constructed to serve each community. It appears that virtually all communities have a nearby source of water supply coming from a forest area which has been-- or could be --developed as a relatively safe source of water supply. These water supply watersheds near each community should be identified and reserved perpetually for the provision of a safe and reliable water supply. It may be possible to also use these areas for the limited and controlled extraction of forest products such as fuel wood. Where at all possible, groundwater seeps or springs should be developed for water supply instead of surface streams because they are less-easily contaminated. Simple chlorination and storage facilities might be justified for larger communities in the future.

At the existing level of development, most rural families do not face a problem in obtaining adequate supplies of high quality drinking water. However, as population pressures increase the level of contamination will also increase. Thus, rural families should also be encouraged to set aside the upper watershed of smaller streams to serve as the source of water supply for the family or for groups of families. Again, this protected forest could be harvested on a limited sustained yield basis. Where it is not possible to identify or protect a water supply watershed, water supplies for rural families may be provided from simple wells or infiltration galleries constructed in or next to stream beds.

At the very beginning of colonization it will be particularly important to educate colonists and communities of the need to reserve a forested watershed for water supply, before these watersheds are cleared for agricultural purposes and their water supply value is destroyed. Identification and protection of water supply watersheds should be an integral part of the development program.

Hygiene education for rural families, and particularly encouraging the use of latrines and boiling of drinking water, is an educational need which is not currently being met. This will become more important in the future as the population grows and rural families are exposed to increasing levels of contamination.

5.3. Changes in Volume of Streamflow

5.3.1. Problem Description

One of the most fundamental effects of deforestation is to dramatically alter the hydrologic character of the watershed as a result of changes in vegetative cover and the resultant changes in soil structure. In the Palcazu area virtually all deforested lands have been converted to pasture, and the conversion of forest to pasture will probably continue to be predominant land use trend in the future.

The removal of forest vegetation and initiation of grazing results in soil compaction, decreased soil permeability, and decreased water-holding capacity. This decreases infiltration during rainstorms and increases the percentage of total rainfall which flows overland and is rapidly discharged to rivers, resulting in higher flood levels. Conversely, the minimum flow or "base flow" of streams between rainstorms, and during the dry season, is decreased because a smaller percentage of rainfall was able to percolate into the soil column, from which it could be released slowly over a longer period of time.

5.3.2. Effect on flood hazard

Deforestation increases the total amount of runoff from a given rainstorm, as well as increasing the rates at which the overland flow is delivered to streams. Both factors increase the severity of flooding. This problem increases in severity as the soils slope increases. No studies have been undertaken to determine the relative magnitude of the increased flooding hazard stemming from deforestation in this area, and there is currently insufficient data on the Palcazu watershed to make such a determination. However, it should be recalled that there is virtually no flat land within the Palcazu watershed.

Flood hazard will be increased due to higher levels of floodwaters as well as an increase in the frequency of severe flooding. This will increase the damage to structure, equipment, and crops which are located within the floodplain. Drowning of livestock will also occur, and some farmers in the Palcazu area have already lost livestock to floods.

At the current limited level of deforestation, the water level in severe floods (approximately once in 10 or 20 years) inundates the Iscozacín airstrip, and river levels may rise approximately 6 meters above low-water stage from Pto. Mayro to Chaparral.

Flooding is not currently a severe hazard within the valley. The probable levels of flooding are well-known and are respected by local residents, and damage is not great due to the low level of development within the valley. However, the severity of these effects will increase as the area becomes more developed. Not only will flood levels increase due to deforestation, but there will also be more structures to be damaged.

5.3.3. Effect on navigation

As a result of decreased infiltration and storage of rainwater within the soil column, the base flow of streams and rivers will be decreased. If deforestation is limited to only the valley floor, the decrease in base flow of the Rio Palcazu-- and the effects on dry-season navigation-- will probably not be significant. A more severe impediment to navigation will be the increased delivery of eroded materials to the rivers, which is discussed elsewhere.

Inasmuch as surface transportation is expected to largely replace river transport, the economic effect of decreased river navigability will probably be small or negligible.

5.3.4. Effect on fisheries

Decreased low flow will have an adverse effect on fisheries due to reduced habitat areas and possible interference with life cycle processes. However, a far more important effect on fisheries will probably stem from increased sediment loading in the rivers during the flood stages.

5.3.5. Effect on water supplies

Deforestationwill decrease the base flow streams and shallow groundwater seeps which are used for water supply. However, the water resources throughout the valley are so copious compared to any imaginable level of development that the lack of sufficient volumes of water should never be a problem. Rather, the major deleterious effect on water supply resulting from deforestation and colonization will be due to increased contamination, which has already been discussed.

5.4. Increased Erosion and Sediment Transport

5.4.1. Problem description

The beef production techniques used in the Palcazu area are land-extensive; the yield of the grazing operations is increased not by improving management of existing pastures, but by continuously converting additional forest lands to pasture. Basic soil conservation practices are not applied to existing pastures, and the expansion of pastures lands exposes an ever-enlarging area to accelerated erosion.

Much of the existing pasture has been developed on level river terraces. However, since most of the level soils have already been exploited, future pasture areas will be developed on sloping soils on which erosion potential will be considerable. Thus, doubling the amount of pasture in the Palcazu will more than double the amount of erosion and the sediment load delivered to the stream.

It is also possible that with increased colonization pressure and limited land availability, there will be a tendency to overgraze and overutilize the soil resource. This could increase the rate of erosion per unit of land area above the existing rate of erosion. On steep slopes the action of cattle will form terraces which can lead to severe erosion and gully formation. Severe erosion along streambanks--including gully formation-- occurs when streambank vegetation is removed.

Erosion could be significantly reduced by retaining forest vegetation on riverbanks, in the bottoms of small creeks, and on very steep slopes. However, the customary practice is to remove all forest vegetation from pastures so that cattle do not become accustomed to entering forested areas. This is necessary because pastures are generally not fenced and the forest boundary itself is used to contain cattle.

5.4.2. Effect on fisheries

The report by Bayley (1981) outlines the importance of existing river fisheries as a source of protein for Palcazu residents. Intensive colonization and land clearing will completely alter the hydrologic regime of the river to the point that this fisheries resources can be completely destroyed. In addition to hydrologic change, the fishery will also be subjected to higher harvest pressure as the population increases.

The major impact will be caused by the increased incidence and severity of flooding, and the increased sediment concentration which these floodwaters will carry compared to existing conditions. Sediments deposition in the streambed will eliminate habitat and restrict feeding, and heavy sediment concentrations can cause fish kills through suffocation. Deeper pools can become filled with rocks and the streams themselves will become braided in response to the large amounts of sediments and cobbles which are washed from unprotected slopes. It is also probable that the pH of the river streams will become slightly more acid, particularly during flood events. However, the extent to which this factor may contribute to the disturbance of fisheries is unknown.

If the Palcazu Valley floor is completely deforested and colonized, without the benefit of adequate soil conservation measures, it is certain that the fisheries resource will be destroyed. It is possible that the hydrologic changes accompanying deforestation will be so great that the fisheries will be destroyed even with good soil conservation practices. This will probably have a significant adverse effect on the Amuesha, who are highly reliant on fisheries and hunting for protein. Development of suitable alternative protein sources for the native communitiesshould fit within existing subsistence agricultural activities.

5.4.3. Effect on navigation

The sedimentation of rivers and the conversion of existing watercourses to braided conditions will make rivers non-navigable. However, the economic effect of decreased navigability will probably be limited because river transport will be largely replaced by road transportation.

5.4.4. Recommendations to limit sedimentation

Increased erosion and sediment loading in rivers will be an unavoidable effect of the project.

In many areas active streambank and gully erosion is already underway, and yet no soil conservation techniques are practiced in the Palcazu area to stabilize these areas of active erosion. These areas can probably be best stabilized through the selection and planting of apropriate natural vegetation which can sprout from sprigs or easily-collected seeds. The identification and demonstrations of the use of natural species for erosion control should be undertaken as a project element.

Several key elements which can be incorporated into the project to minimize erosion and sedimentation are:

1. Maintain stream and riverbank vegetation, and to the extent possible also maintain a buffer strip of natural vegetation several meters inland of the top of the riverbank.

2. Maintain all lands outside of the valley floor itself in natural forest cover.

3. Use technical assistance to avoid overgrazing, particularly on slopes.

4. Use natural species for erosion control plantings.

6. RECOMMENDED DATA COLLECTION

Climatological stations should be established at three points in the Palcazu Valley: Loma Linda, Iscozacín, and Puerto Mayro. These stations could be operated by personnel from the Pichis-Palcazu Special Project Office, which has or plans to have a local office in each of these communities. Due to personnel restrictions, monitoring at Loma Linda and Puerto Mayro should be limited to only the most basic.

It is recommended that the following types of data be collected at each site:

Iscozacín	Loma Linda and Puerto Mayro
Rainfall (daily)	Rainfall (daily)
Temperature (max. & min.)	Temperature (max. & min.)
Pan Evaporation	
Solar Radiation	

This is the most basic type of data which is useful for determining the climatological feasibility of various agricultural alternatives. This data will also be essential for comparing the agricultural experience obtained in the Palcazu Valley to other areas in Peru having similar climatic conditions.

Accurate streamflow data is much more difficult to obtain than climatological data. Because there is no real need for accurate streamflow data, and due to the cost and difficulty of obtaining data which is accurate, no streamflow monitoring program is recommended at this point.

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APPENDIX K

AGRICULTURAL POTENTIAL AND NATURAL RESOURCES MANAGEMENT OF THE PALCAZU VALLEY, PERU

Douglas J. Pool

CONTENTS

TABLES

1. ISSUES

1.1. The successful colonization and sustained yield agriculture/forestry of the upper selva has not been achieved in Peru since politicians and rural developer planners refuse to recognize the socio-economic and ecological limitations of the natural resource potential (Nelson, 1973 and Bunin, 1981). Even with the planned road construction, the Palcazu valley cannot realistically be expected to be the "breadbasket" of Peru due to the limited availability of fertile soils, extremely wet climate, and sharply dissected topography. The best soils of the valley are already occupied by colonists or native communities and the potential for additional colonization is limited.

1.2. Considering the socio-economic and ecological limitations of the area, the success of the Palcazu development depends not only on the energy inputs necessary to increase agricultural and forestry output, but also the ability of the GOP institutions, native communities, and resident colonists to incorporate appropriate strategies of natural resources management.

1.3. The extent and location of lands suitable for livestock production is controversial since some of the areas overlap with more intensive potential uses (annual crops) while other areas have been classified as forestry production or watershed protection due to high rainfall and steep slopes. Expansion of livestock activities to marginal areas increases the risks of erosion and degradation of natural resources.

2. RECOMMENDATIONS

2.1. The deforestation, conversion to pasture and livestock expansion will accelerate upon construction of any road in the Palcazu. Serious environmental consequences (Table 1) could result unless the land titling process is completed and land use zoning is immediately implemented in an overall management plan. Activities in order of priority include: overall project management and administration, strict land use zoning, land titling, distribution of economic land holdings to native communities as well as colonists, agricultural research and extension, forestry and watershed management, and national park establishment.

2.2. Any increase in agricultural production will have to come from intensifying the use of relatively level, fertile soils and increasing yields by improving traditional methods of production (i.e. low level inputs of fertilizer and pesticides).

2.3. Emphasis on agricultural extension and research will focus on improving existing livestock and crop production systems and appropriate small farm technologies that promote the productive, sustained use of natural resources by current valley residents. Management of small farms which include crop and pasture rotations, nutrient cycling, as well as integrative crop/small animal production units will be emphasized.

2.4. USAID funding should de-emphasize colonization. Resident colonists and Amuesha are in a critical land situation. Redistribution of available valley lands should consider economic family units to include at least one of the following units:

10 ha. of lands capable of intensive annual cropping, 30 Ha. of permanent cropped lands, and 50 has. of lands capable of pasture production.

2.5. The experience in Peru has demonstrated that the construction of roads, establishment of agricultural production and credit programs solely has not been sufficient for the successful development of colonization schemes in the Selva. Therefore it is important that any project encouraging improvement of agricultural production needs to be accompanied by programs in technical assistance, marketing, research, agro-industrialization and education.

2.6. Coordinate agricultural research and extension projects with La Molina, Ministry of Agriculture, INIPA, Yurimaguas Tropical Soils Experiment Station, REDINAA, as well as ongoing selva development projects (i.e., Upper Huallaga Agricultural Development).

TABLE 1 - DEVELOPMENT SCENARIOS AND ENVIRONMENTAL CONSEQUENCES

SCENARIOS

IMPACT/ACTIVITY	CONSEQUENCE	MITIGATION
Forest to pasture conversion	loss of forest resource, poor pasture, low livestock production, erosion	Encourage pasture improvement by extension and applied research. Do not fund livestock development projects.
Cultivation of marginal soils	low production	Encourage agricultural production on best soils; improve extension and establish research applicable to these social and ecological conditions
Road construction/uncontrolled spontaneous colonization	Continued subsistence level of living	Design project to favor resident native communities and colonists.

3. INTRODUCTION

3.1. Scope

This report was prepared to assess land and resources capability/suitability of the Palcazu valley as well as to aid in definitition of specific projects in agriculture, crop improvement, and soil management that AID might wish to sponsor. This evaluation, carried out during the period 31 August and 13 October, 1981 included seven field days in the Palcazu, three days in surrounding areas (San Ramon and Satipo) and the remaining time reviewing documents, discussing project design with PEPP, AID, and fellow evaluation team members and preparing the final report. Specific terms of reference, work schedule and persons interviewed can be found in the annexes.

3.2. Existing Conditions

3.2.1. The Palcazu watershed consists of approximately 189,208 has. (PEPP, 1981) settled by an estimated 10 - 15,000 people including Amuesha, foreign and migrant colonists (Miller and Martínez, 1981) and(Smith, 1981).

3.2.2. A re-evaluation of valley lands (95,000 has.) adjacent to the proposed road indicates that only 7.6% (7,200 has.) is appropriate for intensive management of clean cultivated crops. Permanent crops (14.4%) and pastures (13.3%) cummulatively account for 27.7% of the lands, whereas, forestry (46.2%) and protection lands (18.5%) account for nearly two-thirds of the total area evaluated by Tosi (1981).

3.2.3. The special project office (PEPP) responsible for the development of the Palcazu, recognizes that a large scale regional development project is unrealistic in terms of the area's potential for colonization and constraints on widespread intensive agriculture.

The progress report of the PEPP Office (July, 1981) states that development limitations include:

- Restrictions for an intensive agricultural exploitation are due to the poor quality of soils and low carrying capacity of pastures as well as the irregular and diverse distribution of lands appropriate for agriculture.

- Occupation of alluvial soils by native communities and individual farmers widely dispersed throughout the project area. The possibilities of population increase and incorporation of agricultural productive lands by new colonizers are limited.

- Vulnerability of the tropical forest ecosystem which is susceptible to accelerated degradation due to inadequate management and conservation of resources.

3.2.4. The construction of the Pichanaz - Puerto Mairo road will encourage non-native populations to settle lands occupied by native Amuesha communities whose land titling process is incomplete. An estimated 3000 Amuesha Indians are claiming land title to 28,000 has. (Smith, 1981). Five more communities (785 people) are claiming an estimated 10,000 has. which are presently untitled.

3.2.5. Unsettled arable land is limited. Estimates indicate that at least 20,000 has. of the estimated 33,500 has. of land suitable for agriculture (annual and permanent crops, pasture) are already occupied or have land ownership claims (USAID, 1981 and Tosi, 1981). Agricultural land that is available for new settlers is located in the northern part of the Palcazu valley characterized by unoccupied hills with gently rolling topography, less humid climate conditions, but not accessible from the proposed road.

3.2.6. Soils are characterized as acidic, nutrient poor and highly erodable. Agricultural research and extension directed toward the management and conservation of these soils is particularly lacking.

3.2.7. An estimated 12,300 head of livestock and 3,200 head of pigs are raised by the Amuesha and colonists in the Palcazu valley. In 1980-81, an estimated 465,980 kg. of beef and 14,400 kg. of pork were shipped to San Ramon from the Palcazu. Beef production was calculated at 31 kg/year with individual producers reporting from 20 - 40 kg/ha/year (Staver, 1981).

3,2.8. Staver (1981) estimated beef production costs at S/.22,040/ha/year. At the present price of S/.720/kg of beef (prices of October, 1981) a gross return of S/.22,320/ha/year is realized or S/.120,240 animal based on a 167 kg carcass average. While it appears that Palcazu livestock producers are making a profit since their land was cleared and pastures established at pre-inflationary prices, livestock specialists at La Molina agree that extensive beef production systems cannot be economically intensified in eastern Peru.

4. AGRICULTURAL SETTING

4.1. Access

The current access to the Palcazu valley is via SASA air taxi service (San Ramon-Iscozacín, passenger airfare S/.6,500, Sept., 1981), on foot trails from Villa Rica, Oxapampa or Pozuzo or via river (Ucayali, Pachitea) from Pucallpa (2 - 3 days). Freight rates for boat transport from Pucallpa to Iscozacín are S/.100 Kg, whereas air freight from San Ramon to Iscozacín is S/.60/kg.

4.2. Geology

The Palcazu basin has been formed by the successive uplifting and erosion of sedimentary rocks resulting in topography of two types:

- The steep sided mountains, such as the Yanachaga, and sharp ridges with deeply incised river valleys, such as those on the Cacazu.

- The wider, sediment-filled valleys characterized with alluvial deposits and bench terraces.

The region is geologically young and consequently erosion has not yet reduced the mountains to the peneplains typical of geologically older areas: the down cutting of the major rivers and their tributaries through the sediment filling in the wider valleys has formed a very choppy terrace topography (TAMS, 1966). The Yanachaga mountains reach approximately 3000 m. above sea level whereas, the Palcazu valley floor ranges from 270 to 700 m. elevation. See Tosi (1981) report for more detailed explanation of the land form and geomorphological processes (Table 2).

4.3. Climate

Both Tosi (1981) and Morris (1981) discuss the climatic characteristics related to the ecological life zones and surrounding physical features of the Palcazu watershed.

Based on ecological life zone extrapolation,rainfall in the valley ranges from 2600 - 4600 mm/year and even higher in the Yanachaga mountains (Table 3). Temperature in the valley floor averages 25 - 26°C with extremes of 18 and 33°C. There are no months when lack of water limits plant growth. The months of June through September are considered less wet when burning is likely to be most successful whereas December through March are considered wet periods.

TABLE 2

SUMMARY OF LAND FORMS AND THEIR POTENTIAL USE (Tosi,1981)

LAND FORM	POTENTIAL USE
Alluvial Terraces	Intensive use, annual crops, pasture
Medium to High Terraces	Intensive use, annuals, tree crops, pastures
Low Hills	Forestry, permanent crops in specific sites
High Hills	Watershed protection
Mountain Slopes	Watershed protection

TABLE 3

SUMMARY OF ECOLOGICAL LIFE ZONES MAPPED IN THE PALCAZU WATERSHED
(Bolaños and Watson, 1981, ONERN, 1976)

GEOGRAPHIC POSITION	LIFE ZONE	SYMBOL	MEAN ANNUAL BIOTEMPERATURE (°C)	MEAN ANNUAL PRECIPITA. (mm)	RANGE IN ELEVATION (m)	POTENTIAL USE
Valley/hills	Tropical moist	bh-T	24-25	2900-3000	270-700	Agricultural use in good soils
	Tropical moist transition to perhumid	bh-T	24-25	3000-3200	270-320	Agricultural use in good soils
	Tropical wet	bmh-T	24-25	4000-4600	300-700	Forestry potential, permanent crops
	Tropical wet transition to Premontane	bmh-Tv	24-23	4000-4300	700-900	Watershed protection
	Tropical Pre-montane wet	bmh-P	21-24	3000-4000	700-1100	Limited agricultural use
	Premontane wet basal transit.	bmh-Pv	24-25	3200-4000	280-700	Permanent crops
Yanachaga Mountains	Premontane wet transit.to rain	bmh-Pv	21-23	4000-4500	800-1100	Watershed protection
	Premontane rainforest	bp-P	17-22	4000-5000	900-1650	Watershed protection
	Lower Montane rainforest	bp-MB	12-17	3600-5000	1550-2400	Watershed protection
	Montane rain-forest	bp-M	8-13	2500-4000	2400-3000	Watershed protection

Local residents revealed that mangoes produce irregularly, if at all which is an indication that there is no definite dry season, a requirement for good mango production.

Very few "unusual" weather events are recorded. During one site visit (September 15, 1981) it rained steadily for 15 hours raising water levels to cover previously exposed beaches and hazardous rocks, thus making river navigation more convenient. On September 28 a strong gale with heavy rainfall was reported in Iscozacín that sheared off bananas and plantains, broke branches of fruit and forest trees, and lifted sheets of zinc roofing. Local residents claim that these gusty winds are annual events that mark the change of seasons.

4.4. Ecological Life Zones

The detailed study of the ecological life zones (Bolaños and Watson, 1981) covers approximately 95,000 Has. or essentially the Palcazu valley floor extending from Loma Linda in the south to Codo del Pozuzo in the north and from the west bank of the Palcazu river to the steeply sloping hills at the base of the Yanachaga mountains. The results of this detailed analysis reveal that the area is more humid land than the life zone map of Peru (1976) indicates. The tropical moist (bh-T) life zone is most appropriate for agricultural development, but only covers 15% of the lands mapped on the valley floor. 40% of the area is classified as tropical wet forest characterized by more than 4000 mm annual rainfall making intensive annual cropping and pasture maintenance difficult. The crops and cropping systems that might be recommended for the tropical moist life zone cannot be expected to give the same yields in the tropical wet life zone due to higher annual rainfall and lack of definite dry season. Additionally, areas characterized with heavy -textured soils implies slow drainage that is detrimental to many annual and tree crops. Humid conditions imply more restrictive land uses for agriculture. These restrictions affect the cropping and livestock activities; whereas forestry use is more tolerant of wet conditions.

4.5. Land Capability and Land use

There exists a fairly good profile of the Native Communities (Smith,1981 as far as land use, crop, livestock and pasture production (Table 4). Data for colonists is scarce and in many cases unknown. As far as potential land use (Table 5), there are approximately 33,500 has. of agricultural lands (Tosi, 1981) of which an estimated 20,000 has. are already settled. A large block of Class A lands (intensive annual cultivation) are located near the Codo del Pozuzo, whereas the Class C and Class P lands are distributed throughout the valley.

4.6. Soils

Soils series mapped by ONERN (1981) based on 1974-1977 aerial photos were divided geomorphologically as follows:

a) recent alluvial soils of low terraces distributed along the principal rivers some of which are subject to annual flooding

b) old alluvial soils situated on nearby level terraces, gentle slopes and hills

c) soils derived from residual materials found on slopes and hills.

Soils are characterized by low fertility, low pH,and a considerable amount of exchangeable aluminum (Table 6).

TABLE 4

SUMMARY OF PALCACINOS

	AMUESHA	COLONISTS	TOTAL
Population	300	10- 12,000	13 - 15,000
Number of Families a/	419	2,000	2,419
Average total land per family (has.) b/	16.5	N.A.	
Annual Crop land per family (A)	2.2	N.A.	
Permanent Crop Land per family (C)	9.3	N.A.	
Pasture Land per family (P)	6.0	6.2	-
Livestock (head)	2,000	11,000	13,000

a/ If upper watershed and lower Palcazu is included there are 550 native families

b/ A, C. and P land in valley

TABLE 5

LAND USE CAPABILITY OF PALCAZU VALLEY BASED ON 95,000 HECTARES SURVEYED BY ONERN (1981) AND RE - EVALUATED BY TOSI (1981)

CAPABILITY CLASS		TOTAL AREA	
MAP	APPROPRIATE USE	HECTARES	%
A	Continuous cultivation, annual row crops	7,200	7.6
P	Pastures	12,671	13.3
C	Permanent crops (fruit trees, cacao, pineapple, palms)	13,653	14.4
	Total agricultural lands	33,554	35.3
F	Forestry	43,796	46.2
X	Protection	17,680	18.5
	Total Area	95,000	100.0

Note: Refer to Tosi (1981) Land Use Capability Evaluation for detailed discussion of methodologies and definitions

TABLE 6

EVALUATION OF THE SOIL FERTILITY IN THE PALCAZU VALLEY (ONERN, 1970) a/

SERIES	AREA Ha	% Total	pH	Total N	Avail. P	Exch. K	Al Sat.%
Iscozacin	3,810	1.9	5.3	.162	6	.28	-
Pozuzo	800	0.4	4.9	.584	8	.18	-
Palcazu	16,200	8.2	6.8	.262	11	.31	-
Ispoacazu	12,300	6.3	7.0	.112	2	.10	0
Pachitea	5,996	3.1	6.0	.261	3	1.07	0
Chuchurras	4,200	2.1	5.0	.189	2	.18	-
Chorrillos	4,348	2.2	4.6	.311	20	.22	49
Charapa	3,000	1.5	4.8	.230	3	.21	44
Lagarto	14,510	7.4	4.9	.319	6	.14	-
S.Cristobal	10,162	5.2	4.6	.303	6	.14	-
Yanatias	35,600	18.1	4.4	.238	3	.20	81
Pichis	28,390	14.4	4.7	.450	2	.33	90
Matias	5,700	2.9	4.8	.247	2	.14	80
Esmeralda	3,900	1.9	4.8	.378	2	.15	73
Bermudez	34,480	17.5	4.8	.146	2	.21	81
Pucallpa	2,998	1.5	3.7	.129	6	.17	-
Hilea	5,996	3.1	4.6	.138	2	.13	83
Other	4,140	2.1					
TOTAL:	196,570	100					

a/ Original soil studies covered area from Pichanaz to Puerto Mairo and the left hand margin of the Pozuzo River and Lower Palcazu (Section Pozuzo - San Pedro).

4.7. Soil Fertility

Although the nutrient reservoir of acid soils is especially poor, the fertility of some soils increases immediately after forest burning due to the incorporation of organic matter and release of nutrient from leaves, branches, seeds, etc. As a consequence, it is frequently observed that yields diminish rapidly when these soils are continuously cultivated without applying fertilizers or allowing a period of forest follow. Yield reduction is a natural phenomenon of most unfertilized soils no matter where they are located, but a particular limitation to the continous cultivation of acid soils in high rainfall areas such as the Palcazu. Adequate levels of major soil elements for normal crop plant growth are given in Table 7 to be used as guidelines in evaluating soil test analysis of the Palcazu. No data is available for evaluating minor elements.

To date it is still controversial as to what level of technology is appropriate for the Palcazu. Most soil and plant deficiency problems can be resolved through liming and fertilization, but the costs are high and the technological transfer is not complete. The level of technology including energetic inputs and infrastructure must be adapted to the capacity and ability of the colonists and Amuesha to absorb it.

5. CROP PRODUCTION

5.1. Estimates of Cultivated Area

Available data (Villachica, 1981; Muro, 1981, INIPA, 1981) indicates that areas planted to annual or permanent crops are small and generally insignificant in their contribution to the regional economy (Table 8). Total crop production per farm is very small and in many cases unregistered.

TABLE 7

ADEQUATE LEVELS OF MAJOR SOIL ELEMENTS FOR NORMAL CROP PLANT GROWTH (VILLACHICA,1981) 1/

NUTRIENT	ADEQUATE	DEFICIENT
Nitrogen	.15%	.15%
Phosphorus (available)	15 ppm	7 ppm
Potassium (exchangeable)	130 meq/100 g	.15 - .20 meq/100 g

1/ Acid soils present problems of aluminum toxicity to susceptible plants when aluminum saturation is greater than 30-40%. Depending on the particular soil, at least 3-4 tons/ha. of lime will be required to raise the pH toward neutral ranges where crop plants grow best. This liming will last for at least three rotation crops or three years and then needs to be repeated.

TABLE 8

ESTIMATED GROSS AGRICULTURAL PRODUCTION IN THE PALCAZU VALLEY - 1980 a/

	HARVESTED AREA (ha) Colonist	Amuesha	TOTAL	YIELD d/ T/ha.	TOTAL Production	PRICE b/ S/./kg.	GROSS VALUE (000 Soles)	
ANNUAL CROPS					Tons.			
Rice	100	215	315	1.0	315	90	28,350	
Beans	20	32	52	.7	36.4	100	3,640	
Corn	100	234	334	1.2	401	50	20,000	
Yuca	300	217	517	12.5	6,462	20	129,250	
Peanuts	-	3	3	1.2	36	100	360	
TOTALS:	520	701						153,250
PERENNIAL CROPS								
Plantains	150	143	293	7.0	2,051	50	102,550	
Citrus	10	10	20	8.0	160	30	4,800	
Cacao	4	12	16	.4	6.4	680	4,352	
Achiote	100	?	100	1.0	100	150	15,000	
TOTALS:	264	165						126,702
LIVESTOCK c/								
Beef			2790		466	420	195,711	
Pork			480		14	350	5,040	
TOTALS:								200,751
ESTIMATED GROSS AGRICULTURAL PRODUCTION								480,763

a/ Areas of crop production have been based on recent census of the native communities (PEPP, 1981) and estimates of the Distrito Agropecuario de Puerto Bermudez (1979-80 campaign) (Villachica, 1981). Although coffee is produced in the upper watershed, no data was available concerning areas cultivated.

b/ Data reflecting realistic farm gate prices is conflicting. Guesstimates are based on Villachica, 1981; Muro, 1981; and interviews with Palcazu farmers.

c/ Meat flown to San Ramon 1980-81, (Staver, 1981). Total number of cattle sold was calculated by dividing the total weight of meat by an average carcass weight of 167 kgs. Estimated average pig carcass was 30 kgs.

d/ Yield estimates are problematic since there is very little reliable data. Actual yields were estimated from data generated in the Upper Huallaga Agricultural Development project (USAID, 1981), Villachica, (1981), Muro, (1981) and farmer interviews.

Pastures account for the largest land use in the valley (approximately 15,000 has.) since the livestock sector has a proven market outlet (Staver, 1981).

Coffee is cultivated in the higher elevations near Villa Rica and the upper portion of the Cacazu; whereas, very small plantings of annual crops (corn, rice, beans, peanuts) are found on the alluvial soils of the Palcazu and its tributaries. Yuca, plantains, bananas and taro as well as fruits such as papaya, pineapple, sour sop, guava, and pejibaye are planted in subsistence plots close to the living quarters.

5.2. Marketing

Most of the agricultural products are produced for home consumption or consumed within the region. Rice and bananas are occasionally transported to Pucallpa via river. There are no storage facilities for basic grains in the area since there is not sufficient production to warrant it. Food crops and cattle produced by the Amuesha are generally sold to colonists who act as intermediaries (Miller and Martínez, 1981). Agro-Yanesha has initiated efforts to commercialize their agricultural products to markets in San Ramon, Pucallpa and Lima and should be used as a model for establishing future marketing linkages.

5.3. Yields

Yields reflect conditions of subsistence agriculture typical of roadless areas of the Peruvian Selva that lack market access. Yields can be increased with the addition of fertilizers, but the access and the marketing situation do not justify those added costs under the present conditions (Table 9).

TABLE 9

CROP YIELDS OF THE PALCAZU VALLEY a/

CROPS	ACTUAL YIELD (TONS/HA.)	WITH FERTILIZER b/
ANNUALS		
Rice	1.0	2.0 - 3.0
Beans	0.7	1.0 - 1.5
Corn	1.2	2.5 - 3.0
Peanuts	1.2	1.5 - 2.0
Yuca	12.5	15.0 - 20.0
PERENNIALS		
Plantain	7.0	10.0 - 12.0
Cacao	0.4	0.6 - 0.7
Citrus	8.0	10.0 - 15.0
Pineapple	6.5	12.0 - 20.0
Achiote	1.0	1.5
Rubber	.6	N.A.
Pejibaye c/	20	30

a/ Estimates based on USAID (1981), Villachica (1981).
b/ Improved agronomic practices and level of management as well as use of inputs are factors that determine yield and crop profitability.
c/ Pejibaye is grown occassionally arround homesteads but not commercially. Yield estimates are based on producing trees in Costa Rica. (CATIE, 1979).

5.4. Costs of Production

The absence of planting schedules and crop projections is a consequence of migratory agriculture, lack of infrastructure and technical assistance and general isolation of the Palcazu. Some estimates of costs of production and projected incomes can be found in Villachica, 1981 and Muro, 1981 . These costs include inputs purchased and yield and value estimates (Table 10). Normally these estimates do not consider family labor and the added difficulties of transporting harvested products. Land clearing costs have been included in Table 11.

5.5. Level of Technology

Land clearing, planting, and harvesting is accomplished utilizing traditional methods especially intensive in hand labor. Since the crop production is difficult to market, the application of fertilizers does not have an adequate economic justification. Contrasting, improved seeds are rapidly accepted by farmers. However, frequently improved varieties require high levels of fertilization and pesticide use in order to reach the expected yields. For this reason it is frequently observed that traditional varieties outproduce improved varieties.

5.6. Agricultural Extension

As far as technical assistance, there are five recently graduated ag-extensionists assigned to the Iscozacín PEPP Office in addition to the two Ministry of Agriculture extensionists, however, their attention is directed toward livestock production rather than crop improvement or soil conservation measures. Frequently these technicians lack transport and supplies to adequately support farmers.

TABLE 10

POTENTIAL CROP INCOME PER HECTARE IN THE PALCAZU

(Based on USAID, 1981; Villachica, 1981; Muro, 1981; and findings of this study)

CROP	PURCHASED INPUTS	YIELD KG/HA.	SALE PRICE SOLES/KG.	GROSS INCOME	NET INCOME (Return to Labor)	LABOR PERSON DAYS	GROWING PERIOD (Days)	INCOME PER PERSON PER DAY (SOLES)
Annuals								
Rice *	22,541	1000	90	90,000	67,459	69	150	978
Rice **	82,203	2500	90	225,000	142,697	71	150	2010
Corn *	22,682	1200	50	60,000	37,318	65	140	574
Corn **	93,881	2500	50	125,000	31,119	38 a/	140	818
Peanuts **	23,661	1200	100	120,000	96,339	75	130	1285
Peanuts **	68,656	2000	100	200,000	131,344	75	130	1751
Beans *	20,092	700	100	70,000	49,908	63	120	792
Beans **	63,684	1250	100	125,000	61,316	63	120	973
Yuca *	53,570	12500	20	250,000	196,430	125	365	1571
Yuca **	139,361	17000	20	340,000	200,639	125	365	1605
Perennials								
Plantain	78,100	7000	50	350,000	271,900	80	365	3398
Plantain	186,220	10000	50	500,000	313,780	80	365	3922
Cacao *	94,336	400	680	272,000	177,664	76	365	2337
Cacao **	227,828	650	680	442,000	214,172	76	365	2818
Citrus *	72,380	8000	50	400,000	327,620	65	365	5040
Citrus **	215,405	15000	50	750,000	534,595	65	365	8225
Pineapple *	170,500	6500	35	227,500	57,000	153	365	373
Pineapple **	351,596	16000	35	560,000	208,404	153	365	1362
Achiote *	7,535	1000	150	150,000	142,465	68	365	2095
Achiote **	85,375	1500	150	225,000	139,625	68	365	2053
Rubber *	225,500	650	800	520,000	294,500	125	365	2356

* Traditional slash and burn agriculture without fertilizer where costs include improved seeds, transport of harvested crop and 10% miscellaneous costs.

** Yields and production costs (seeds, fertilizer, herbicide, pesticide, transport, interest charges, 10% miscellaneous costs) based on medium levels of technology as proposed in small farm improvement project.

a/ No land clearing costs.

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The agricultural extension and applied research program should be directed toward the small farmer utilizing integrated crop, livestock and small animal production systems.

TABLE 11

LABOR ESTIMATES FOR MANUALLY CLEARING ONE HECTARE OF VIRGIN FOREST (VILLACHICA,1981)

OPERATION	LABOR (Man-Days)
Cut underbrush	15
Cut trees	12
Cut limbs	6
Burn and cleanup	12
TOTAL: a/	45 man-days, each S/.1,300/day = S/.58,500 b/

a/ Utilizing a chainsaw for 8 days (S/.5,000 per day) reduces the total labor to 30 man-days per ha.

b/ Labor costs based on October, 1981 wages

6. SUITABLE CROPS FOR THE PALCAZU

Specific projects should attempt to diversify production per unit land area by incorporating associated and rotational crops which provide a variety of foods for the local diet as well as assuring the farmer continous food supply for his family. If a crop is lost or destroyed then he should have the flexibility to substitute another without losing income. All of these innovations, assurances, and efficiencies in integrated cropping/livestock systems should translate to an increased income for the farmer as well as an improved diet for his family and efficient use of appropriate lands.

6.1. Annuals

CORN - Local varieties (NC, Morocho, Pozuzo) are probably best adapted.

RICE - Several rice varieties are available from the Proyecto Nacional de Investigación de Arroz which are well adapted to high rainfall areas of the Palcazu.

BEANS - All types of beans are utilized in the local diet. Site selection and time of planting is very important in bean production since rainy periods can make harvest difficult. The varieties grown by the native communities are probably best adapted to the region.

PEANUTS - On fertile alluvial soils peanuts can be grown as a rotation crop.

SWEET POTATO - Camote is an underutilized dual purpose crop. The foliage can be utilized for animal feed and the tubers can be used for both animal and human consumption.

VEGETABLES - Even though leafy vegetables as well as tomatoes, peppers, egg plant and melons are difficult to produce commercially in humid climates, local varieties are available for the Palcazu growing conditions and could be planted for home consumption. Squash can be interplanted with corn or planted in the door yard garden.

6.2. Perennials

YUCA - This crop is well adapted to humid climates, poor soils, and is rarely attacked by insects or disease. Yuca could be an important crop if marketing is guaranteed and industrialization of yuca flour, starch, and leaf pellets is developed. Yuca is also easily intercropped while establishing long term permanent crops as well as planted in association with short term crops such as rice, beans and corn. Besides local varieties, research results from Tingo María, Tarapoto, Yurimaguas as well as CIAT and Brazilian efforts can provide access to improved varieties.

TARO - Pituca is very rustic and adapts easily especially in areas of heavy rainfall and poor soils. Although there is no industrial market developed, the tuber and leaf are well known components of the rural diet.

PLANTAIN - Already widely planted, the farmers of the region understand the cultivation methods and normally adapt suggestions from extensionists quite readily. Yields are generally quite good, but the establishment of an industrial market would encourage more plantings.

COFFEE - In the upper elevations of the Palcazu watershed, coffee is probably the best adapted crop. Plantains or forest species can be used for shade. Prices tend to be quite cyclic and the effects of the coffee rust will be reflected in lower yields.

CACAO - Careful handling and well managed fermentation will turn out a quality cacao that brings premium prices. Pejibaye palm might be used as shade so that fruit and heart of palm can be harvested as well as the cacao. The agricultural experiment station at Tulumayo has selected seeds that are disease resistant and yield well.

ACHIOTE - If a market is guaranteed for this coloring agent, then achiote cultivation should be encouraged despite the intensive labor requirements in harvest and drying.

FRUITS - Pineapple, papaya, citrus , passion fruit, guava, sour sop, breadfruit are all adapted to this area, but require an estabilized fruit processing plant and a fresh market outlet before widescale planting is encouraged.

AFRICAN OIL PALM - Since large plantations are required to support the industrial processing of oil palm, an investigation of the available lands is necessary before any recommendations can be made. The general dissected, broken topograpy of the Palcazu combined with the heterogenous distribution of appropriate lands for oil palm cultivation appear as major constraints against future development of such an industry.

RUBBER - With the quadrupling of the price during the 1970's, control of the South American leaf blight and improved grafting techniques the prospects for reviving the production of natural rubber in Peru appear favorable. However, the negative experience of 1950-60 when the Agrarian Bank cancelled all loans for rubber production has left few trained rubber collectors who understand the collecting/processing techniques nor the form of agro-silviculture that was generally practiced during the first four or five years of plantation establishment.

OTHER - Jute (Cochorus capsularis), kenaf (Hibiscus spp.), ramie (Boehmeria nivea), abacá (Musa textilis) and tropical nuts such as cashew, Brazil nut, and Macadamia all have development potential, but the lack of assured markets suggests that further study is needed before recommending these crops. Coconut would also adapt to the region, but again processing and commercialization are lacking.

6.3. The Pejibaye Potential

A potential tree crop that is not currently exploited in the Palcazu, but is known by the indigenous people for its fruit and other useful parts is the Pejibaye palm (Bactris gasipaes). It grows well and is adapted to a humid climate such as the Palcazu. It is thought to have grown wild on the eastern slopes of the Andes where it is known as "pijuayo" (CATIE, 1979). Because the fruit crop is seasonal, the indians had developed methods of storing the fruit, which they ate cooked and from which they prepared alcoholic drinks. The palm stems were used for house construction, tools, and weapons.

The most important product is the fruit. The edible portion is the dry floury mesocarp which contains oil, calcium, carotene, and ascorbic acid as well as high levels of phosphorus and niacine thus providing one of the best balanced foods in the wet tropics. According to CATIE reports (1979), food value appears to vary with the color, with red fruits containing more nutrients than yellow ones. In Central America, under average conditions pejibaye yields 30 tons of fruits and 4 tons of heart of palm per hectare per year. The pejibaya starts to yield fruit in three years.

Superior varieties are known which yield good quality fruits; however, widerspread multiplication is not practical since pejibaye do not breed true from seed. Vegetative propagation is practiced by severing ratoon shoots from the base of the preferred palm and planting them.

The second important product is palmito or heart of palm cut from the inner portion of the terminal bud, where the tender-young leaf bases are rolled around one another in cylindrical form. Palmito can be served fresh as well as baked or boiled. Removal of the terminal bud for Palmito kills the tree. However, since the parent tree has multiple suckers or ratoons it is possible to harvest successive trunks at proper size without impairing the production and harvest of fruits.

In Central America, a current production system utilizes pejibaye as high shade over cacao or coffee or in conjunction with annual crops. Investigations of the wood which is very hard and attractive are underway. An unexplored potential use of the fruit is the suitability as a large component for feed for pigs. Also the Yurimaguas tropical soils research station (North Carolina State University) is planting pastures under pejibaye palm.

7. AGRICULTURAL PRODUCTION PACKAGE

7.1. Economic Size of Farms

There seems to be little concensus of opinion as to the economic size of land holding necessary for not only feeding the family, but also generating a stable cash income.

The Ministry of Agriculture's Proyecto Integrado de Asentamiento Rural - Pichis-Palcazu suggests a minimum of 64 hectares per family for crop production, 120 hectares per family for livestock production, and approximately 90 hectares for mixed crop-livestock unit.

Muro (1981) suggests 8-10 hectares per family as a minimum for intensive annual crop production or 30 hectares per family utilizing the traditional shifting cultivation methods on poor soils only capable of growing permanent crops.

In order to project potential agricultural income of the Palcazu, cropping mixes and predicted incomes are presented characteristic of (1) fertile, level alluvial soils capable of intensive cultivation (class A lands); (2) areas with slightly sloping soils of low fertility most appropriate for cultivation of permanent crops (Class C land); and (3) areas for pastures and livestock production (Class P land). Realistically any agricultural land use plan implemented in the Palcazu will have to consider the heterogenous distribution of land classes. Under actual conditions each economic farm unit will probably consist of a mix of the three types described.

7.2. Cropping System for Fertile Alluvial Soils

The cropping schedule in Table 12 illustrates that the income generated from cultivating 8-10 hectares of which only 5-6 hectares are under cultivation at any one time amounts to approximately US$1347 per year or US$225/ha/yr or slightly higher with inputs of improved technology.

7.3. Cropping System for Sloping, Poor Fertility Soils

From a total of 30-35 hectares of land classified appropriate for pastures or permanent tree crops one hectare will be planted with corn and yuca while the permanent crops are becoming established. Ideally there would always be 1 or 2 hectares of yuca intercropped so as to supplement the pig ration which includes pejibaye and plantains. More exact proportions of the swine ration will be worked out as the farmers learn what specific quantities are consumed daily and what other locally available feeds may be incorporated into the ration that result in efficient gains. Eventually the permanent crops will take over the entire farm as fallow or pasture areas are incorporated into the scheme.

TABLE 12

CROPPING SYSTEM FOR FERTILE ALLUVIAL SOILS

CROP	HAS	ESTIMATED NET INCOME	
		Traditional	Low Level Technology
Cacao	2	355,328	428,344
Corn	1	37,318	31,119
Rice	1	67,459	142,697
Beans	1	49,908	61,316
Peanuts	1	96,399	131,344
Fallow or Pasture	4	-	-
TOTAL CROPPED LAND:	6	606,352	794,820

After the pejibaye starts to produce fruits (3 years), suckers or one of the multiple stems can be harvested for the heart of palm. Meanwhile, pineapple which is quite tolerant of acid soils can provide each income from the second year after establishment. The successful development of the small animal/permanent cropping scheme will increase present levels of farm income, provide a variety to the rural diet and at the same stabilize the rural population by encouraging long term production on appropriate lands. The crops production plan (Table 13) alone, will provide an income of US$1750/year or US$291/hectare/year which will be supplemented by pig production in year two or three. Characteristics of a pig feeding unit based on locally produced feeds can be found in the small animal project description.

7.4. Pasture Unit

Any livestock production can probably be combined with either of the above cropping systems as long as expansion for any of the agricultural activities does not exploit marginal lands. With pasture improvement and rotation as well as improved herd management, 50 hectares of pasture should be large enough to support a family. 56 kg of beef per hectare per year was an estimated potential production based on improving herd health and nutrition. Based on current prices the annual gross income comes to US$90/hectare or $4480 on 50 hectares. Other cropping/livestock combinations and alternatives exist and can be developed as appropriate.

TABLE 13

CROPPING SYSTEM FOR SLOPING, POOR FERTILITY SOILS

CROPS	HAS.	LABOR MAN DAYS	ESTIMATED NET INCOME (SOLES)	
			Traditional	Low Level Technolog
Pejibaye *	2	136	284,930	385,900
Pineapple	2	306	114,000	416,808
Corn/Yuca	1	88	116,874	146,873
Plantain	1	80	271,900	313,780
Unused land to be planted later	24			
TOTAL AREA WORKED:	6 a/	535	787,704	1,263,361

* Estimated - no data available for verification

a/ Eventually the entire 30 Has. will be cultivated to permanent crops increasing level of farm income.

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ANNEX

TERMS OF REFERENCE

LAND AND RESOURCE CAPABILITY - SUITABILITY: PROJECT DESIGN

AGRONOMIST, CROP-ECOLOGIST

Douglas J. Pool

- Evaluate existing agricultural systems in Palcazu Valley.
- Assess agricultural potential of Palcazu Valley in light of the proposed Palcazu Project.
- Evaluation and assessment should take into account the capacity of the various soils and lands in the Palcazu to support various crops and cropping methods.
- Determination of any wild or cultivated species or varieties which could be endangered by the project.
- Recommend methods to improve productivity, increase ecological compatibility, preserve existing genetic diversity in projected agricultural development.
- Outline specific projects in agriculture, crops improvement, soils management or related subjects that AID might wish to sponsor in the Palcazu.

ANNEX (Cont'd)

RESOURCE PERSONS INTERVIEWED

Universidad Nacional Agraria La Molina
- Dr. Hugo Villachica - Soil Scientist
- Dr. Rafael Franciosi - Tropical Fruit Specialist
- Ing. Arturo Carrasco, Tropical Livestock

INIPA
- Dr. José Muro, Soil and Crops Specialist

ONERN
- Ing. Victor Grande, Forest Ecologist
- Ing. Raul Bao, Soil Scientist

PROYECTO ESPECIAL PICHIS-PALCAZU
- Ing. Edmundo del Aguila, Director
- Dr. Carlos Velarde - Technical Coordinador
- Ronald Rojas Pebes - Economist
- Ing. Walter Mallma - Director at Iscozacín
- Arch. Jorge Miranda - Architect

Palcazu residents:

- Luis Egg
- Emma de Egg
- Francisco Wyngaert
- Alberto Zehnder

OXFAM
- Dr. Brian S. Pratt - Regional Director
- David Tolliday - British Volunteer, Shiringamazu

USAID
- Lee Twentyman
- George Wachtenheim
- Bob Adler
- John O'Donnell
- Debora Schulze
- Loren Schulze
- Bob Otto
- Frank Zadroga
- John D. Flood

WORK SCHEDULE

August	31	Arrive Lima
September	1-9	Review documents, visit ONERN, PEPP and AID offices
September	10	Land Travel Lima - San Ramon
September	11	Visit Fundo La Genova managed by Instituto de la Selva-citrus, papaya, coffee, reforestation. Travel overland to Satipo.
September	12	Visit Fundo Santa Teresa - citrus, corn, soya land clearing comparisons; Travel overland to San Ramon
September	13	Visited with Sr. Villachica discussing fruit production potential of the Palcazu
September	14	San Ramon - Iscozazin, PEPP discussions, logistical planning
September	15	15 hour rain. Boat travel to Puerto Mairo.
September	16	Rio Chuchurras - Villa America - Iscozazin
September	17	Iscozazin - San Ramon - Lima
September	18	Meet with evaluation team and Bob Otto to discuss project synthesis and format
September	19-25	Return to Puerto Rico
September	26	Review Tosi land capability evaluation
September	28	Meeting with PEPP, AID, and project consultants to design projects.
October	2	Lima - San Ramon - Palcazu overflight, overnight in Iscozazin
October	3	Return Lima
October	5-13	Report preparation

APPENDIX L

LAND, NATURAL RESOURCES, AND ECONOMIC DEVELOPMENT OF THE AMUESHA NATIVE COMMUNITIES IN THE PALCAZU VALLEY

Dr. Richard Chase Smith

CONTENTS

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1. SUMMARY

The consultant evaluated the potential of the present land and natural resource base of the Palcazu native communities to sustain their future economic development within the framework of the market economy. He presented a report of his findings which is based on work and research with the Amuesha over a period of 12 years. It is intended that this report complement the social analysis and soundness report presented to U.S.AID by the Central Selva Resource Management Project Evaluation Team.

Fourteen of a total of 29 Amuesha Native Communities (NNCC) are located in the immediate area of the Palcazu Special Project. In 1976, there were about 2,500 inhabitants in these 14 NNCC: current estimates place the population at about 3,000 (Miller and Martínez, 1981) for an annual population growth of about 4.5.%. Nine of these 14 NNCC have legal communal title (under DC 22175) to their lands for a total of 28,226 Has.

In order for an indigenous population to successfully participate in the market economy, and retain their distinctive social organization and cultural identity, they must be assured an adequate land and resource base, sufficient technical capacity, and capital to organize, develop and administer their own productive forces in such a way as to maximize a sustained yield economy capable of maintaining the community through generations. Although the Amuesha have been participating in the market economy for over a century through wage labor, coffe production, cattle raising, etc., the great majority remain extremely poor. This is so because the conditions under which they participate in the market economy have always been extremely unfavorable, (Miller, Martínez, 1981) and as is demonstrated in this report, their reduced resource base, while adequate for shifting subsistence agriculture, is not adequate for commercially productive activities.

An analysis was made of the land use suitability areas within the land holdings of 10 of the 14 NNCC in the upper Palcazu drainage area. The land per family ratio was calculated for each land use class using both the ONERN interpretation (ONERN, 1981) and the revised interpretation (Tosi, 1981). The results show that the quality of the lands under community title varies substantially from one community to another. As is to be expected, those NNCC located on alluvial lands have more and richer agricultural lands than those located near or in the mountainous headwater areas. Population density also varies from one NC to another.

Land/family ratios for agricultural land in unit-equivalents (1 ha. A land = 3 has. C land = 5 has. P land) vary from a high of 10.3 per family to a low of 2 per family. Land/family ratios for production forest land vary from a high of 77 has. per family to a low of 3.5 has. per family. Of the 9 NNCC studied in detail, 6 had more that 60% of their agricultural lands under cultivation; 2 have already passed that limit and are actively converting forest and protection land to pasture.

Comparisons were made between the current land/family ratio and the estimated land needs for subsistence and commercial agricultural, cattle raising, and production forestry. The best estimates demonstrate that a minimum of 10 unit-equivalents of agricultural land are needed to support one family. For production forestry, estimates range from 120 has. to 400 has. per family.

As a result, it was ascertained that only one NC has a good chance of sustained economic development which would assure a successful participation in the market economy; 4 NNCC received a fair rating and 5 a critically poor rating. The negative consequences of this situation given the prospect of spontaneous colonization promoted by the construction of penetration roads, includes:

- The pauperization of a large part of the Amuesha population;
- Increased migration of poor Amuesha to resource-richer NNCC or to urban areas;
- Increased social resentment and conflict between different socio-economic groups in the valley;
- The disintegration of the social and ethnic unity of the Amuesha communities.

Two general recommendations are made:

- Prior to any new colonization of the Palcazu Valley, the land needs of the present population must be satisfied. Individual NC holdings need to be increased to guarantee a recommended land/ family ratio of 10 unit-equivalents of agricultural (Class A,C, P) land, 70 has. of production forest land (Class F1, F2), and 50 has. of protection land for the current population of the 14 NNCC. This would require an overall increase of approximately 3014 unit-equivalents of agricultural lands, 26,804 has. of production forest land, and 7,239 has. of protection land. Such increases should be made in areas continuous to the communities where possible, or in other unsettled areas such as the Codo de Pozuzo and the lower Palcazu.
- The development of activities to improve commercial and subsistence production in the NNCC must come as a result of a program of land use planning and careful management of community resources. To accomplish this, available lands should be mapped out according to their land use capability, and, in coordination with local com-

munity organizations, strategies should be developed for their most efficient, sustained yield use. The implementation of such a program must be based on an improved capacity of the Amuesha to manage and administer commercial production systems.

2. INTRODUCTION

2.1. Population and Current Land Holdings of the Native Communities

The Amuesha are an indigenous group which has inhabited the Central Selva of Perú for several milenia. They maintain a distinct language and culture from both the Andean and Coastal peoples who have moved into the area. Today the 5000 Amuesha are organized into 29 Native Communities (NNCC) which were legally established in 1974 by the Law of Native Communities and Agricultural Development of the Selva (D.L. 20653, changed in 1978 for D.L. 21175). These 29 NNCC are located in the Departments of Pasco, Junín, and Huánuco. Under D.L. 20653 and D.L. 21175, the Peruvian Government has extended communal land titles to 17 of these NNCC for a total area of approximately 40,000 hectares. Community lands are by law, inalienable, whether through sale, rent, mortgage, or any other arrangement. Though in most cases the lands are worked by individual families they are administered and defended collectively by the Community Assembly. The 1978 version of the law distinguishes between lands with agricultural, forestry and protection capacity, and states in Art. 11 that forest lands within a Community territory cannot be titled, but only ceded in usufruct to the community. Only 2 NNCC (Alto Lagarto and Alto Iscozacín) were titled under the 1975 law. Furthermore, in many NNCC a band 50 meters wide along major rivers was reserved for the public domain and discounted from the titled area.

Due to changing policies and priorities within the Military Government, land titling for NNCC came to a virtual halt after early 1978. No Amuesha NC received a title for its lands after that date, although 12 NNCC still have no legal protection for their lands. So far this policy has continued with the present government.

Fourteen of these 29 Amuesha NNCC are located in the Upper Palcazu drainage area. In 1976 the Amuesha population of this area was about 2,500 (Smith, 1976); current estimates place the population at 3,000 (Miller, Martínez, 1981) for an annual population growth of about 4.5%. Some of that growth is due to immigration from land poor communities, in the Villa Rica - Oxapampa area. Nine of the 14 NNCC in the upper Palcazu drainage area have legal title to their lands for a total of 28,226.28 has. (See Diagram 1).

2.2. Current Land Titling Situation

Since receiving their land titles in 1976, all of these NNCC have petitioned the government to increase the size of their land holdings. In 1977, the Amuesha Congress proposed to the Peruvian Government the Amuesha-Yanachaga project. This project would create a Yanachaga National Park, a continuous community territory of about 60,000 has., and several Communal Reserves in between the Park and the community territory (Smith, 1977). The governments response was favorable and the proposal was included in the regional development priorities and plans (PID-Pichis Palcazu,1977; PAR-Pichis Palcazu, 1978). In February of this year, the Amuesha Congress presented a petition to the Minister of Agriculture and to the Pichis-Palcazu Special Project (PEPP) Director asking that the Amuesha Yanachaga Project be reactivated and that the NNCC land holdings be increased.

DIAGRAM No. 1

NATIVE COMMUNITIES OF THE UPPER PALCAZU WATERSHED AREA

	AREA DEMARCATED	AREA TITLED	YEAR TITLED	POPULATION / FAMILIES 1968	1976	1981
Unión de la Selva Cacazú	425	425	1976	n.d.	n.d.	27
Yuncullmas/Puellas	1437	1437	1976	9	20	34
San Pedro Pichanaz	6750	6750	1976	32	43	50
Shiringamazú	2851.1	2851.1	1976	27	31	44
Alto Iscozacín	2502.0	1660.12	1978	-	26	26
Buenos Aires	3485.68	3257.66	1976	-	30	42
Santa Rosa de Chuchuras	2126	2048	1976	15	21	21
7 de Junio	8782.25	8733.5	1976	95	104	116
Alto Lagarto	2004.5	1064	1978	n.d.	19	20
Machca Bocaz	-			12	n.d.	20
Santa Rosa de Pichinaz	1379			3	5	12
Loma Linda	5713			60	61	64
Puerto Laguna	-				21	24
Nueva Esperanza				0	37	37
		28,226.28			453 2265	537 2685

Source: Smith 1976
Miller, Martínez 1981
Informe de Viaje 1 & 2, 1981

During the annual meeting of the Amuesha Congress in July of this year, PEPP Director del Aguila explained to the delegates the PEPP land titling project for the Palcazu Valley, and secured the voluntary cooperation of the NNCC to clear a wide path of forest along the NNCC boundary lines and a circle with a 30 yard diameter at the transect points. These clearings are to aid the technical staff locate the boundaries on air photographs which will be taken in November of this year. Under the supervision of PEPP topographers, community members began clearing their boundary lines while the U.S. AID Evaluation Team was visiting the area (July 19 - 25,1981).

During that visit, PEPP Technical Director, Dr. Hugo Velarde explained that these procedures applied only to already titled lands; untitled NNCC were to be demarcated at some unspecified time in the future. He said that no community would receive an increase in land holdings unless it had cleared at least 60% of its present holdings. PEPP Director later explained that PEPP's policy is to encourage the incorporation of the native population into the national market economy by promoting their conversion from subsistence agriculture to land use directed at producing for the market economy. PEPP feels that the NNCC have sufficient land in their current holdings to do this.

On August 6, 1981, the PEPP signed a contract with the Dirección General de Reforma Agraria y Asentamiento Rural (DGRA/AR), with the Oficina General de Cadastro Rural (O.G.C.R.), and with the Region Agraria (RA XII) XII-Huancayo, all of the Ministry of Agriculture, to finance and implent a comprehensive program of land demarcation, land settlement, and titling for the Pichis-Palcazu area. This project, which will cost approximately US$ 660,000 for 1981, will be directed and administered by the

DGR/RA, headquartered in Lima. The activities are to be carried out jointly by the four parties to the agreement.

According to the calendar of activities, the project will by December 1981, inspect and reviw 66 current land titles, 780 untitled land holders, and grant 200 contracts to new settlers in both valleys. While alluding to the Native Communities, the agreement states no clear policy or line of action regarding the native population.

3. GUIDELINES FOR THE INCORPORATION OF AMUESHA INTO THE MARKET ECONOMY*

3.1. By "incorporation of the Amuesha into the national market economy" we understand: assuring them sufficient resources, technical capacity, and capital to develop and organize their own productive forces to a point which permits them to participate in the market exchange on a competitive basis.

3.1.1. By "their own productive forces" we mean activities, in addition to subsistence ones, which permit the native population to produce marketable items--agricultural, animal, or forest products, manufactures, etc.--from which they receive a cash income.

Preference should be given to enterprises which guarantee a maximum of community participation and which are located within physical boundaries of the NNCC. These enterprises should be ecologically sound, follow resource management and conservation practices, and give long term sustained yields capable of sustaining the community through generations.

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* Information used to document this report and the recommendations made are based on the author's field experience with the Amuesha as a researcher and as an advisor to a variety of community development programs. The author has worked with Amuesha between 1967 and 1969, and again between 1973 and 1981. The author participated in the design of several earlier development projects for the Pichis-Palcazu region.

3.1.2 By "resource base" we mean a sufficient quantity of land suitable for agricultural activities which will produce both for the Indians own consumption and for the market; a sufficient quantity of land suitable for production forestry which can provide for the NNCC own building needs as well as for commercial lumbering; and a sufficient quantity of land suitable only for protection wich can provide protein from hunting, medicinal plants, edible wild plants, and raw materials for domestic manufacture. By sufficent we mean an area, the sustained yield of which, when consumed and converted to cash, amply covers the material needs of the present population and guarantees the continued survival and sustenance of the community and its social and cultural integrity in the future.

3.1.3. By "technical capacity" we mean the education, training, and guidance needed for the native people to initiate, organize and administer commercial production systems. Such training must allow Amuesha participation in the decision making and in the design of the programs. It can be expected that education and training must advance slowly over a long period of time (15-20 years or more).

3.1.4. By "initial capital" we mean low interest, high risk loans which can be used to initiate or improve productive activities. It must be assumed that there has not been sufficient capital accumulation within the community to provide an initial investment capital.

3.2. The process of incorporation and participation in the market economy must not be a coercive one. Political and cultural autonomy are not the price to pay for participating in the larger national project. Amuesha's autonomy and right to make decisions and choices throughout the process mustbe respected.

3.2.1. There are fundamental differences between the social and cultural orientation of the Amuesha and that of the colonist which must be taken into consideration when planning for and promoting economic development. The Amuesha live in an integrated social system which has its own rules for social interaction and its own internal dynamics. Amuesha social and economic life is oriented toward the needs of extended family, the community, and the ethnic group. The community organization, based ultimately on common kinship and cultural ties, is becoming an important focus of their life. The social world of the colonist on the other hand, is neither homogenous nor integrated; the emphasis here is almost exclusively on the individual and his nuclear family.

3.2.1. The community provides a convenient structure through which the Amuesha's own economic development can be more easily promoted; it is not, as some claim, an obstacle to development. The community organization has been entrusted, by law, with ownership rights to the land and exclusive usufruct rights to the forest resources. Economic activities must be organized in such a way that the community participates and accumulates capital for investment in socially beneficial projects like health, education, and recreational facilities.

3.3. Participation in the market does not imply giving up subsistence agriculture nor any other activities which promote the economic self-sufficiency of the family (hunting, fishing, gathering, building, domestic manufacture, etc.). These activities give the family and their community greater economic security; this, in the long run will encourage greater experimentation within the market economy. These activities are the only insurance the Amuesha family has against the abysmal poverty to which the market economy subjects so many marginal groups who grow to depend on it for their needs.

3.4. The Amuesha have been interacting with the market economy for over a century. They are currently engaged in commercial agriculture, cattle raising, coffee production, lumbering, and in one NC, small industry - a commercial pottery. They have experimented with communal and cooperative forms of production and marketing for 15 years. However, the great majority remain extremely poor; this is so because the conditions under which they participate in the market economy are extremely unfavorable, and their resource base is inadequate.

3.4.1. By "unfavorable conditions for participating in the market economy" we mean:

A) Market economy organization and principles of capital accumulation are foreign to, and often contradictory with Amuesha cultural patterns. Therefore the incorporation of this population into the market economy signifies a complete reorientation of many of those patterns. This is a slow and difficult process.

B) In the Palcazu Valley, access to markets, transportation, credit, technology, education, and cash have been monopolized by a few colonist families for almost 100 years (Miller and Martínez, 1981). This has impeded the development of the Amuesha's own productive forces and their incorporation into the market economy.

C) Racism, based on both race and culture, has also prevented the Amuesha from gaining access to the above.

D) The Amuesha had no secure land base before 1976. The continuous uprooting of Amuesha settlement over the past century has impeded the development of commercial agriculture or any other stable commercial economic base among the Amuesha (Miller and Martínez, 1981).

3.4.2. We will clarify what is meant by "an inadequate resource base" in the following section.

3.5. The native inhabitants of an area such as the Palcazu are often the best suited participants of a long range program of economic development. They have already developed sophisticated survival strategies based on their accumulated knowledge of the environment and long term experimentation with appropriate technologies. Because it is their homeland, the native inhabitant has a vested interest in conserving the limited natural resource on which the future of his society depends. The new settler, on the other hand, who often sees his future in the urban areas, develops strategies for exploiting the natural resources on a short-term, high profit basis for the capitalization of economic activities outside the area. Furthermore, for the same reason, the native inhabitant is less likely to abandon the area if the development program fails.

4. ANALYSIS OF LAND AND NATURAL RESOURCE BASE OF PALCAZU NNCC

4.1. Introduction and Methodology

The debate over how much land should be titled for a NC in the tropical forest area of Perú has been going on for many years. Unfortunately it has been carried on with too little specific data and too many stereotyped arguments. In the case of the Palcazu Valley, there is now enough specific data to make accurate calculations of the resource base of each individual community. With these results it is possible to analyze more accurately the adequacy of the current land holdings and to make specific recommendations about future needs.

Three kinds of data were used in this study; the ONERN soil and land use classification maps for the Palcazu Valley, at a scale of 1/25,000; the original land survey maps for each titled community at a scale of 1/20,000 (provided by the Agrarian Reform Office, Lima); and population censuses for the same communities (Smith, 1976; Miller and Martínez, 1981). The procedure was simple: after transposing the boundaries of the NNCC to the ONERN map, a polar planimeter was used to ascertain the area in hectares of the different land use capacity classes (A,P,C, F1,F2, X) within the boundaries of each community. Then the total area of each subclass was divided by the number of families living in each community to give an accurate land/family ratio.

4.1.1. Problems with Methodology

There were some problems. Neither Loma Linda nor Puerto Laguna are titled. However, they were surveyed as one community in 1976. The area demarcated in that survey was used here; boundaries were drawn on the ONERN map roughly in accordance with that survey. For the other NNCC which fall outside the area covered by the ONERN study (San Pedro Pichanas, Santa Rosa Pichanas, Lagarto), the officially titled or surveyed areas were used. Estimates of the percentage of total land area for each land use class were based on comparisons with similar or nearby areas on the ONERN map and on the consultant's personal knowledge of the area. Two communities (Machca Bocaz, and Nueva Esperanza) were eliminated

DIAGRAM No. 2

AREAS OF LAND USE CAPABILITY CLASSES BY NATIVE COMMUNITY

NATIVE COMMUNITY	NUMBER FAMILIES 1980	LAND USE CLASS	ONERN TOTAL HEC.	REVISED INTERPRETATION (TOSI, 1981) TOTAL HEC.	% TOTAL	HEC./FAM '80	'90
1. 7 de Junio	116 (M,M) (133)	A	1232	395	4.5	3.4	2.2
		P	0	1580	18	13.6	9
		C	4497	1493	17	12.8	8.5
		F_1	2373	3073	35	26.5	17.5
		F_2		1317	15	11.3	7.5
		X	681	924	10.5	5.9	3.8
		TOTAL	8782	8782			
2. Santa Rosa de Chuchurras	21 (20+)	A	60	60	2.8	2.7	1.8
		P	0	0	0	0	0
		C	864	368	17	16.7	11
		F_1	1125	736	34	35	23
		F_2		952	44	45	27
		X	116	49	2.2	2.3	1.4
		TOTAL	2165	2165			
3. Buenos Aires	42* (42+)	A	129	35	1	0.8	0.5
		P	0	348.5	10	8.3	5.5
		C	1254	366	10.5	8.7	5.7
		F_1	1080	714.4	20.5	17	11.2
		F_2		906	26	21.5	14.2
		X	1022	1115	32	26.5	17.5
		TOTAL	3485	3485			

* Miller and Martínez 1981
\+ Informe de Viaje, PEPP, 1981

DIAGRAM No. 2 (Cont.)

AREAS OF LAND USE CAPABILITY CLASSES BY NATIVE COMMUNITY

NATIVE COMMUNITY	NUMBER FAMILIES 1980	LAND USE CLASS	ONERN TOTAL HEC.	REVISED INTERPRETATION (TOSI, 1981) TOTAL HEC.	% TOTAL	HEC./FAM '80	'90
4. Alto Iscozacín	26 (20+)	A	150	43	1.7	1.6	1
		P	0	100	4	3.8	2.5
		C	519	263	10.5	10.1	6.6
		F1	1070	250	10	9.6	6,3
		F2		450	18	17.3	1..4
		X	763	1396	55.8	53.7	35.8
		TOTAL	2502	2502			
5. Shiringamazu	44 (51+)	A	305	0	0	0	0
		P	0	85	3	1.9	1.2
		C	936	456	16	10.3	6.8
		F1	1288	827	29	18.8	12.4
		F2		370	13	8.4	5.5
		X	322	1113	39	25	16.7
		TOTAL	2851	2851			
6. Loma Linda Puerto Laguna	88 (84+)	A	408	0	0	0	0
		P	0	200	3.5	2.2	1.5
		C	489	514	9	5.8	3.8
		F1	1828	200	3.5	2.2	1.5
		F2		114	2	1.3	0.85
		X	2988	4685	82	53.2	35
		TOTAL	5713	5713			

* Miller and Martínez 1981
\+ Informe de Viaje,PEPP, 1981

DIAGRAM No. 2 (cont.)

AREAS OF LAND USE CAPABILITY CLASSES BY NATIVE COMMUNITY

NATIVE COMMUNITY	NUMBER FAMILIES 1980	LAND USE CLASS	ONERN TOTAL HEC.	REVISED INTERPRETATION (TOSI, 1981) TOTAL HEC.	% TOTAL	HEC./FAM '80	'90
7. Santa Rosa de Pichanas	12* (18+)	A	n.d	0	0	0	0
		P	n.d.	27	2	2.3	1.5
		C	n.d.	69	5	5.7	3.7
		F_1	n.d.	42	3	3.5	2.3
		F_2	n.d.	42	3	3.5	2.3
		X	n.d.	1200	87	100	66
		TOTAL		1379			
8. San Pedro de Pichanas	50* (50+)	A	n.d	0	0	0	0
		P	n.d.	135	2	2.7	1.8
		C	n.d.	270	4	5.4	3.5
		F_1	n.d.	203	3	4	2.6
		F_2	n.d.	203	3	4	2.6
		X	n.d.	5940	88	118.8	78
		TOTAL		6750			
9. Alto Lagarto	20*	A	n.d.	0	0	0	0
		P	n.d.	40	2	2	1.3
		C	n.d.	100	5	5	3.3
		F_1	n.d.	60	3	3	2
		F_2	n.d.	60	3	3	2
		X	n.d.	1744	87	87.2	57.5
		TOTAL		2 004			

* Miller, Martínez 1981
\+ Informe de Viaje, PEPP, 1981

from the study for the lack of any officially surveyed area figure.

Members of the Central Selva Resource Management Project Team have raised doubt about the land use capacity imparted to the Palcazu soils by ONERN. For this reason, this study was conducted with both the ONERN classification and the revised classification (see Tosi Appendix) for comparative purposes. The results based on the revised classification were used for evaluating the adequacy of the NNCC land holdings.

4.2. Results of the Analysis

The results of the analysis appear in Diagram 2 on the following three pages. As might be expected, there is a wide range in the quantity and quality of lands available in the 10 NNCC considered here. Agricultural lands (Class A, P, C) range from a high of 39.5% of the total area in the case of NC 7 de Junio to a low 6% in the case of NC San Pedro Pichanas. Forest lands range from a high 78% of total land area in NC Santa Rosa Chuchurras to a low 6% in NNCC San Pedro Pichanas, Santa Rosa Pichanas, and Alto Lagarto. Protected areas range from a very low 2.2% in NC Santa Rosa Chuchurras to a high of 88% in NC San Pedro Pichanas (See diagram 3).

DIAGRAM No. 3

LAND USE CAPABILITY CLASS AREAS AS PERCENTAGE OF TOTAL AREA

NATIVE COMMUNITY	CLASS A+C+P	CLASS F1+F2	TOTAL USABLE AREA
1. 7 de Junio	39.5%	50 %	89.5%
2. Santa Rosa Chucharras	19.8%	78 %	97.8%
3. Buenos Aires	21.5%	51.5%	73 %
4. Alto Iscozacin	16.2%	28 %	44.2%
5. Shiringamazu	19 %	42 %	61 %
6. Loma Linda - P.Laguna	12.5%	5.5%	18 %
7. Santa Rosa Pichanas	7 %	6 %	13 %
8. San Pedro Pichanas	6 %	6 %	12 %
9. Alto Lagarto	7 %	6 %	13 %

There is clearly an unequal distribution of usable lands amongst the NNCC; those NNCC located on the alluvial plains of the Palcazu River and its tributaries (7 de Junio, Santa Rosa Chuchurras, Buenos Aires, Alto Iscozacin, and Shiringamazu) have more better quality lands than those NNCC located in the mountainous headwaters. This can be explained by the fact that lands were demarcated between 1968 and 1976, according to population and settlement pattern. The quality of the land itself was not taken into account.

A comparison of the ratios of agricultural land per family points at this inequality more clearly. (See Diagram 4). The 10 NNCC of the study fall into three groups; NC 7 de Junio with a ratio of 29.8 hectares/family is clearly in a class by itself as the NC best endowed with agricultural lands.

DIAGRAM No. 4

RATIO OF AGRICULTURAL LANDS PER FAMILY
(CLASS A, CLASS P, CLASS C)

NATIVE COMMUNITY	HECTARES/FAMILY 1980	HECTARES/FAMILY 1990
7 de Junio	29.5	19.6
Santa Rosa Chuchurras	19.4	12.8
Buenos Aires	17.5	11.7
Alto Iscozacín	15.5	10.2
Shiringamazu	12.2	8
Loma Linda - P. Laguna	8	5.2
Santa Rosa de Pichanas	8	5.2
San Pedro de Pichanas	8.1	5.3
Lagarto	7	4.6

The second group with ratios ranging from 12.2 has/family to 19.4 has/family, contains the four other floodplain communities. The third group with ratios ranging from 7 has/family to 8.1 has./family is the poorest and contains the five headwater NNCC. When we look at the ratio of forest land per family we find a similar grouping (See Diagram 5). NC Santa Rosa Chuchurras stands out with a much higher ratio of 77 has./ family, the other flood plain NNCC range from 26.9 has/family to 37.5 has./family. The five headwater NNCC range from 3.5 has./family to 8.1 has/family.

DIAGRAM No. 5

RATIO OF PRODUCTION FORESTRY LANDS PER FAMILY (CLASS F1 AND F2)

NATIVE COMMUNITY	HECTARES/FAMILY 1980	HECTARES/FAMILY 1990
Santa Rosa Chuchurras	77	50.8
Buenos Aires	38.5	25.4
7 De Junio	37.8	25
Shiringamazu	27.2	17.9
Alto Iscozacín	26.9	17.7
San Pedro de Pichanas	8.1	5.3
Santa Rosa de Pichanas	6.9	4.5
Lagarto	6	3.9
Loma Linda - P. Laguna	3.5	2.3

4.3. Interpretation of the Results

In this section the land/family ratios are compared with the land needs of the population for different economic activities in order to calculate the adequacy of present land holdings. Subsistence agriculture, commercial agriculture, cattle raising and production forestry are considered.

4.3.1. Land/Family Ratio and Subsistence Agriculture

The Amuesha, like the colonists of the Palcazu Valley, practice a variety of slash and burn agriculture, by which they cut an area of forest (usually, early secondary vegetation) burn it, and plant their food crops. When depleted soil fertility and the invasion of weeds make the garden production dwindle (usually after one or two years), the site is abandoned and the forest is allowed to regenerate itself. In this way the soils are permitted to recover their lost fertility. The site will remain fallow for 10 to 20 years before it is reused as a garden site. Recently, population pressure is forcing each family to use their garden sites for a longer time and to shorten the fallow period. This causes a general degradation of the soils and a lower yield as is evident in the Amuesha communities around the town of Villa Rica.

Each family plants up to three separate gardens each year:

1. The smallest, often less than 1/4 hectare , is planted in climbing beans.
2. On the flood plains, the family will plant up to one hectare of bananas, corn, beans, manioc, a variety of tubers, peanuts, sugar cane, fruits, etc.
3. In areas of poorer soils, up to one hectare of manioc and rice is planted. The family supplies its own vegetable needs from its garden, feeds

the frequent visitors, and redistributes any excess production to nearby kinfolk.

If we assume an average size garden of 1.5 hectares per year and an average fallow time of 10 years, then a minimum of 15 hectares of agricultural land is needed to supply the vegetable food intake of an individual Amuesha family. As of 1980, six NNCC did not have sufficient agricultural land to provide each family with this minimum. Three NNCC could provide a small margin beyond that needed for subsistence.

In 10 years time, assuming current 4.5% annual population growth (natural growth plus immigration) only one community will have sufficient farm land to feed its own population through subsistence agriculture and still have an excess for commercial agriculture. The others will already have been clearing and planting lands appropriate only for production forestry and protection, promoting the long term degradation of the soils and the forest reserves, and resulting in greatly lowered yields. This combination of deteriorated land base and nutritional deficiencies is characteristic of all Amuesha NNCC in the heavily colonized region of Villa Rica - Oxapampa.

4.3.2. Subsistence Agriculture and the Market Economy

One may argue that once the Amuesha have been incorporated into the market economy, they can supplement their need for subsistence agriculture by buying food on the market, and thus freeing their labor to produce a cash income in some other activity. However, it should be pointed out that it will take many years of training, guidance, and experimentation plus the initial capital to establish a revenue generating commercial enterprise capable of sustaining a large number of Amuesha families. Meanwhile, the Amuesha and colonist population must feed itself from the limited land base it has. If the Amuesha are able, one day, to earn sufficient cash income to pay for their subsistence needs, it is unclear who, then, will produce the food which they will buy.

One could also argue that with more capital and labor inputs, the yields of the gardens could increase to the point where it would be unnecessary to rotate them as often or at all. In this way, less land would be needed for the population to feed itself. At this point the Amuesha do not have sufficient capital to invest in their subsistence gardens. Fertilizers, for example, are in short supply in Perú and are expensive. The current high cost and monopolization of transport into the Palcazu also put fertilizers beyond the Amuesha reach. Even if they had access to fertilizers, they would lack the technical knowledge to use them properly.

The labor supply for a given garden is limited by the number of hands in the family . Few Amuesha have enough capital to hire outsiders to work on their gardens. In some communities however, both men and women have been experimenting with cooperative work groups, held together on the basis of reciprocal obligations. The whole group works an equal amount of time in the garden of each individual member. Ideally such arrangement could improve productivity. Finally, this subsistence pattern, common to most peoples living in tropical forest regions, is a very deeply rooted cultural pattern. For that reason, it will change only when it is proven beyond doubt that some other pattern will produce more for less input.

4.3.3. Land/Family Ratio, Commercial Agriculture and Cattle Raising

Because commercial agriculture is not an important activity in the Palcazu Valley, it is difficult to estimate with precision the minimum amount of land which is necessary for a viable agricultural enterprise. In December, 1980, the Proyecto de Inversión de Asentamiento Rural Pichis-Palcazu (PIAR-PP, Ministry of Agriculture) estimated for this area that the minimum unit of land which could support a single family engaged in agriculture was 64 hectares.

A study commissioned by PEPP for the Pichis Valley estimates as a minimum size 8-10 hectares on Class A soils for intensive annual crop production or 30 hectares per family on poorer soils utilizing the traditional shifting cultivation with permanent crops. Pool (appendix) supports those estimates by drawing up a cropping and annual income schedule for each type of production unit. According to his estimates incomes from those two agricultural units could average about US$ 2,000 per year, under optimal conditions.

The PIAR-PP estimated that the minimum size unit which could support a single family engaged in cattle raising is 120 hectares. Data from the Staver report (Appendix) shows that 50 has. of pasture land (Class P Lands) would be required to produce an annual income equivalent to 10 has. of Class A lands or 30 has. of Class C lands.* Pool concurs with this figure.

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* The Staver Appendix demonstrates that under current conditions, one hectare of pasture produces an average of 31 Kg. of meat per year--for a gross income of approximately US$ 48 per ha. per year. The same report also demonstrate that costs per hectare to produce the 31 Kg. of meat are slightly higher than the market value of the meat, producing a loss on net income.However if we assume that the labor costs accrue to the family- run business, one hectare of pasture would produce an annual income of US$36. In this case 50 has. of psture (Class P Lands) would be required to produce an annual income equivalent to 10 has. of Class A Lands or 3 has. of Class C Lands.

By converting the land available in the NNCC to Class A land unit-equivalents (1 ha. A land = 3 has. C land = 5 has. P land) it is possible to establish current ratio of agricultural land unit-equivalents per family for each NC. By comparing this figure with the minimum 10 unit-equivalents/family necessary to support a family, a fair estimate of the adequacy of the current land holdings can be established (See Diagram 6).

DIAGRAM No. 6

RATIO OF UNIT - EQUIVALENTS OF AGRICULTURAL LAND PER FAMILY (1 ha. A Land = 3 has. C Land = 5 has. P Land)		
NATIVE COMMUNITY	UNIT-EQUIVALENT 1980	UNIT-EQUIVALENT 1990
1. 7 de Junio	10.4	6.8
2. Santa Rosa Chuchurras	8.7	5.7
3. Buenos Aires	5.4	3.5
4. Alto Iscozacín	5.8	3.8
5. Shiringamazu	3.8	2.8
6. San Pedro Picharas	2.3	1.6
7. Loma Lima	2.4	1.5
8. Santa Rosa Pichanas	2.3	1.5
9. Alto Lagarto	2	1.3

This analysis shows that only one NC, 7 de Junio, currently has sufficient agricultural lands to provide the minimum of 10 unit-equivalents per family. Six NNCC, those of the headwaters, are well below this minimum. The current land holdings therefore are not even minimally sufficient to provide a cash income from either agriculture or cattle raising.

Because of the severe land limitations, cattle raising is not an alternative which is both economically viable and economically sound. However, the Amuesha in all of the Palcazu NNCC are actively engaged in cattle raising; the current cattle population in the NNCC is at 2,500 head and growing. A comparison of total area of agricultural lands with the areas under cultivation shows that in all but two cases, areas under pasture far exceed the areas classified for that activity (Diagram 7). In 2 NNCC the total area under cultivation surpasses the land use capacity. Further expansion of the cattle industry needs to be closely monitored to prevent further deterioration of lands unsuited to that activity.

4.3.4. Land Family Ratio and Production Forestry

The PIAR-PP estimated the minimum size of a family forestry unit at 400 has. for the Pichis-Palcazu region. This implies a rotation period of 30 years. PEPP made two different calculations of the parcel size for the forestry colonization project within the Von Humboldt National Forest. One established a parcel size of 400 has. with a yearly exploitation of 20 has.; the other 235 has. with a yearly exploitation of 12 has. In each case the colonist would presumably combine some subsistence agriculture with his forestry activities in order to provide food for his family.

DIAGRAM No. 7

COMPARISON OF TOTAL AREA BY LAND USE CAPABILITY CLASS WITH TOTAL AREA CURRENTLY UNDER CULTIVATION

NATIVE COMMUNITY	CLASS A + C	IN CROP CULTI-VATION	CLASS P	IN PASTURE	CLASS A + C + P	TOTAL UNDER CULTI-VATION	% UNDER CULTI-VATION
1. 7 DE JUNIO	1888	165	1580	1000	3468	1165	34%
2. SNTA.ROSA CHUCHURRAS	428	38	0	250	428	288	67%
3. BUENOS AIRES	401	96	348	850	749	946	126%
4. ALTO ISCOZACIN	306	70	100	180	406	250	62%
5. SHIRINGAMAZU	456	180	85	720	541	900	166%
6. LOMA LINDA-P LAGUNA	514	267	200	230	714	497	70%
7. STA. ROSA PICHANAS	69	45	27	35	96	80	83%
8. SAN PEDRO PICHANAS	270	130	135	60	405	190	47%
9. ALTO LAGARTO	100	n.d.	40	n.d.	140	n.d.	

Judging from this basis, no NC in the Palcazu watershed area has sufficient forest lands (Class F1 and F2) to make lumber production a viable economic alternative on a long term sustained yield basis. By combining production forestry with subsistence and commercial agriculture, two NNCC (7 de Junio, Santa Rosa de Chuchunas) may have an adequate resource base to support their populations. The five NNCC with less than 10 has./family cannot count on sustained yield lumbering to support any portion of their population. At best the lumber from these communities could provide an initial capital for investing in other more productive activities.

Two other factors complicate the forestry picture. First, much of the accessible forest within the NNCC has already been exploited for house construction, boat building, and for commercial sale. Those forests would now be less productive for commercial lumbering and a larger area of forest would be needed to support a family.

Second, the Forestry and Wildlife Law (D.L.21147) states that the forest resources within the NNCC boundaries remain under the public domain. Article 35 of that law says that the community has exclusive right to exploit those forests, but only after submitting a plan for communal exploitation of the resource and securing permission from local forestry office. According to PEPP personnel unscrupulous timber dealers are encouraging individuals within the NNCC to sell off the timber. Management of these forests, under the jurisdiction of the community assembly, needs to be implemented to protect them and to rationalize their exploitation.

5. CONCLUSION AND RECOMMENDATIONS

5.1. Land Holdings and Development Potential

It is difficult to foresee all the factors which will affect the future development of the Palcazu NNCC. However, there is general agreement among those who have worked in similar situations that land and natural resources are amongst the most important factors. In this vein, we have attempted to rate the Palcazu NNCC in terms of the capacity of their current land and resource base to support long range economic development and to permit the Amuesha residents to participate successfully in the market economy. One NC (7 de Junio) received a good rating; four NNCC (Santa Rosa Chuchuras, Alto Iscozacín, Buenos Aires, and Shiringamazu) a fair rating; and five NNCC (Loma Linda/Laguna, Santa Rosa Pichanas, San Pedro Pichanas, and Alto Lagarto) a critically poor rating. We will examine each group individually.

5.1.1. The largest Amuesha community, 7 de Junio, with 8782 hectares of valley bottom land, is well endowed with agricultural lands and moderately well endowed with forestry lands. This NC can withstand moderate population growth and a substantial expansion of agricultural activities. The management of the large number of cattle raising enterprises must be improved in order to increase productivity and reduce the area needed for pasture.

A shift to commercial agriculture, preferably to some permanent crops, should be encouraged. This NC has very little land for protection only, this will manifest itself, if it hasn't already, in a reduced protein intake from hunting.

5.1.2. The four NNCC rated fair are minimally endowed with agricultural lands and moderately well endowed with forest lands. A mixed economy of agriculture, cattle raising, and production forestry is indicated. While Santa Rosa Chuchurras has a large forest land /family ratio, its agricultural lands are small. Fifty percent of the agricultural lands are now under pasture. This community should inmediately begin shifting emphasis to production forestry while intensifying the cattle production. Any further expansion of the pastures will be at the expense of forest land. An area of agricultural lands should be reserved for subsistence agriculture.

Alto Iscozacín can continue to expand its agricultural and cattle raising activities for a few years, but should begin to intensify both while going into production forestry.

Both Shiringamazu and Buenos Aires have more lands under cultivation then is recommended. The excess is entirely in pasture. This means that production forest and protection lands are already being cleared for new pastures. A shift to permanent crops should be encouraged while cattle production is intensified.

In both communities the forest reserves are relatively small and will need careful management. None of these NNCC can withstand any significant increase in their population without serious problems in soil deterioration and generally lower productivity.

5.1.3. The five NNCC rated critically poor are so poorly endowed with agricultural and forest lands that their situation is alraady critical. Serious problems have so far been avoided only because the residents of these NNCC have been relatively insolated and therefore minimally dependent on the market economy. As the Palcazu branch road will shortly pass through three of these NNCC, their needs for consumer goods will rapidly increase as will the pressure on their land and resources to produce greater cash incomes to pay for these goods. Within the decade, the resources of these NNCC will be under severe pressure, provoking serious overall environmental degradation and possible food shortages.

None of these five NNCC offer any prospects for activities directed towards the market economy. Once the forest resource has been depleted, the small areas of agricultural lands will support very few people with new consumer demands. The forced incorporation of these communities into the market economy through the construction of the Palcazu road will produce mass emmigration to the NNCC of valley bottom increasing the land pressure there, and the pauperization of those who stay behind. Many other Amuesha communities in the Villa Rica - Oxapampa area have repeated this same pattern in the past two decades.

5.2. Long Range Effects of Land and Resource Scarcity in Palcazu NNCC

1. The Amuesha will become poorer. Increasing population, decreasing soil fertility, and resource depletion will combine to reduce productivity and income per capita. Individual Amuesha families will become less able to sustain their own basic needs for food, clothing, and shelter from local resources and thus more dependent on the market to supply them.

2. The Amuesha population who can no longer satisfy their increasing needs for cash will:

a. Continue to live and practice subsistence agriculture in their community, but form part of a marginally employed labor poor for the large cattle ranches and the growing lumber industry of the Palcazu Valley;

b. Migrate to other better endowed NNCC increasing the pressure on their resources;

c. Migrate to urban areas in search of higher paying jobs, thus adding to the ranks of the urban unemployed.

3. The current situation will create a marked inequality in land distribution in the valley with individual colonists hold ing up to 50 times the amount of land available to individual Amuesha families. This will increase both social resentment and potential conflict between different socio-economic groups.

4. As the land/family ratio decreases, the control over the communities' lands and forest resources will become more individualized, and distribution of these resources will become less equal. As competition for scarce resources increases, prompted by the exigencies of the market economy, social conflict will increase within the community, straining the community structure and the whole web of ties which holds the Amuesha together as a distinct social and ethnic group.

5.3. Recommendations

5.3.1. Increased Land Holdings

In order to assure the Amuesha of the Palcazu Valley a sustained and beneficial economic development which would guarantee them a competitive participation in the market economy, it is essential that the Peruvian Government increase the recognized land holdings of the Palcazu NNCC to the point that each family is guaranteed a minimum land and resource base. This is the necessary first step of a long range program of economic development for the Amuesha. The redistribution of the Palcazu Valley lands to assure the current residents, Amuesha and colonists, an adequate land base, must take top priority, coming before any plan to distribute those lands to outsiders for colonization or for production forestry.

We strongly recommend a minimum of 10 unit-equivalents of agricultural land (1A = 3C = 5P) per family, 70 hectares of production forestry land (Class F) per family, and 50 hectares of protection lands (Class X) per family. This we feel would offer an adequate base for a mixed economy of agriculture, cattle raising, forestry, and subsistence within each community plus room for some future population growth.

Because Amuesha culture is intricately interwoven into its forest environment, it is extremely important to provide adequate areas of land for the extraction of materials for domestic construction and manufacture, for the management of the wild fauna, and for the harvest of medicinal and other culturally important plants.

We also strongly recommend that this minimum land base formula be applied to all 14 NNCC of the Palcazu drainage basin, including those of the Bocaz and Cacazu Rivers.* Members of those NNCC are already migrating into the Palcazu Valley in search of lands.

The current titled land holdings of 28,226 has. provide only 40% of the required minimum. Calculations for land increases should be based on what is needed to bring each NC up to the minimum level established here. In some cases a NC already has the minimum land/family ratio for a particular class of land. For example, Lagarto has 20 families; it should have a minimum of 200 units of agricultural land, but has only 41 units. An increase of 159 equivalent units of agricultural land is called for.

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* It is also recommended that this formula, perhaps with the exception of the protection lands be applied to the colonist population in order to assure that they too have a minimum land base for their future development.

Lagarto should have a minimum of 1330 hectares of production forestry land; it has 346 hectares which necessitates an increase of 983 hectares. Lagarto should have a minimum of 950 hectares of protection land; it has 1212 hectares, and therefore requires no further increase. According to these calculations, among the 14 NNCC with 537 families, there needs to be an increase of 3014 unit -equivalents of agricultural lands, 26,804 hectares of production forestry lands, and 7239 hectares of protection lands.

Where possible, these increases should be made on lands contigous to the community. The Amuesha - Yanachaga project (Smith, 1977) offers concrete proposals along these lines. Although new colonization has been heavy since that proposal was made, many of the areas suggested then for expanding the NNCC are still unsettled. In general terms, these lands would border the proposed Yanachaga National Park. Where this is not possible, lands should be titled under Art. 10 of D.L. 21175 in another part of the Palcazu Valley.

Areas of possible expansion for the NNCC are the lower Pozuzo-Codo de Pozuzo area, Enock - Flor de un Día area in the lower Palcazu, the forest block between the Chuchurras and Lagarto Rivers, or the forest block between the Lagarto and Mairo Rivers. The residents of the headwater communities should be encouraged to migrate to these new community lands.

5.3.2. Land and Resource Management Plan

Once the Peruvian government has recognized the land holding increases recommended here, there will be no possibility of any significant increases in the future. With the arrival of the road to the Palcazu, unclaimed lands will become a thing of the past. The Amuesha will have to build their future on the lands already titled. If those

DIAGRAM No. 8

RECOMMENDED INCREASES IN LAND HOLDINGS FOR PALCAZU NATIVE COMMUNITIES Based on minimum land/family ratio of 10 unit-equivalents agricultural land, 70 hec. production forest land, 50 hec. protection land for the current population				
	CLASS A,C,P land UNIT-EQUIVALENT	CLASS F1, F2 LAND	CLASS X LAND	TOTAL
1. 7 de Junio	--	3735	5115	
2. Santa Rosa Chuchurras	27	--	1002	
3. Buenos Aires	193	1323	987	
4. Alto Iscozacín	102	1120	(-96)*	
5. Shiringamazu	273	1870	1100	
6. Loma Linda/P.Laguna	669	5852	(-285)	
7. Santa Rosa Pichanas	92	757	(-600)	
8. San Pedro Pichanas	385	2975	(-3440)	
9. Alto Lagarto	160	1280	(-744)	
10. Nueva Esperanza	370	2590	1850	
11. Machca Bocaz	200	1400	1000	
12. Yuncullmas-Puellas	320	2237	00	
13. Union Cacazu	216	1665	1350	
TOTAL	3014	26804	7239	

* Numbers in parenthesis represent an excess of protection lands which are discounted from the total.

lands are poorly used, and the soils deteriorate rapidly, productivity will decrease. For these reasons, it is strongly recommended that as the second step in a long-range program of economic development for the Amuesha, a land planning and resource management program be developed and implemented for all community lands in the Palcazu. This plan should locate the available lands and their capability, and develop strategies for their most efficient use which could guarantee environmentally sound, sustained-yield productivity (Staver Appendix 1981).

Such a plan can work only if it is elaborated with the full participation and consent of the Amuesha, through their representative organizations: the Amuesha Congress, its branches the Casa Cultural and Agro-Yanesha, and the General Assemblies of each NC in question. As there would probably be some initial resistance to such a plan, it is vital that prior to developing such a plan, the Amuesha residents be educated as to why it is necessary and how they will benefit from it. This stage is the key to future success with such a plan.

This plan must not only establish appropriate activities such as production schedules, fallow periods, and inputs needed, but also limits to other activities. Cattle raising needs to be severly limited in some communities and in others, it needs to be better managed to improve productivity without expanding pasture areas. As commercial agriculture, especially permanent crops, becomes more profitable, it should be promoted as an alternative to cattle raising, but again only in appropriate areas. Forests need to be managed in such a way as to provide long term sustained-yield productivity. This could be done through selective lumbering, natural reforestation of valuable species, and limiting the areas to be lumbered annually. As the land and resources differ from one community to another, productive activities must also differ.

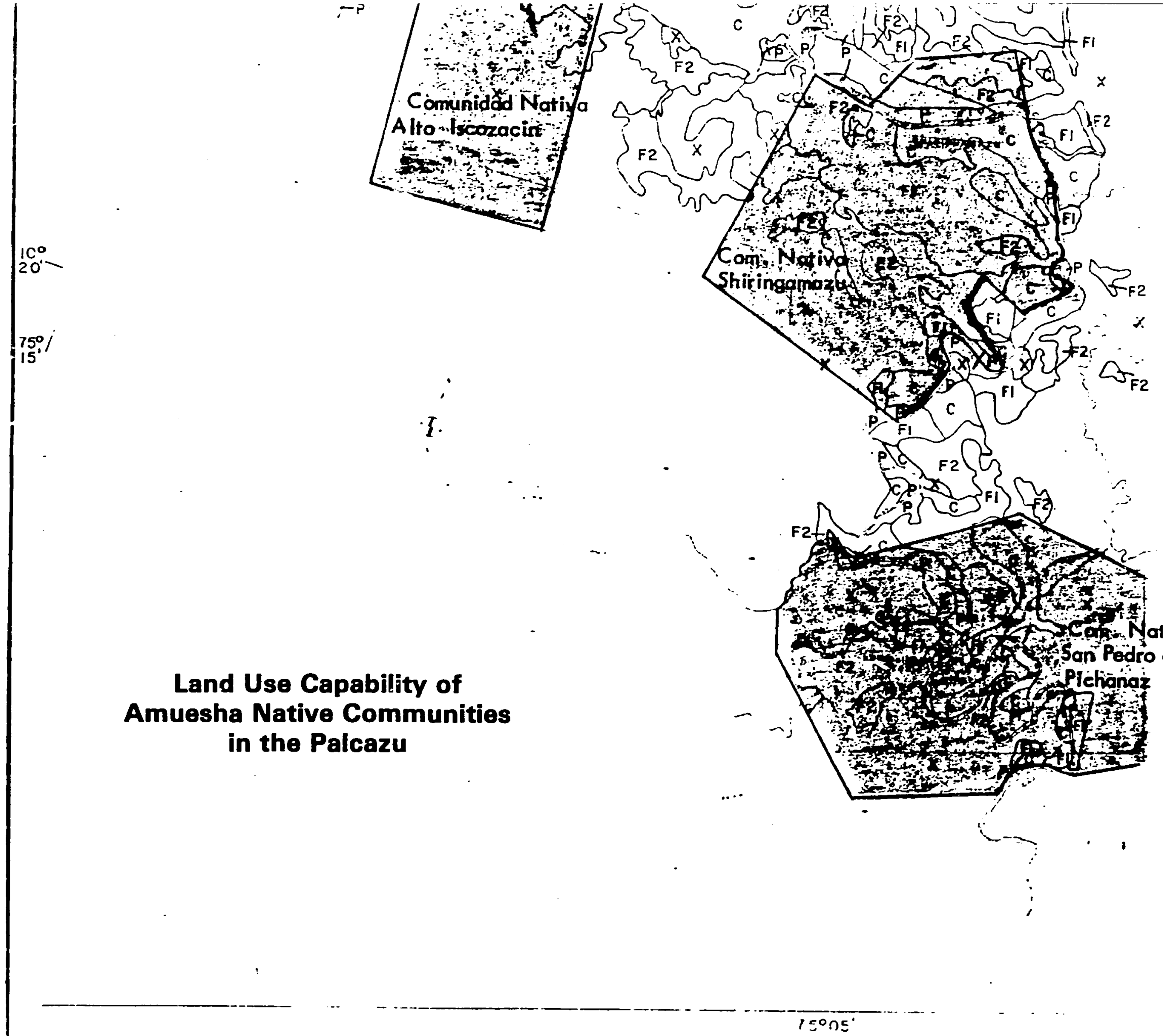
Perhaps the keystone to this plan must be the satisfaction of basic subsistence needs. Areas of agricultural lands around settlements should be reserved permanently for subsistence gardening so as to assure an adequate food supply in the future. Wild palms which provide leaves for roofing should be carefully managed in their natural state, and also planted in areas near settlements. A wildlife management plan should also be developed to assure a continued supply of protein from hunting.

This plan should encourage experimentation with new economic activities which lessen the already heavy load on the environment. The collection and industrialization of rubber and other wild gums could offer such an alternative.

It is our opinion that all specific development projects for the Palcazu NNCC are contingent on the two conditions outlined above; without an adequate land and resource base, and without a long term land and resource management plan, other efforts would only temporarily relieve a chronically worsening situation. With these two conditions met, the Amuesha can look forward to participating beneficially in the Peruvian nation and economy.


Comunidad Nativa Sta. Rosa de Chuchurras
Comunidad Nativa Buenos Aires
San Juan
Iscozacin
10°
10'

402


Comunidad Nativa
Alto Iscozacin
Com. Nativa
Shiringamazu
Com. Nat
San Pedro
Pichanaz
10°
20'
75°
15'
75°05'
Land Use Capability of
Amuesha Native Communities
in the Palcazu

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APPENDIX M

ANIMAL PRODUCTION SYSTEMS IN THE PALCAZU VALLEY AND MEANS FOR THEIR EXPANSION AND INTENSIFICATION

Charles Staver

CONTENTS

TABLES

SUMMARY

This report was prepared during a three-week period in August - September, 1981 to assess the land and resource suitability for sustained production systems with animals in the Palcazu River basin in the Central Jungle of Peru.

The following characteristics were found significant with regard to expansion and intensification of existing animal production systems in the area.

1. The land base of the Palcazu valley is a complex, fragile topography of low native fertility subject to high rainfall.

2. The land base of the Palcazu valley does not contain large, uniform areas available for the expansion of crop production or pastures.

3. Three groups of people, of different skills and with different levels of available resources inhabit the area:

   - The Amueshas are undergoing a transition from traditional shifting agriculture and few domestic animals and heavy dependence on "los patrones" to participation in the market system within a limited land base and with limited skills to manage new production activities such as cattle raising.

   - The established colonists of European descent, occupying the best lands along the river, can no longer expand their extensive beef cattle production with the same profitability

as before due to lower productivity of hill soils and higher labor costs . However, ownership of best lands and management skills and experience in cattle production should provide the colonists with a solid basis to intensify their operations.

- The new colonists in the area have low levels of capital, are unfamiliar with the climate and soils of the area, and are relegated to the more marginal lands. They have certain skills useful for animal raising and for participation in the market economy, but often extract small profits from the land through shifting agriculture and move on.

4. Increased levels of beef and milk production in the Palcazu based on forages requires improved farmer management akills, increased inputs, and adapted technical information currently unavailable for the area. Little land is available for expansion of cattle production.
5. Restricted quality and quantity of local protein limits the intensification of poultry and swine production. Competition for crop land may also limit the availability of carbohydrates. Permanent crop byproducts and forest and tree products may be used for animal feeds, if harvesting and processing technology is developed.
6. Institutional structure in the valley is rudimentary and will need reinforcement in land use capability, resource management, applied agricultural research and extension.
7. Current economic conditions severely restrict the alternatives for animal raisers, especially in the absence of tested technical

recommendations based on economic analysis.

The following components were suggested for the AID Central Selva Resource Management Project:

1. An environmental assessment and management short course for all project staff.
2. Assistance for land use planning, resource administration and development of new production activities to Amuesha communities.
3. Research, training and extension unit in cattle production and pasture management with focus on pasture renovation, sequential transition from present extensive beef systems to intensive dual purpose systems, and monitoring the effect of cattle systems on soil compaction, erosion and runoff.
4. Research, training and extension unit in feed processing and ration formulation for monogastrics with focus on the testing of small-scale technology for feed processing, the formulation of rations based on local forest products, crops and crop and animal byproducts, and the design of production systems of greater profitability and productivity.

Planned colonization of the area based on non-destructive management will require sustained permanent crop and forest production systems involving technology presently untested in Peru and colonists with skills different from those of the average immigrant to the jungle. Animals can be usefully integrated into these systems if the appropriate research and then extension are carried out.

INTRODUCTION

This report was prepared to assess land resources capability-suitability in the Palcazu River basin with specific reference to animal production systems. Productivity of existing systems and their effect on the environment as well as the potential for expansion and creation of new animal production systems were evaluated during a three-week period which included seven days in the Palcazu River basin, three days in jungle areas adjacent to the Palcazu (Pucallpa and Chanchamayo) and eight days in Lima in report preparation and consultation with livestock specialists and project personnel at Universidad Nacional La Molina and San Marcos, Instituto Nacional de Investigación y Promoción Agropecuaria, office of Agency for International Development, and office of Proyecto Especial Pichis Palcazu.See final sections,for specific terms of reference, travel itinerary, and persons consulted.

1. SITE DESCRIPTION

The Palcazu River with a basin covering an area of 189,208 Has. is located in the central jungle of Peru and with the Pozuzo and Pichis Rivers, forms the Pachitea River which farther north joins the Ucayali River. The valley floor ranges from 270 meters above sea level in Puerto Mayro to 400 meters above sea level in Loma Linda,where the Cacazu and Pichinaz Rivers join to form the Palcazu. Tributaries to the west flow out of the Yanachaga range of mountains with peaks reaching 3000 meters and to the east out of San Matías Mountains which are 1000-1500 meters above sea level.

The two mountain ranges are the principal topographic features of the watershed with the valley floor composed of extensively dissected terraces forming a complex hilly landscape and recent flat terraces in narrow bands along the Palcazu and its principal tributaries (ONERN, 1981).

Temperatures in the valley floor average 25-26°C with extremes of 33°C and 18°C and rainfall ranges from 2600 to 4600 mm/year. The driest months (extrapolating from Puerto Bermudez weather station) are June thru September and the wettest months are December thru March. In terms of life zones, 40% of the valley floor is tropical wet forest, 45% is tropical wet premontane, basal transition and 15% is tropical moist forest (Watson and Bolaños, 1981).

The soils, except in the recent alluvial terraces, are highly acid with high levels of aluminum saturation, low levels of available phosphorus and textures of loams to clay loams and clays. (ONERN, 1981).

2. EXISTING ANIMAL PRODUCTION SYSTEMS IN THE PALCAZU BASIN

Productivity and levels of production of production systems involving animals result from the farmers and his family's management and utilization of different animal species and their feed sources throughout a yearly cycle given the the natural resources of an area including soil, topography and climate. While climate and soils are not determinant of species and production levels, they do set limits on types of feed sources, their availability throughout the year, and animal species and their reproductive cycles in an area. Thus in analyzing production systems with animals, the management skills of the farmer and his family and limitations of soils and climate for production of animal feed supply are fundamental points which must be evaluated. This system view is necessary in the identification of factors limiting actual productivity and production levels, in the planning of new production systems, and in the improvement of existing systems. Without this view backed by solid economic analysis, one can expect the types of project failures seen throughout the years in the jungle of Peru. In addition to lack of recognition of natural resource limitations and of inappropriate management abilities of farmers, the failures can also be attributed to institutional limitations in planning and administering complex and sophisticated projects. When an agro-industrial system is proposed for a virtually undeveloped area, not only are all the links between farmers, animal feed supply and natural resources subject to breakdown, but also all the links in infrastructure, raw technology design, extension, credit and the processing itself are also areas prone to function at less than expected smoothness. Thus, before making recommendations for the Palcazu area, it is proposed to look at the existing production systems, their levels of productivity, and their effect on the environment.

The Palcazu valley was originally settled by the Amueshas tribe who may have been in the area as long as 1500 years before the arrival of Spanish missionaries. In the middle of the last century, German settlers moved into surrounding valley- Pozuzo, Oxapampa and Villa Rica and have also become established in the Palcazu valley (Smith, 1977, Miller and Martinez, 1981). In more recent years mountain Indians have moved into the area from Villa Rica into the upper Cacazu watershed and from Pozuzo into the Mayro River area. The production systems as they relate to animals of each of these groups will be looked at in turn. Tables 1 and 2 show animal population and meat exported respectively.

TABLE I

DOMESTIC ANIMAL POPULATION IN THE PALCAZU BASIN (Probable Undercount)

SPECIES	NUMBER
Cattle	12,296
Pigs	3,246
Horses	33
Sheep	106
Chickens	8,036

Source: (Quevedo, 1981)

TABLE 2

MEAT SHIPPED FROM PICHIS-PALCAZU TO SAN RAMON 1980-81

Beef	465,980 Kg
Pork	14,400 Kg

Source: (Ore, 1981)

2.1. Amueshas

The Amuesha have practiced and continue to practice shifting agriculture based principally on cassava, maize, plantains, taro, cotton,peanuts, sweet potatoes, papaya, sugar cane, beans, rice and pumpkins. Maize and certain beans are grown only on flood-plain soils known as "maize" lands, while other crops are grown on the more acid upland soils. They have not traditionally been animal raisers, but instead have depended on fishing and hunting for protein. However, chicken and pigs are now quite common in most Amuesha communities, although in the communities where Adventists predominate,pigs are much less abundant since pork consumption is prohibited. Both species

species are scavengers, free to roam around the house and into the forest, sometimes receiving supplements of cassava or plantains. Maize which is difficult to store is used more frequently for human consumption. Chickens are consumed by the family while pigs are often sold to colonists and traders to be taken to Pucallpa or shipped to San Ramon.

The Amuesha life style has been greatly altered through contacts with the European colonists and their descendents. The native people have served as cheap wage labor for forest clearing and pasture management, and are the main clientle for colonist-run stores, but at the same time the colonists brought new crops which the Amuesha now grow. In addition the Amuesha have begun to develop their own cattle herds, purchasing young stock and accepting cows in partnership with the colonists (Smith, 1977)

The communities in closest contact with the colonists, primarily Santa Rosa, Buenos Aires, Villa America and Alto Isco , have a longer history of cattle production and also raise a larger quantity (table below). Several members of Buenos Aires were in attendance at the livestock producers meeting and individual herds of up to 60 head are not uncommon. See also figure 8, Miller and Martinez, 1981.

Community	Families	Cattle
Alto Lagarto	19	-
7 de Junio (Villa Ame.)	124	698
Chuchurras (S.Rosa)	21	264
Buenos Aires	30	361
Alto Isco	26	195
Shiringamazu	31	174
Loma Linda-Laguna	82	100

Source: Smith, 1977

Nonetheless, management levels are insufficient due to lack of cash to purchase inputs, lack of corrals for animal handling, and lack of technical information. Animals are often sold at light weights and low prices to colonists when a family emergency arises.

Cattle raising is also being taken up by Amuesha in less contact with colonists such as in Loma Linda and Shiringamazu. Herds of 2-12 were observed with a predominance of heifers and cows. Young bulls are sold or traded for heifers in an effort to expand herd size. Pastures are primarily kudzu, an extensively vining legume which suppresses weeds and requires less careful management . Cattle are often unfenced in isolated clearings free to roam the forest. In many cases pastures were underutilized, since it is easier to clear land and plant pasture than to purchase or trade for more cattle. Lack of experience with cattle and shortage of cash for inputs and capitalization are the main limitations on the level of management.

Mention must also be made of the Munsingen, Switzerland supported cattle project among the Amuesha communities. Groups of criollo-Zebu heifers, a bull,and fencing supplies were given to five communities which had planted pastures primarily of kudzu. A British volunteer has given courses on cattle raising and has assisted in the formation of Agro Yanesha, an Amuesha organization which is promoting cooperative crop sales and sells veterinary products (Tolliday, 1981). Agro Yanesha also has a boat, a rice mill, and livestock equipment, such as back-pack sprayer and worming pistol. Some of the communities continue to manage the herd communally, while others have divided the herd up by families. Once the herd has multiplied itself 3 -4 times, two females must be passed on to another new livestock producer.

According to W. Bistolfi who administers the program for Munsingen, some communities will fail and others will succeed, but the idea is to give them an opportunity to begin commercial production and to begin to develop skills to participate in the market economy.

The present Amuesha situation could be summarized as follows:

a. With disappearance of fish and game, their diet suffers from shortage of protein. While chickens and pigs help to offset the problem, cattle are not consumed within the communities. With the shortage of "maize" lands, there would appear to be a need for community-wide solutions to the protein problem.

b. The Amuesha people are undergoing a transition from traditional shifting agriculture and heavy dependence on "los patrones" to participation in the market system within a limited land base. This represents both a challenge for the individual Amuesha who does not have the skills to manage nor the capital to undertake new production activities and for the community which must distribute land and plan for rational resource use such that their community lands at least serve for the period of time of transition until new generations are moving to new areas, if not longer.

c. Stratification of community members is occurring and will continue to occur as available land becomes more scarce and opportunities for commercial production increase. Differences in size of livestock herds reflects this trend.

2.2. Established Colonists

These farmers of German descent are located on individual farms along the Palcazu River and its major tributaries. They are self sufficient units in many aspects except for dependence on Amuesha labor : and are characterized by a high degree of participation of family members in production activities . Land area ranges from 50 hectares to over 1,000 hectares. While the main production activity is cattle, each farm has a planting of cassava, plantains and sometimes maize and rice as well as a few fruit trees and a small vegetable garden. Pigs are raised on cassava, taro,and plantains, but are free to roam. One farmer was reported to have over 100 head at one time, but generally 4 - 10 animals are kept depending on feed supplies. Pork is smoked for preservation and also stored within tubs of lard for up to one year. Chickens are also kept as scavengers, although maize is frequently fed. The colonists claimed that the area was largely self sufficient in eggs and chicken, not the case for Puerto Bermudez and Pucallpa. The cash flow provided by sale of cattle down river to Pucallpa (before the organization of SASA air transport company, and since SASA to San Ramon) has enabled the colonists to establish a dependence on fossil fuels in the form of out-board motors, chain saws, refrigerators, and generators as well as tractors in some cases.

Cattle herds range in size from 50 head to over 1000 head and are raised primarily for beef. Pastures are largely composed of torourco, a native Paspalum resistant to trampling and tolerant of overgrazing, although some producers have established H. rufa and B. decumbens and kudzu is also used. A rough calculation of stocking rate using Pichis-Palcazu (INIPA, 1981) figures for herd size and total pasture area approximated .8 animal units/ ha for the zone. Banco Agrario figures just for the Palcazu produced .72 animal units/ha. for the area. Calculations for individual producers receiving credit showed a range of stocking rates from .7 An/ha to 1.7 An/ha. Established pastures were generally free of large weeds and brush, quite untypical of pasture throughout the tropics. Two weedings are given per year and a broad leaf herbicide U-46 (2,4 - D product) is also used in the area. The Agro Line salesman says he has sold 20-30 back-pack sprayers in the area. Pastures of up to 20 years of age were still being grazed, although there were signs of overgrazing especially on hill pastures. Small slumps, gullies and base spots are not uncommon in the area and suggest that the hill pastures will not have the same life as the pastures on alluvial terraces. In most areas the forest has been cleared right to the water's edge. Only minimal rotation of pastures is done, if at all, often between 2-4 different fields.

Herd management consists of the separation of bull calves for weaning, although the herd size is with the herd year round and breeds young heifers which are not weaned and grown out properly. Production records are not kept in a systematic way and selection of replacement females is not based on dam or individual performance. In a livestock producers meeting on August 28, great concern was expressed about the lack of good quality bulls in the area. Salt and some minerals, although not free choices, are fed, although such minerals as Pecutrin and Suplamin Selva with higher phosphorus contents which would appear to be necessary due to the low phosphorus soils of the area, are not used due to higher price. Vaccination for foot and mouth, blackleg,and rabies is carried out by most producers, especially if they have lost animals to blackleg or rabies. Rabies has been spreading up from Puerto Mayro and vaccionation campaign is underway. Foot and mouth has never been reported in the area, but vaccination is required by the Ministry of Agriculture if animals are to be sold for meat.

The low productivity of livestock in the Palcazu River, as seen in the indices below, reflects the difficult conditions of the area and the high cost of inputs rather than poor management. Reproductive efficiency as estimated through approximations of several producers ranged from 50-66% with one small producer with 80% last year. Extraction rate for the Pichis-Palcazu area as a whole was 15% based on the number of head carried by SASA to San Ramon, which was estimated by INIPA (1981) to be 80% of the animals slaughtered in the area. Three percent were used locally and 17% went to Pucallpa and Pozuzo. Meat production per hectare per year for the area was calculated at 31 Kg with a carcass average of 167 kg. Individual producers reported from 20-40 Kg/HA/yr.

The following growth rates would produce a 180 Kg. carcass, average weight of bull carcass, at the end of three years and indicate the low levels of productivity in the area.

.5 Kg/day	to 8 months	120 kg
.2 Kg/day	8-12 months	20 kg
.3 Kg/day	12-36 months	220 kg
		360 kg

The tables on the following page were compiled as a rough approximation of production costs in the area based on Banco Agrario and producer estimates:

ANIMAL HEALTH

3 vaccinations against hoof and mouth	180 soles
1 vaccination against black leg	50
1 vaccination against rabies	250
3 injections against internal parasites	180
4 applications against external parasites	400
antibiotics and other	300
	400
	1,760/animal/year

SALT AND MINERALS - recommended Banco Agrario

27 kg salt	1,890 soles
7 kg saltmineral	1,400
transportation	1,500
	4,790 animal/year

PASTURE ESTABLISHMENT AND MANAGEMENT

2 pasture weedings/ha	12,000 - 20,000 Soles/ha
pasture establishment	25,000 - 40,000 Soles/ha
deforestation	
burning	
seeding	
one weeding	
3 kg of seed	3,000/ha

FENCING/KILOMETER

500 posts	200,000 Soles
15 rolls of barbed wire-4 strand fence	240,000
8 kg staples	8,000
5 kg nails	3,250
30 man days of labor	36,000
	487,250/kilometer

One meter of wooden fence for corrals and chutes	4,300/meter

Using these production costs, yearly costs/hectare can

be established as follows:

Fencing	S/ 1,500/ha
Pasture establishment apportioned over 10 yrs.	3,300/ha
2 weedings per year	12,000
Salt and minerals for .8/An/ha	3,832
Animal health for .8 An/ha	1,408
	S/ 22,040/ha

The value of 31 kg of meat produced per hectare per year at 680 Soles per kg. which is the top price paid by SASA is S/ 21,080. This would indicate that at the present moment, on the average livestock producers of the Palcazu valley are making a profit, because their pasture, fences and installations were built at earlier prices and because they carry out less than the recommended practices.

Institutional support for livestock production in the Palcazu River comes from the Ministry of Agriculture which carried out vaccination campaigns, although the office in Iscozacín has been closed over two months and the PEPP office has now undertaken programs in support of livestock production in the area. Banco Agrario has loaned 68,000,000 Soles to 32 producers in the area for 20 short term and 22 long term loans. Short term loans are being used for bull fattening and pasture maintenance, while long term credit is for pasture establishment and the purchase of bulls and cows. While visits are made every three months to the area by the bank representative, there is apparently no special criteria for the type of land on which pasture can be established. This credit comes from a BID loan with total interest on short term loans of 49% rate. The producer who receives a 17% subsidy pays 32%, although until December the rate was 14%. All loans contain a clause which permits the bank to change the interest rate as circumstances warrant, a condition which makes economic planning difficult for the producer. Only one Amuesha has received credit from Banco Agrario.

The present established colonist situation could be summarized as follows:

a. The best flat lands have already been cleared for pasture and new areas available are hill slopes with acid soils. The traditional system of pasture establishment and maintenance can be expected to be less profitable in the future.

b. Labor costs are increasing as Amuesha develop their own cattle herds and focus their attention on community lands. If Agro Yanesha succeeds in organizing a marketing system, the colonists will also have to pay more for rice, maize and plantains as well as bull calves and pigs. The established colonists will not be subsidized by cheap Amuesha labor and products in the future.

c. The closer the connection becomes with the outside market, the more costs of production and value of products will reflect general market conditions. Meat will be worth more and inputs will have a lower cost of transport, but labor costs will probably continue to rise as more opportunities for new enterprises open up in the area. This will require changes in technology and management levels.

d. Ownership of the best flat land in the valley and management skills and experience in cattle production should provide a solid basis for the established colonists to intensify their animal production systems, if they are supported by government research and extension and by an adequate price structure.

2.3. New Colonists

This group was less well represented during the travel itinerary as they are located in the less accessible areas of the river basin, but based on several conversations and prior experience in the Oxapampa valley, it can be said that the new colonists are peasants rather than natives. They have participated in the market economy in some cases as coffee pickers in Villa Rica or as laborers in Pozuzo. They have also raised animals. Shifting agriculture for the peasants interviewed is a way to capitalize and to minimize living expenses. Maize production is used to raise chickens which may be sold to buy a pig. Pigs are raised on maize, cassava, plantains and taro for sale and the cash is used to begin cattle production. Little by little a herd of cattle can be built up, although diseases such as rabies in the Puerto Mayro area and family emergencies can reduce the herd size, which ranges from 6 to 20.

Special mention must be made of the upper Cacazu basin (2500 mm rainfall - 2000 meters above sea level) where a purebred Brown Swiss herd of 70 animals has been established on 30 Has. A wide variety of pasture species have been tried on the farm, pasture rotation is carried out and cows are taken to the bull when they come into heat. Milk production is 7 liters/day and reproductive efficiency of the females is high. Walter Bistolfi, who owns and operates the farm also administrates a heifer project for Munsingen, Switzerland, with the surrounding colonists. Two heifers and fence are given to farmers who have established improved pastures. Medicine and equipment are provided and recipients must undergo training on Bistolfi's farm. Two hundred families have participated in the project, each returning two females which are then given to another colonist. Plans are to establish a reforestation program and a fisheries program as well as small cheese factories and pig production with the whey.

The new colonist situation in the Palcazu basin could be summarized as follows:

a. They are generally unfamiliar with the land resources and the climate of the area.

b. Initially their management skills are limited by lack of capital and lack of experience in the area.

c. Best lands in the Palcazu basin are no longer available

d. If the land that they choose has enough native productivity to permit them to capitalize, their skills with animal management will enable the establishment of a small herd. However, if the land is poor, they will extract what they can and move on.

3. IMPACT OF EXISTING ANIMAL PRODUCTION SYSTEMS ON THE ENVIRONMENT

The Palcazu basin in its undisturbed state was completely forested. Settlement by Amuesha and colonists has resulted in two types of deforestation.

The first is temporary deforestation that accompanies shifting agriculture, mentioned here because cassava, plantains, and taro are often feed sources for pigs and because shifting agriculture is used by new colonists to capitalize their cattle operations. Under existing population densities, regrowth of the forest after the cropping cycle on the hill land soils is rapid and there is a long rotation period until the forest is out again.

Efforts to expand land area under cassava, rice or plantains as a base for pork or poultry production would lead to use of more marginal land and shorter rotation period. Over longer periods a scrub vegetation can be produced by shifting agriculture as in Chanchamayo which would retard forest regeneration. The pressure for maize lands in the area has already led to shorter rotation periods and the felling of forests on terrace banks, but the effects are largely due to bank slips and erosion rather than negative effects due to the shorter rotation period. The area cannot tolerate spontaneous colonization based on shifting agriculture without serious environmental degradation.

The second type of deforestation is permanent and accompanies pasture establishment, a subclimax vegetation which is maintained with human and fossil energy inputs. The effect of deforestation for pasture establishment in the Palcazu basin are three fold: soil erosion, stream flow alteration, and soil compaction.

Soil erosion is occurring on the flat lands in the form of slumps along the river banks where trees have been cut. Flood waters can also erode gullies deep into the alluvial terrace as they rush back towards the river. Several examples were seen above Iscozacín. Soil erosion is occurring on the hills as gully erosion and sheet erosion. On the few highly regular gently sloping hills in the Palcazu valley, well managed pastures provide a good coverage, but on the irregular steeper hillsides that are increasingly being cleared for pasture by established and new colonists, grass cover is not complete. Even torourco which resists trampling does not grow on the steep phases of slopes that are cleared along with gentler slopes within a single field. Farmers prefer to clear cut so that animals do not get lost and predators do not have a place to hide. Lightly grazed kudzu provides excellent cover for even the most irregular slope, but becomes patchy in its coverage under inadequate grazing management. Cattle trails over the hills are also the start of gullies which can be seen in almost every hill pasture, except the most carefully managed. The irregular nature of the topography means cattle concentrate and disperse to cross streams and ditches and every place cattle gather as they move, bare spots and later gullies will result. If pasture expansion continues on the hill areas, soil erosion will reduce the carrying capacity of the pasture and contribute sediments to the stream and river beds.

Pasture establishment on the hill lands will also alter stream flows. The greater the area deforested the greater alteration in flows. Small streams whose basins are completely stripped of trees will experience higher peak flows and lower base flows. As the deforested area expands, the larger rivers will also begin to experience higher peak flows and lower base flows. The potential for destructive flooding is very high in the area. Flood levels even with a high percentage of forest covering the watershed are 5 - 10 meters above the dry season base flow.

Soil compaction as a result of improper grazing management is a problem in and of itself as it may reduce the growth of pasture and weed species exposing the soil to erosion forces, but soil compaction is a greater problem due to its indirect effects. On compacted soil less water infiltrates and thus more water runs off. Greater runoff means greater erosive capacity of the water as well as alteration of stream hydrographs mentioned before.

It should also be mentioned that when forests are replaced with grass, there is less evapotranspiration, at least in the case of the heavily grazed torourco of the Palcazu valley which will also result in more runoff into the streams.

In summary, while deforestation for pasture establishment has not yet had a widespread impact in the Palcazu valley, encroachment is begining to be made into unsuitable lands and an expansion of that trend would have serious effects within the valley and downstream.

A second impact of existing animal production systems is the use of herbicides. Last year 8 - 10,000 liters of U=46 were sold in the Palcazu valley, enough to treat more than half of the established pastures. The lack of recommendations for herbicide use generated under conditions similar to the area,and the absence of a government education and training program relating to pesticide use make this a potentially problematic practice, but current economic conditions have greatly reduced herbicide sales in the area and coupled with high interest rates on Banco Agrario loans ,should delay increased use of herbicides in the near future.

The final impact of existing production systems onthe environment is the simplification of the ecosystem. Single species or 3 - 4 species pastures are replacing forests with hundreds of species and cattle herds are replacing a diverse forest fauna. With this simplification comes susceptibility to individual pests and diseases. Livestock producers in the Palcazu valley reported the presence of a green worm in large numbers which preferred toururco above all otherfoliage. On several farms the worms destroyed the pasture to the bare ground. While it appears that the worm only flourishes under certain conditions and is destroyed by heavy rain showers, its presence serves as a reminder that wholesale propagation of single species pastures or crop areas creates a vulnerability to natural disasters. A similar case is represented by the yellow aphid of Pangola grass which threatens large areas of pastures in Puerto Rico and Venezuela.

4. POTENTIAL OF THE PALCAZU VALLEY TO SUPPORT ANIMAL PRODUCTION AND CONSTRAINTS TO THE ACHIEVEMENT OF HIGHER PRODUCTIVITY

4.1. Natural Resource Base

Initially it must be stated, without considering soil productivity and climate, that the Palcazu basin is a highly complex area. The landscape is composed of many different degrees and types of slopes forming an intricate pattern of narrow hilltops and irregular hillsides. Thus there are not large areas of uniform land that can be dedicated to a single activity under a single type of management. For an extension office or a development project such a landscape presents a difficult challenge in administration and training, because no simple rules or enforcement procedures can be applied. The task instead is to educate each individual user in such a way that he or she makes appropriate use of each land type.

In terms of animal production in the Palcazu valley, there are three types of relevant land use: pasture lands, croplands producing animal feeds, and cropland and forest producing by-products that may be used for animal feed. The ONERN (1981) soil study and land capability study provides a basis for considering the potential of the Palcazu valley and capability classes refered to here will be taken from that report.

The "A2" class, the best land for tilled crops in the watershed, is currently underutilized in the area in extensive livestock and shifting agriculture. From the standpoint of animal production systems, this land should be more intensively used for crop production with by-products or crops for use in animal supplement. However, considering that much of this land is already owned by cattle breeders, it might also be used for intensive pasture or cut forage production, especially for bull fattening or milk production. The use of rotation systems including pastures and tilled crops would also be appropriate.

ONERN considers soils on level topography with low pH and high aluminum saturation as marginally appropriate for crops "A-3". These lands could be used for semi-intensive pastures where lower levels of inputs combined with adapted species would give higher returns than annual crops with high input levels of lime and fertilizer. Again a rotation system with longer periods of pasture may be applied.

The permanent crops category "C" is the next most intensive use followed by pastures "P". Thus according to ONERN system, all lands designated for permanent crops could also be used for pastures with equal or more protection for the landscape. However, such tree crops as rubber, oil palm, coconut, and cacao offer much more protection than pastures and it is recommendable that none of the class "C2es" be used for pastures, of the extensive nature now common in the Palcazu basin.

The soils for livestock production of the watershed are represented by the series Molino and Quintero. The most problematic slope phase of these soils is "D" 8-15%. These slopes in and of themselves are not excessively steep for pastures, but given the complex nature of the landscape, steeper slopes of 25% or greater presenting problems of erosion may be included within the "D" phase. The use of the "D" phase, therefore, depends on the judgement of the land planner and each livestock producer as he sees a particular slope.

The poorly drained areas suggested for pastures representing only 234 hectares should be designated for seasonally extensive grazing use, rather than intensive year round use due to management difficulties and destruction of soils structure due to trampling (Watson and Bolaños, 1981b).

Since the ONERN study was completed, a more detailed life zone study has been completed (Watson and Bolaños, 1981a) which suggests that large areas of the Palcazu valley receive upwards of 4500 mm of rainfall per year, particularly in the area towards the Yanachaga range. Cattle production should not be expanded into those areas as pastures maintenance problems and susceptibility to erosion and compaction will present serious obstacles to sustained pasture productivity. A field study of pastures already established in the Wet Forest Life Zone would be appropriate with special emphasis on data-taking during the rainy season.

Total land area by land capability in the Palcazu area could be summarized as follows:

ACTUAL ONERN CLASS	HECTARES	POSSIBLE USE
A2	4,552	crops, intensive pastures
A3	13,261	pastures with some crops
P2(0-8%)	3,877	pastures
P2(8-15%)	4,606	doubtful for pasture,perhaj tree crops
C2 (0-8%)	10,400	pastures or tree crops
C2 (8-15%)	10,512	doubtful for pastures,perh tree crops

This breakdown of land capability indicates clearly that the land base of the Palcazu River basin does not offer great potential for increasing agricultural production based on the clearing of new lands, even without discounting those lands in the Tropical Wet Forest Life Zone as suggested by Watson and Bolaños (1981b).

4.2. Forages in the Wet Tropical Environment

The following levels were suggested by McDowell (1972) for a forage to make an acceptable contribution to a feed budget.

Dry matter content	20-30%
Total digestible nutrients	> 45%
Digestible Crude protein	>10%
Calcium	>.1%
Phosphorus	>.05%

Attainable production levels for given levels of digestibility of a ration are as follows:

Maximum Production	>70%
Intermediate	60%
Medium	55%

.5 - .6 kg weight gain/day

11 - 12 kg milk/day

Maintenance	45%

(McDowell, 1972)

However, in the case of tropical forages these levels are often hard to meet simultaneously, specially in a wet environment. Dry matter percentage may still be very close to 20% even after 30 days of growth. Thus the grazing animal is consuming much water and few digestible nutrients and is not able to get sufficient nutrients for medium to high levels of production. The dry matter percentage increases as the grass matures, but at the same time the protein level decreases from 10-12% at 30 days to 7-8% at 60 days. Therefore, although the animal may be able to increase its dry matter intake with older forage, the lower protein content of the forage will limit animal productivity. There is also a decline in total digestibility with age as shown in Figure 1. It should be pointed out that even at 30 days of age total digestibility is not sufficient to support more than intermediate levels of production,and by 60 days of age total digestibility will only support production levels slightly above maintenance.

A grazing animal in the Palcazu basin attempts to balance its intake thru selective grazing, but low intake levels as a result of time spent inefficiently in small bites, inadequate energy or protein level, and low forage mineral levels due to the phosphorus status and acidity of the soils are reflected in low weight gains, low levels of milk production, and reproductive inefficiency. While no nutrient analysis has been done on the native pasture species known as torourco, the estimated weight gains of .3 kg/day suggest that torourco is not a species on which to base improved cattle raising.

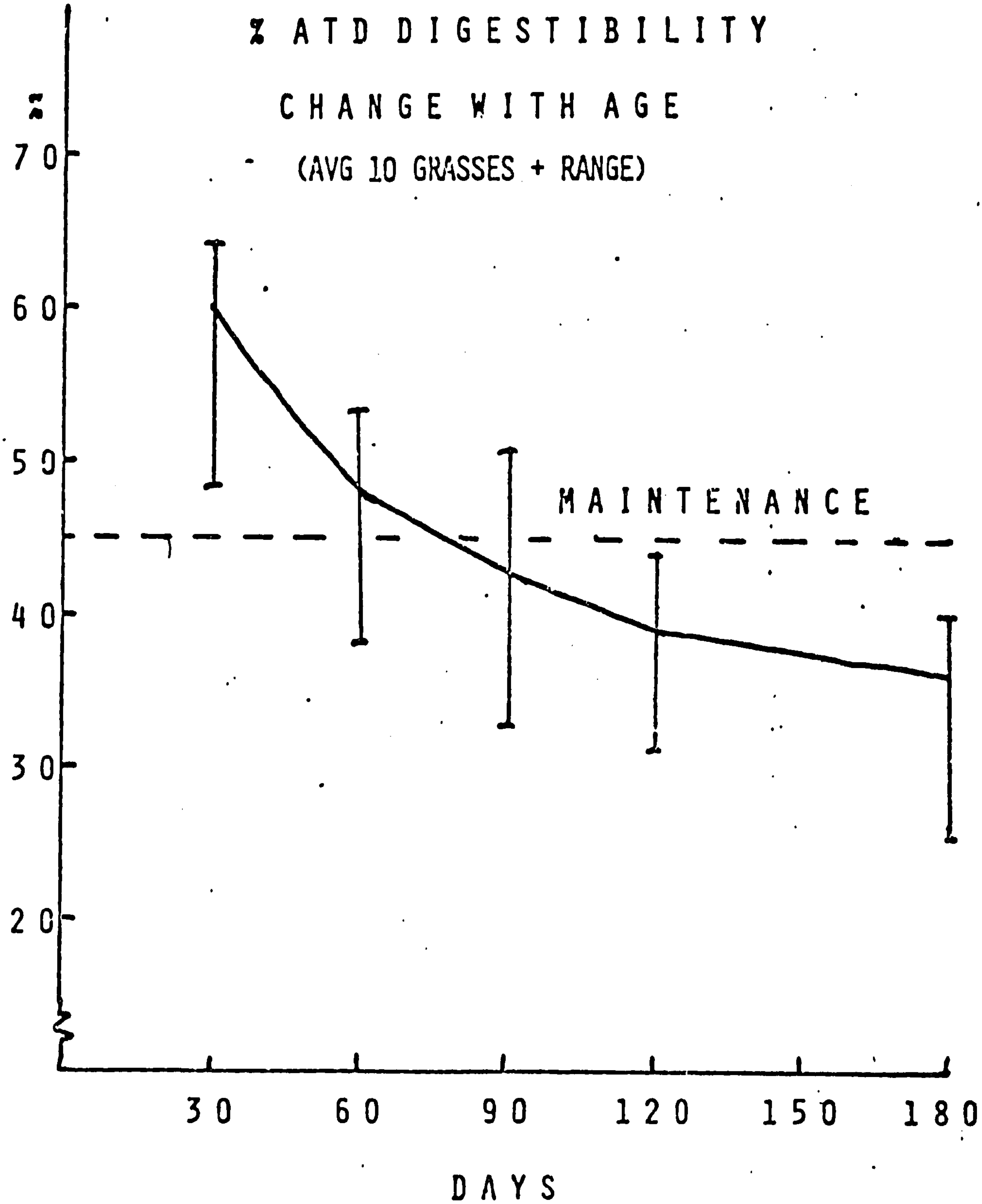
Possible alternatives for the improvement of the forage production in the Palcazu valley are as follows:

1. Pasture rotation to facilitate consumption of forage between 25-35 days of age (depending on species chosen).

2. Supplementation with minerals, particularly phosphorus. In an experiment done at IVITA in Pucallpa, 87% of heifers fed mineral supplement settled when exposed to a bull, while only 28% of heifers not fed mineral supplement settled (Santhirasegeram, 1979).

3. Use of fertilizer, legumes and selected grass species to increase pasture productivity and forage nutritive value (Sánchez,no date).

4. Herd management on a variety of forages of different levels of productivity and nutritive value. Animals in critical stages of production such as weaned calves and cows in early lactation would receive preference for improved pastures, while dry and gestating cows could be placed on unimproved pastures. In this way animal production levels can be increased without increasing forage production on the whcle farm.



(McDowell,1972)

FIGURE 1.-

Sánchez (no date) reports that strategic use of improved pastures accounting for 10% of the total pasture area increased the annual live weight output of the herd 250%.

The alternatives are more numerous than mentioned here. However, it must be pointed out that all the alternatives require improved management skills on the part of the farmer, additional inputs, careful record keeping, and situation-specific technical recommendations generated by research and extension staff.

4.3. Low Protein Levels for Monogastrics in Humid Tropics

The table below indicates the feed values of those materials used for chicken and swine feed in the Palcazu valley.

	% Humidity	% Protein	% Fats	% Fiber	%Carbohydrat
Cassava	61.6	1.1	.2	1	35.5
Sweet potato	68.7	1.5	.4	1.4	27.1
Taro	71.9	1.7	.8	.6	23.8
Green plantain	60.2	1.4	.4	.4	36.9
Maize	14.0	8.7	4.3	2.0	69.0

Source: (Instituto Nacional de Nutrición, 1973)

While disease and parasite problems certainly are responsible for mortality and low growth and reproductive rates among chickens and swine in the Palcazu valley, the protein level in the diet is far below 12-20% of protein needed depending on animal age and production level (in intensive breeding systems). Fortunately the animals are allowed to roam in search of additional protein, but the overall result is diminished egg laying and low growth rates. IVITA (1979) reported that the "criollo"pig under extensive management was 130 days older and 30 kg lighter at slaughter than an improved pig under intensive management.

While improved preventive medicine programs would help to increase monogastric production in the Palcazu area, increased animal populations would quickly strain available feed supply, especially with regard to protein. The alternative for increasing protein supplies in the area are as follows:

1. Bring high quality protein concentrate from the coast as done by IVITA Pucallpa (Camacho, 1979) and as suggested by Velarde (1981).

2. Drying of high carbohydrate food sources to increase effective protein levels Thus, for example, cassava meal would have a protein level of 2.6% and sweet potato - 4.3%. While these levels are not adequate for intensive production, they would permit a small increment in production.

3. Use of fresh or dried leaf protein such as Kudzu, sweet potato tops, cassava leaves, or leaves or seeds from forest or successorial species. The table below indicates protein levels in these leaves.

	% Humidity	%Crude Protein	%Fats	%Fiber	%Carbohydrates
Dried cassava leaves	16.07	14.69	8.39	15.63	45.22
Dried taro leaves	12.33	24.95	10.66	12.08	39.89
Dried sweet potato leaves	11.47	24.65	3.58	9.1	51.2

Source: (Oyenaga, 1968)

For both alternatives 2 and 3 appropriate technology is underdeveloped, unavailable or untested in the Central Jungle. Reportedly a kudzu meal plant in the Pucallpa area failed for lack of sufficient fresh kudzu.

4. By-products from permanent crops which may be planted on over 20,000 hectares of the Palcazu valley. The potential of this source for protein or energy will depend on the specific crops recommended (See AID Palcazu report, Douglas Pool, 1981).

5. By-products generated within the animal sector. Whey, a by-product of cheese production may become available if a conversion to dual purpose cattle is made with the construction of the road. Whey is already being used in the upper Cacazu area for pig production.

Finally, it should be mentioned that an increase in area devoted to crop production either for use as animal feed or for human consumption would quickly encounter limits on land area and would come at the expense of present pasture land. New pastures would then have to be opened up on marginal land. Without the formation of intensive integrated systems of production for the Palcazu area, increases in either monogastric animal production or cattle production would decrease the possibilities for expansion of the other sector.

4.4. Availability and Adequacy of Technical Information and Services in the Palcazu

Detailed, practical investigation on cattle production systems has been carried out in IVITA Pucallpa, Carimagua CIA and USDA, Puerto Rico and information of partial value related to soils management, crop production and monogastric production has been generated in Yurimaguas, CIAT Colombia, and many other areas. Detailed packages of recommendations are available for dry forest areas and savanna, but for areas of tropical wet forest such as Palcazu, pasture species and management practices and herd management recommendations are unavailable. The extrapolation of results from areas with a different climatic regime and different topography and soils is not recommended, except as partial guide for initial research. Within the Peruvian experimental station network, the Tulumayo station most closely approximates the conditions in the Palcazu valley and they have generally left pasture research to IVITA in Pucallpa.

The Ministry of Agriculture office in Iscozacín, normally staffed with 2 - 3 technicians has been closed for two months. Livestock producers reported that vaccines were often improperly stored without refrigeration and the national brands which the Ministry used had sometimes proved ineffective, especially against rabies.

The PEPP office in Iscozacín, staffed with 3 animal scientists, 3 agronomists and 2 animal technicians, has been attempting to fill the gap due to the inactivity of the Ministry of Agriculture, in addition to regular programming of work such as boundary demarcation, agronomic extension with native communities, and planning of projects in rubber and forestry and a pilot farm in Puerto Mayro. The staff is enthusiastic, willing to work under difficult conditions, and have a good familiarity with the area residents, both Amuesha and colonists. Plans are to hire a veterinarian and several technicians and decentralize the office to 4 - 5 different sites, once additional boats and motors are obtained. The level of effectiveness of the PEPP office in Iscozacín will be adversely affected by the lack of technical information applicable to the area, by the lack of experience of the staff which is recently graduated from university, and by the lack of experienced guidance and direction on a day to day basis. While the office director judged the staff sufficient to carry out PEPP responsibilities in the area, it would appear that as the pilot farm and other extension programs in crops and natural resources begin to expand, staff will be insufficient in terms of number. If the native communities also look to PEPP for guidance in new crops, land use and livestock, the need for more staff and technical support will be even greater.

The Banco Agrario which has been working in the area since 1977, has a serious interest in providing commercial credit to the Palcazu valley. Discussions are underway in relation to the opening of a branch office in Iscozacín, since presently clients must fly to Chanchamayo to receive their loans, an expense in terms of time and money. Financial evaluation of loans and amount of credit for different production activities is based on unconfirmed technical recommendations and livestock performance levels established by the credit agent. For example, transportation costs of inputs are not included in financial analysis of return on investment, bull weight at slaughter is overestimated by 50-100 Kg., nitrogen fertilizer is recommended for legume pastures, and a different animal health calendar from the PEPP office is suggested. In the future, closer coordination between Banco Agrario and PEPP will be necessary in terms of technical recommendations and in the use of credit for deforestation for livestock and crop activity.

The PEPP office will be undertaking an extensive program in dual purpose livestock production for the Pichis-upper Pachitea financed by BID. Depending on the road construction schedule for the Pichis and Palcazu valleys, the BID project will serve as a source of information for the Palcazu valley or will benefit from experiences obtained in PEPP programs with animal production in the Palcazu valley, especially in terms of organization of extension education and generation of technical recommendations. The Palcazu valley could serve as a training center for farmers and technicians who could later be moved to the Pichis-Pachitea.

The AID Alto Huallaga program which will strengthen research, extension and training in Universidad Nacional de la Selva and in INIPA, should play an important role in the development of the Palcazu valley, since the two areas are similar climatically and are undertaking major development efforts nearly simultaneously. However, from the description it would appear that cattle and pasture research will not receive major emphasis, an area in which the Palcazu valley and the Pichis-Pachitea milk project will need careful attention. The absence of programs in swine and poultry feeding in the PP Alto Huallaga for UNAS is less crucial presently, but will take on great importance as crop production develops in the area and as demand increases with the establishment of new population centers.

4.5. Economic Conditions

The present situation of the cattle producer in the Palcazu valley is somewhat precarious. Not only is the value of production barely sufficient to cover production costs, but it is also agreed by livestock specialists in IVITA and Universidad La Molina, that extensive beef production systems cannot be economically intensified in the Peruvian selva. Several farmers even suggested that pork production was also antieconomic at the moment, except for home use. While empirical knowledge and experience has enabled the Amuesha and the colonists of the Palcazu valley to develop previously viable production systems, the construction of the road and greatly altered economic conditions have made necessary the development of new production patterns requiring more precise technical and scientific knowledge and inputs.

The limitations and constraints to greater production of animal products in the Palcazu can be summed as follows:

a. The land base of the Palcazu valley is a complex, fragile topography of low native fertility subject to high rainfall.

b. The land base of the Palcazu valley does not contain large uniform areas available for expansion of crop production or pastures.

c. Increased levels of production based on forages requires improved farmer management skills, increased inputs, and adapted technical information currently unavailable for the area. Little land is available for the expansion of cattle production.

d. Restricted quantity and quality of local protein limits intensification of poultry and swine production in the Palcazu area. Competition for available crop land may also limit availability of energy. Permanent crop by-products and forest and tree products may be used for animal feeds, if harvesting and processing technology is developed.

e. Institutional support for development in the Palcazu valley will need frequent readjustment and alteration as the field staff gains experience and technical recommendations are generated. Constant re-evaluation of programming will be important in increasing production in already colonized areas and in establishing sustained production systems in new areas.

f. Current economic conditions severely restrict the alternatives for animal producers, especially in the absence of tested technical recommendations based on economic analysis.

g. Planned colonization of the Palcazu valley based on non-destructive management will require sustained permanent crop and forest production systems involving technology presently untested in Peru and colonists with skills different from those of the average immigrant to the jungle. Animals can be usefully integrated into these systems if appropriate research on year round feed supply and the extension is carried out.

5. GUIDELINES FOR ENVIRONMENTALLY SAFE ANIMAL PRODUCTION IN THE PALCAZU VALLEY

The central issue of environmentally safe animal production in the Palcazu valley is not whether it is possible, but whether it can be implemented administratively by project staff and economically by the farmer. The following are general considerations not taking into account economics and administration:

- Land classification by susceptibility to degradation. Pastures should not be established on steep complex slopes, poorly drained forest areas, or in areas of excessive rainfall, as for example the foothills of the Yanachaga in the Palcazu valley.
- Maintenance of forest vegetation buffer strips along waterways within pastures and on river banks.
- Fencing of pastures into uniform units in terms of landscape characteristics and pasture species composition to facilitate uniform grazing.
- Pasture establishment and maintenance and grazing management to insure adequate soil cover.
- Location of corrals, gates and salt licks to prevent the concentration of animals on slopes and to avoid the formation of animal paths.
- Careful location of intensive units of poultry and swine and of cattle stables in relation to water courses to avoid water contamination.
- Use of proper crop product on techniques to avoid soil erosion in the cultivation of animal feed stuffs.
- Proper stocking rate of free roaming swine to prevent excessive uprooting of soil root layer, especially on steep slopes.

6. RECOMMENDATIONS FOR AID PROJECT IN THE PALCAZU VALLEY

6.1. Environmental Assessment and Management Short Course for all Project Staff

This course should cover the geology-geomorphy of the Pichis-Palcazu-Pachitea Watershed, how the soils were formed, the hydrology of of the area and the effect of land forms and vegetation on the interaction of land and water and the ecology of natural systems and prominent human-managed systems in the area. In addition, the effects of changing land use on the hydrology, soils and remaining natural areas should be discussed along with an evaluation of alternative futures for the area. This may also include an introduction to the economics of rational land use. The course should be of 1 - 2 week duration and simple, but technical enough so that agronomists and animal scientists, as well as planners, understand the why of land use management. Course content and materials, which should include a manual, visual aids, and brief case studies of well managed and degraded wet tropical areas, should be designed by a team consisting of a resource economist, a geomorphologist, an ecologist, an agronomist and a geographer. This group could form part of the regular PEPP staff working on land use and resources management.

6.2. Land Use Planning, Resource Administration and New Production Activities for Native Communities.

While there is a place for cattle raising, swine and poultry production, or fishculture in the Amuesha communities, the development of these activities must come as a result of an overall process of land use planning, establishment of mechanisms for resource administration, development of new production activities, and an increase in Amuesha capacity to administer and manage commercial production systems. Communities are heterogeneous in terms of land base, established production systems, and level of interest in communal and individual production activities. While community members are very aware of their need to learn new skills, their capacity to receive and effectively utilize large amounts of credit and information is limited. A long term, low key program should raise the following questions with the community:

a. How does their traditional agriculture fit into a limited land base and entry into the market economy?

b. What are the results of differing land use both in altering natural processes and in producing benefits? Is cattle production a viable alternative?

c. What are the alternative land uses in the short and long term and what do those uses imply in terms of community structure and organization, possibilities for sustained production, participation and dependence on market economy, and finally the possibilities to absorb future generations on community lands?

Project staff responsible for the short course (Recommendation No. 1) could be responsible for materials and training for the Amuesha in land use capability planning, land and soil formation processes, and the structure and function of natural and managed systems.

An anthropologist or sociologist with a background in land resources will also be necessary to aid in the evolution of community structure and resource administration.

Technical information, extension and possibly credit will be available to the communities for cattle and monogastrics as a result of Recommendations 3 and 4. Demonstration projects in cattle and pasture management and in improved feed supplies for monogastrics could be made available depending on community interest and in coordination with Agro Yanesha and the Munsingen Switzerland project.

6.3. Research, Training and Extension Unit in Cattle Production and Pasture Management.

6.3.1. Objectives

- Generate technical recommendations for a stepwise transition from current extensive cattle production for meat to intensive dual-purpose cattle production. Each succeeding step should be paid for by the profits generated from the previous step and credit should be tied to the farmers' implementation of recommendations. The following steps are an example of possible sequence the research team could follow:

a. detailed inventory of cattle production units in terms of pastures and cattle and evaluation of management level and possibilities and interest in improvement. This step would also serve to identify possible farms for on-farm investigation.

b. improved record keeping, more regular health program, and stock selection based on simple production measures.

c. use of improved herd size, probably dual purpose or zebu milk breed to begin transition from meat to milk.

d. fencing to divide existing large pasture units. This should permit ore uniform grazing and allow separation of groups for special management such as mineral supplement high in phosphorus for milking cows and heifers.

f. improvement of small area of pasture with potential for greater response with improved species of grass, legume or fertilization. This area would be used by animals needing highest level of nutrition.

g. expand area of improved pasture and increase number of pasture division.

h. begin to milk cows. Curd could be produced on the farm and transported to a central processing center for cheese production. Whey could be used for pig production.

Develop renovation systems and more intensive use systems for existing pastures thru the use of forage legumes, improved grass species, fertilizers, green manures, crop rotations, and management techniques. Three soil groups must be given separate consideration. Recent alluvial soils in extensive pastures must become more productive through more frequent cropping, use of green chopped forages, and intensive rotational grazing of higher productive species. Ultisols on slopes of 0-4% have less potential for response to inputs, but must also be made more productive through use of selected low levels of inputs and less frequent cropping with acid tolerant crops. The pastures on Ultisol hill soils, where cropping is not possible, will continue to be grazed extensively under careful management or retired from grazing to permanent crops. Use of legumes and phosphorus fertilizer may be necessary for sustained use of these areas.

- Test recommendations for achieving heavier weights at slaughter, milk production increases and improved reproductive efficiency thru more intensive labor use, more careful management and better nutrition, options more readily available to the farmer with few animals. Since the Amuesha and new colonists cannot expect to become large scale cattle farmers, research and extension should be devoted to increasing the value and returns of each animal to them.

- Monitor the impact of grazing management, stocking rate, and age of pasture on completeness of cover, water runoff, erosion, and pasture species composition and nutritive value.

6.3.2. Staff

- Agronomist working with soil fertility management, soil compaction, pasture species, and pasture establishment and maintenance.

- Animal scientist working with grazing management, herd management, stock selection and breeding program, and installations including lower cost fencing.

- Veterinary working with herd health and nutrition

- Economist working with analysis of profitability of technical recommendations, farm business management and record keeping.

- Agronomist (not full time with team) working with crops used in rotation with pastures.

- Forester (not full time with team) working with integration of trees into grazing systems and management of trees and forest within or along pastures.

- Extension officers as research assistants ("doble propósito"). The difficulties in coordinating and carrying out on-farm research make necessary additional staff to assist the researchers and to conduct extension with natives and colonists. However, these positions should be considered as internships or training. After 6 - 12 months, on-the-job with the pasture research team the agronomist or animal scientist would be much better equipped to work in the Pichis-Pachitea livestock program ,for example, or direct a local PEPP extension office.

6.3.3. Training procedures

See AID PP Alto Huallaga Agricultural Development. In-country consulting could be provided by IVITA Pucallpa staff ιn a long term basis and the team could be part of the INIPA system, perpahps as a mobil unit of Tulumayo located in Palcazu-Pichis.

6.3.4. Location

While there may be a need for an experimental station devoted to pasture management and cattle production in the tropical Wet Forest life zone in Peru, the decision on its nature and location should await finalization of plans for the Pichis-Pachitea livestock project.

Several additional factors suggest that the team in cattle management and pastures begin their program with on-farm research. Firstly, a body of research exists on pasture and cattle-management in the humid tropics and should be organized by the research team by climatic profile of the location of the research results. Secondly, the planning, construction and stabilization of research station with a cattle herd would take 4 - 5 years. Finally, the major area of emphasis of the team initially will be pasture renovation and the development of means to intensify existing farms. The conditions on a newly established experimental station would be inappropriate for such work.

A small amount of project land may be necessary for trials with pasture species and fertilization trials, but even these projects can be carried out in the Amuesha communities or on the pilot farm in Puerto Mayro.

6.3.5. Equipment

The equipment needs depend very much on the on-farm research program set up and the willingness of the farmers to collaborate. Budget needs for tractor rental, hired labor, fertilizer,and fencing will be high, but cost sharing plans may be worked out with the participating farmer.

Laboratory facilities and technicians could be obtained from INIPA in Tulumayo or IVITA in Lima and Pucallpa rather than setting up extensive facilities in the Palcazu valley. Facilities at the Pilot farm planned by PEPP should include provisions for the pasture team in terms of office and storage space and field equipment.

6.3.6. Observations

- Expansion of available credit should await the generation of technical recommendations and credit should not be provided for the expansion of cattle production onto unsuitable lands. The $3 million credit component suggested in the PID could not be effectively used in the cattle sector for intensification. Present credit in the area is $152,000 USA and greater amounts made available before a body of technical information has been developed would only lead to deforestation and environmental degradation.

- The on-farm research operation will probably funnel extra benefits to large farmers creating greater inequality of wealth within the area. However, if production is to be intensified in the area, it will occur first on the large farms which are in need of technical recommendations.

- The Amuesha communities would appear to be good sites for the construction of demonstration or cooperative installations, but native cattle herds are dispersed over wide areas and are generally managed as separate units. A credit or cost sharing fund may be kept for communities or groups of new colonists interested in corral construction and other improvement projects.

- On the medium and long term as PEPP plans are more fully expanded the pasture and cattle-management team could expand its area of operation to include Pichis-Pachitea and a permanent station could be set up.

- The conversion of pasture lands on unappropriate sites to other uses will depend on the intensified use of more suitable pasture lands and accompanying level of profitability, the profitability of alternate uses provided by foresters and agronomists working with permanent crops, or incentives offered by the government for land use changes.

6.4. Research, Training and Extension Unit in Feed Processing and Ration Formulation for Monogastrics

6.4.1. Objectives

- Identify potential sources of energy and protein in forests, succession, and among annual and permanent crops traditionally used by natives and colonists and their chemical composition including possible toxic substances. New species introduction may also be necessary.

- Test or develop small scale on-farm technology for drying or processing carbohydrate sources such as cassava, taro, sweet potato and protein sources such as kudzu, forage sweet potato, cowpea. Technology for collection and harvest may also be necessary. Use of local materials should be stressed.

- Design permanent plantings of feed source trees and plants that would improve the production levels of free roaming swine, not requiring confinement and provide year round feed supply.

- Formulate rations for swine and poultry maximizing utilization of local products both processed and fresh, and compare economically to rations imported from the coast.

- Design production systems for swine and poultry based on improved feeding and animal health that are more economically profitable and achieve greater total production than present systems.

- Set up demonstration units of economically feasible feed formulation operations in 3 native communities and carry out extension activities to promote use of the rations in increasing animal production.

- Distribute improved breeding stock, if rations are successfully developed.

6.4.2. Staff

- Botanist, chemist for identifying and analyzing potential sources of protein and energy. This should probably be part of a much greater effort with more staff organized for the Central Jungle, perhaps part of REDINNA with an information and plant materials network between research stations for further testing. Season of production and potential yields should also be approximated.

- Agricultural engineer working with preliminary evaluation of available technology, selection of technology suited for local needs and construction of models to be evaluated.

- Animal scientist working with ration formulation and production systems for monogastrics.

- Agronomist working with production of crops to be used for monogastrics.

- Forester (not full time) working with tree and shrub species or forest products to be used for monogastrics.

- Veterinarian (same individual as pasture unit) with animal health.

- Economist (same individual as pasture unit) working with economic evaluation of rations and production systems.

6.4.3. Training procedures

See AID PP Alto Huallaga Agricultural Development. In-country consultation could be provided by IVITA staff on a long term basis.

6.4.4. Location

Initital work on feed processing should be carried out on the pilot farm with emphasis shifting to demonstration centers as technology is proven and crops supplies become available. As new resources of protein and energy are identified, more development work may be necessary to include those feed stuffs in the rations.

6.4.5. Work Sequence for Research Unit

- Initial efforts should include the obtaining of construction plans for small scale feed processing units (drying, collection, harvest and cooling) and a preliminary evaluation of their use within Peru and possible use in the Palcazu, the quantification of possible surphases of actual crops, possibly serving as monogastric feed and an evaluation of the possibilities for intensification and expansion of their production within land use guidelines, and an evaluation of the productivity and the profitability of existing pig production operations.

- Construction of feed processing units for testing on the pilot farm should be carried out. If improved methods can be developed without processing, or permanent tree crop plantings can be designed, those should be evaluated economically and their use promoted with farmers.

- Once improved rations with processed products are developed, they should be produced by the research unit in sufficient quantities for testing with chickens, ducks and guinea hens on the pilot farm. An economic comparison of prodnction levels with local rations and with rations brought from the coast should be carried out.

- If local rations have been economically formulated and produced in sufficient quantities, a pig unit should be set up on the pilot farm with local stock and then coverted to improved stock as technology of feed processing becomes more reliable. Cross bred (locally-improved) stock could be sold to local farmers.

- Demonstration units of feed processing operation can be set up at this point and feed used for poultry or local swine.

Once production procedures have been worked out, improved stock can be made available to farmers.

6.4.6. Observations

- If imported feeds are cheaper with the arrival of the road, the research unit could shift to work primarily with animal health and nutrition and with installations.

- It will probably be necessary to bring vitamin and mineral supplements from outside the area.

- Small monogastrics could be promoted to increase protein supply in the Amuesha communities. However, this can only occur with increased feed supplies. At present monogastrics compete with humans in the communities for maize, cassava and plantains.

- Basic research facilities in the processing and use of non-traditional sources of protein and energy could be strengthened at Universidad de la Selva or within INIPA, an area which does not appear to have been covered by the Alto Huallaga AID program. The evaluation of medium and large scale technology may also be carried out at a more central location within the context of REDINNA.

- The absence of concrete proposals for direct investment in production activities during the five year period reflects the author's view that a great number of linkages must be established for successful project conclusion, a result only achievable if a linkage is firmly in place before moving to the next, and that monitoring, re-evaluation and adjustments are necessary even within a project of 5 years. Therefore, this report has indicated objectives and possible procedures without specifying timetables and rigid project deadlines. Hopefully this flexible, iterative approach can be expressed within project design and budgeting requirements.

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8. TERMS OF REFERENCE:

LAND AND RESOURCE CAPABILITY - SUITABILITY, PROJECT DESIGN

ANIMAL TECHNOLOGIST
Charles Staver

- Evaluate existing animal technology in Palcazu Valley in terms of productivity and suitability for the lands on which it is conducted.

- Assess potential of the land and soils of the Palcazu Valley to support diverse animal technologies, grazing and others, in light of the proposed Palcazu project

- Assess effects on the environment of continuation and expansion of existing animal technology in the Palcazu.

- Assess effects on the environment of potential types of animal technology that could develop in the Palcazu under the proposed Palcazu project.

- Recommend measures to reduce adverse environmental effects of existing and prospective animal technology in the Palcazu

- Outline specific projects in animal technology that AID might wish to sponsor in the Palcazu.

9. PEOPLE CONSULTED:

A. GOVERNMENT AND RESEARCH AGENCIES

1. INIPA - Lima
Dr. José Muro - Soil and Crops Specialist
Ing. Cerrón - Coordinador, INIPA-IVITA Agreement

2. IVITA LIMA
Dr. Walter Gutierrez - Tropical Fish Project Pucallpa
Dr. Alberto Sato

3. UNIVERSIDAD NACIONAL AGRARIA LA MOLINA
Ing. Arturo Carrasco - Pasture Management Project
Ing. Manuel Rosemberg - Animal Production Department

4. IVITA PUCALLPA
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Dr. Mario García - Animal Production Program
Ing. Carlos Córdova - Pastures
Dr. Antonio Franklin - Animal Health
Dr. Héctor Huaman - Animal Nutrition
Dr. Antonio Ampuero - Swine Production

5. Proyecto Especial Pichis - Palcazu - Lima
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Ronald Rojas Pebes, Economist
Ing. Chiyuki Saito
Ing. Edmundo del Aguila

6. Proyecto Especial Pichis - Palcazu, Iscozacín
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Ing. Alcibiades Sánches - Forestry Program
Ing. César Uriol - Plot Farm and Crops
Ing. Ronald Péres - Animal Production
Ing. Gonzalo Mosquera - Animal Production
Architect Jorge Miranda - Urban Development

7. Established colonists
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Oscar Zendher
Oswald Zendher
Edmundo Egg
Luis Egg
Paolo Kristen
Ingoberto Noche
G. Schuler
Luis Saldani
Emma de Egg

10. TRAVEL ITINERARY

AUGUST 24	Lima orientation JRB Office
AUGUST 25	Lima interview AID Office, interview La Molina
AUGUST 26	Lima interview offices PEPP, INIPA, IVITA Flight to Pucallpa
AUGUST 27	Pucallpa interviews in IVITA Visit San Jorge
AUGUST 28	Flight Pucallpa - Iscozacín - overview of Pachitea and lower Palcazu. Boat trip up Chuchurras River Interview farmers
AUGUST 29	Livestock producers meeting in Iscozacín. Boat Trip to Puerto Mayro - Interviews farmers overnite in Puerto Mayro
AUGUST 30	On foot along trail to Pozuzo - Interview farmers . Boat trip to Iscozacín
AUGUST 31	Boat trip to Loma Linda - Interviews with Amueshas overnite in Shiringamazu
SEPTEMBER 1	On foot to Amuesha pastures and along river to Chaparral. Boat trip to Iscozacín.
SEPTEMBER 2	On foot to Villa América - Interviews with Amuesha
SEPTEMBER 3	Meetings with PEPP Iscozacín Office Flight to San Ramon - Overview of upper Palcazu watershed Interview with Banco Agrario - La Merced.
SEPTEMBER 4	Interview with Ministry of Agriculture San Ramon Interview with Agroline, Chanchamayo
SPT. 5 - 11	Interviews with AID, PEPP, INIPA Report preparation and presentation

8. AMUESHA
Anibal Francisco
Miguel Valeria
Luis Zendher
Domingo Suarez Salazar
Pedro Suarez Salazar

9. NEW COLONISTS
Alberto Andaluz
Aquilino Huaranga
Luis Faulk
Walter Bistolfi

10. OTHERS
David Tolliday - British Volunteer OXFAM - Shiringamazu
Francisco Wyngaert - Boat pilot Pucallpa - Iscozacín
Ing. Francisco Quevedo - Banco Agrario - La Merced
Dr. David Ore Gonzales - Oficina de Comercialización - Ministry of Agriculture - San Ramon
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APPENDIX N

LAND USE CAPABILITY AND RECOMMENDED LAND USE FOR THE PALCAZU VALLEY

Joseph A. Tosi, Ph.D.

CONTENTS

1. INTRODUCTION AND SUMMARY

The consultant's report which follows is part of the overall AID evaluation-team effort to evaluate socio-economic potential and environmental problems which may arise when new highway construction leads to the development of the Palcazu valley region of the Selva Alta in Central Peru. Work was undertaken between September 9 and October 2, and included a four-day field visit to the region, in company with other evaluation team members, followed by review of project documents, including reports of other team members and reports generated by national technical groups and institutions covering the environmental conditions, land capability classification, potential land-using systems, and possible human carrying capacity for the area.

A major activity of the work and a possible contribution to the better understanding and projection of the PEPP/AID project is the preparation and presentation herein of a revised, evaluation-team map of major land use capability for the valley part of the area. This map is then compared with similarly-oriented maps and reports by the Peruvian Office for the Evaluation of Natural Resources and a private consulting group.

It is concluded that other and, particularly, national reports and maps have been overly optimistic concerning the development potential of the area. Part of this optimism appears to have stemmed from a prior ignorance of the climatic conditions, due to a total absence of reliable meteorological station data, and the consequent mis-application of tables in the Peruvian land capability classification system; part appears to be attributable to a lack of fundamental ecological knowledge on the part of technicians trained in drier regions and the belief fostered by a misreading of the findings of the Tropical Soils Research Project of North Carolina State University, conducted on a site in the much less-humid climate at Yurimaguas, Peru. Evaluation of these reports and maps is made in the light of the revised map based an the updated information on climate derived from the new, detailed Ecological Map of the Valley prepared by project consultants, R. Bolaños and V. Watson.

Using as a base the revised land capability map presented here, the consultant has discussed possible options and opportunities for the development of the lands of the valley for both agriculture and forestry. Particular attention is given to the opportunity for sedentary small-farm settlement based upon clean-tilled field crops in the northernmost part of the valley and of permanent or agri-silvicultural cropping systems in several specific sections of the better lands, interspersed with large blocks of lands suitable only for forest production in the remainder of the lowland area.

Land capability in the Yanachaga and San Matías ranges at higher elevations is determined to be absolute protection. Elaboration of management policy options and techniques for these areas are included in the individual reports of other project consultants, particularly Dourojeanni and Brack.

Finally, a very rough estimate of carrying capacity, presuming ideal conditions of land tenure, farm organization, and marketing arrangement is made. It is found that a maximum of about 14,000 people can be supported in all agricultural pursuits if extensive grazing is excluded entirely and all the best alluvial lands now in pasture were to be turned over to intensive cropping. Another three to five thousand people might be supported in intensive forest management on family-sized forestry units on the poorer land, given major efficiency in product utilization and a favourable price situation for family-produced forest products.

2. ECOLOGICAL CONDITIONS RELATING TO LAND CAPABILITY

2.1. Physiography and Surface Geology

Both surface geology and landforms are important determinants of suitability of the environment for economic and social development in the Palcazu Valley. Their influence extends from climate through terrain configuration to soil fertility. Because little mention has been made of them in other project reports, they merit some elaboration here.

The Palcazu Valley is apparently a tectonic depression between the high folds of the western Yanachaga range and the residual upthrust of the low, San Matías range on the east. This originally irregular depression was subsequently leveled to a quasi-plain by the deposition of both coarse and fine, mostly late-Tertiary stream sediments eroded from the soils and riverflanks of the numerous large streams dissecting the Yanachaga range to the west and south. The great mass-volume of this sedimentary deposition forced the Palcazu river eastwards close to the cuesta formed by the San Matías range. Subsequent differential uplift of the general landmass led to entrenchment of the Palcazu and all its major tributaries south of the confluence of the Pozuzo and Palcazu rivers near Puerto Mairo. Today, north of this junction, major streams (Agua Negro, Pucumayo, Carachama, Quintora and Huampumayo) emerge from their mountain canyons to spill out in broad, coalescing fans with the wide braided stream channels which extend all the way across the plain to reach the Pozuzo as it flows southwestwards from the Codo. South of this point, however the major stream channels tend to be entrenched in a matrix of low hills over the eastern half of the plain. Only on the lower western half of the valley floor do the tributary rivers fan out upon emergence from their mountain canyons to form plains of deposition with typical braided channel formations and the associated wider extensions of flat, alluvial lands.

A broad band of intricately dissected and mostly steep-sided low hills extends from the Huampumayo river on the north all the way to Shiringamazu, separating the flatter and more fertile lowlands on the western side of the valley from the entrenched valley and narrow river terraces of the Palcazu river on its eastern border. These hills are comprised for the most part of unconsolidated stream sediments from the more recent stages of geologic deposition and, to a lesser degree, of the emergent remains of a much older, worn-down land surface composed of consolidated sedimentary rocks probably identical to those found in the San Matías range. These latter structures tend to be resistent to weathering and are discerned as very steep, high hills with some rock outcrops and shallow lithic soils. Their presence between the Mairo and Chuchurras rivers is, interestingly, coincident with a higher-than-average total annual rainfall in this zone.

South of Shiringamazu, the Yanachaga and the San Matías ranges come together to form a single, complex, and sharply rising mountain mass in which the Palcazu and its upstream headwaters are very deeply entrenched. Except for a few narrow and intermittent river terraces along the Palcazu, no plains or flat land suitable for settlement exists beyond this point except in the narrow mid-altitude valleys such as that encountered at Bocaz.

Data on surface geology was not readily available for this region but the ONERN soil report and limited field observations support a view that most of the parent material from which soils have been developed is unconsolidated primary and secondary sedimentary rock. With the exception of the shales, siltstones, sandstones and similar solid outcroppings described above and probably similar rocks on the slopes of the San Matías and Yanachaga ranges, the bulk of the area appears to be topped by old and young stream sediments of mostly acidic rocks and of finer materials eroded from soils and streambanks upstream. These have been deposited as stream bed and terraces of the numerous main tributary rivers which cross the valley from west to east. Because these streams have typically unstable and almost continuously shifting, braided, wide channels, the finer materials tend to overlie gravels or stone fragments close to the present soil surface. This is a major limitation in the profile of the existing low to high terrace soils of the valley.

The lithology of the valley, and indeed, of the region in general, appears to have been unfavorable to the development of high-productivity soils in all landform positions. Fine materials represent minerals derived from the erosion of already weathered parent materials and from mature and over-mature low-fertility soils of the surrounding, superhumid uplands, while the coarser materials are either low base-status shales, silt and sandstones or are stream cobbles and gravel cut from bedrock in highly acidic rock areas in the Yanachaga range. Such materials are ordinarily deficient in the complex of elements needed for a biologically nourishing soil.

Landforms in the area fall into five general classes each of which has rather precise value in terms of economic development. First, there are a series of <u>recent low terraces</u> immediately bordering all major and some minor streams. These terraces are subject to some degree of seasonal flooding (see Hydrology report) either annually or once every few years. Frequency, duration, and severity of overflow depends upon a variety of hydrological and climatic variables but there is usually sufficient overground flow to create a hazard to infrastructure, livestock and to unvegetated soils. Overflow, if brief and not voluminous, may lead also to significant additions of fine to coarse sediments on the soil surface, hence the soils on such lands tend to be relatively highest in natural fertility in the valley. The total area of this landform type is limited and virtually all is already in use despite the hazards mentioned.

A second landform type and one which is far more widespread includes the medium and high terraces . These comprise gently rolling land, no longer subject to stream overflow. However, these lands may have soils derived from fairly recent stream sediments. Flat-lying, they have generally poor surface drainage. Permeability, hence internal drainage, varies locally but most areas are free-draining in this respect due to the presence of gravel and stone fragments at a shallow-to-medium depth in the profile. Soils are not nearly as fertile as these on the low terrace lands, but do vary somewhat amongst themselves in this respect, depending upon the age of the surface relative to last flooding and to climate at the location. A reasonably large area is included in landforms of this type which, given its extension, low erosion hazard, and comparative suitability for agriculture is probably the most important in the region from the viewpoint of future development.

A third general class of landform comprises the so-called "lomerios", or undulating very low hills , and the "colinas bajas" or low hills , related land types both of which occur on surfaces long exposed to geological erosion since the time of their original deposition as Quaternary stream sediments. The very low hills present the lowest relief and have the lowest slopes and erosion hazard, being less than 20 meters from highest point to local base level. The latter, or low hills, vary from 20 to 80 meters in overall local relief. As might be expected, these last also have more pronounced slopes. Given the high runoff associated with the prevailing climates in the valley, the hills in general are characterized by an intricate local pattern of small stream dissection and slopes, while short, run from moderatly inclined to very steep and are consequently highly erodable. The soils developed on landforms of the low hill type vary considerably in specific character but all tend to be very acid, inherently infertile, and contain moderate to very high amounts of exchangeable aluminum. Within this general category one also finds, on occasion, undissected and only partially-drained depressions in which the ground is boggy or in which the soils are very poorly-drained. Otherwise, drainage is good to somewhat excessive on the surface while subsurface drainage tends to be imperfect due to the presence of translocated clays in the B-horizon. Lands in this third category of landforms have low or no agricultural potential and are widespread throughout all but the northernmost part of the valley.

High hills, called "colinas altas", constitute a fourth category of landform and are transitional geographically, to the fifth category, mountain slopes ("montañas") with which they tend to merge along the mountain front of the Yanachaga on the west, the San Carlos range on the south and the San Matías range on the east. Elsewhere, one finds them isolated as islands in major blocks of low hills, particularly between the Mairo and Chuchurras rivers. High hills vary in relief from 80 to 300 meters. They differ from low hills in being residual structures on consolidated sedimentary strata, mostly sand and siltstones highly resistent to weathering and to erosion. They present steep to very steep average slopes, narrow ridge tops and valleys, and generally shallow soils over bedrock. High hills, like low hills, have no sustainable agricultural potential at all but differ in being so steep and shallow-soiled as to be incapable of supporting a productive natural forest or of sustaining logging activities without an unacceptable degree of landslide and erosion. Most lands in this high hill category, as all of those in the fifth or mountain slope category, would be rated as protection lands by any classification system.

2.2. Climate

The climate within the area of study has yet to be determined with objective precision from instrumented stations. Except for one rainfall record in a sheltered mid-altitude valley of the Yanachaga range (Bocaz), there are no data-points either within or sufficiently near the area with which to confirm the climatic deductions made by project consultants (Zadroga, Morris, Bolaños and Watson, Staver). Climate, however, is without question the single most important environmental constraint on the development potential of the area and informed judgment concerning it which is essential classification of land capability.

When standard meteorological station data are unavailable, natural vegetation may provide the only indication of real climatic conditions within such an area. Vegetational analysis of climate has been undertaken successfully by application of the World Life Zone System of Ecological Classification, devised by L. R. Holdridge (1967). This system provides a quantified, objective basis for establishing the relationship between natural vegetation and climate. In uninstrumented areas, climatic parameters of total annual precipitation, biotemperature, and potential evaopotranspiration can be inferred directly from field observations of natural vegetation. A diagram relating undisturbed natural vegetation to specified ranges of precipitation and temperature in hexagonal units designated "life zones" is employed for this purpose. Trained observers, familiar with the vegetational physiognomy of each life zone in its various associational and successional-cover groupings, map the boundaries between these units on topographical base maps of the area studied. Systematic observations are based upon a series of ground transects and subsequent extrapolation between observation points employing physiographic information and a knowledge of the general climatic controls operative in the region.

In 1976, ONERN published a revised version of the original Ecological Map of Peru (Tosi,1957) at a scale of 1:1,000,000. On this map, the Palcazu Valley appears as a very small area and detail is insufficient to determine climatic conditions locally within the valley. Moreover, the area is shown as falling within the Tropical moist forest life zone throughout the lowland part of the valley. Inasmuch as no direct field work had ever been undertaken there and because it was suspected that the area might be wetter than shown upon the map, it was decided that the project should undertake a direct, large-scale life zone field mapping procedure there preliminary to review of the land capability and forest type maps as prepared by ONERN and by the forestry faculty at the Agricultural University at La Molina.

Field mapping was conducted in August 1981, for the Project, by R. Bolaños and V. Watson, trained operators from the Tropical Science Center in San José, Costa Rica. In thirty days of intensive field work, mostly in the valley part of the area of study, but with some visits in the Yanachaga and San Matías ranges, these two consultants produced a detailed life zone map at a final scale of 1:100,000 plus a report which is included amongst the Project documents.

This map reveals the distribution of six life zones, including four transitional areas of two of these life zones and extending over large areas in the valley. Significantly only one of these six life zones is moist or "humid", the remaining five are wet("perhumid") or wetter ("superhumid").

Based upon the life zone map, an inference is made of an absolute minimum of 2500 mm. average annual rainfall for the relatively driest part of the area studied. The total area in Tropical moist forest, with rainfall range between

2500 mm. and about 3200 mm is only 15,097 hectares (Table 2). Of this, only 9910 hectares comprises a truly "humid" bioclimate, falling within the non-transitional part of the corresponding life zone hexagon (less than 3000 mm annually). The remainder, some 5187 hectares , is transitional to Tropical wet forest (3000 -3300 mm) and is "perhumid", with more than half the total rainfall constituting surplus over the full evapotranspirational requirements of undisturbed mature forest vegetation.

The truly humid climate constitutes a single small block on the northernmost end of the valley, between the Codo del Pozuzo and the inner Quintora-Huampamazu river floodplains. This is the area climatically most favorable for human settlement and economic soil-based activity in the entire area under study. Its very small total area, therefore, must be considered when evaluating the overall potential of the region for development.

The largest part of the valley "floor" is characterized by "perhumid" or wet bioclimates. In addition to the two small areas of Tropical moist forest , transition to Tropical wet forest , mentioned above, there is a very large area of Tropical Premontane wet forest, transition to Tropical wet forest (50,481 hectares) and almost 30,000 hectares in Tropical wet forest, within the area mapped for soils by ONERN. A larger total area is found in both life zones, inasmuch as these extend westwards to and onto the foothills of the Yanachaga range, outside of the area included in the aforementioned soils map.

The Premontane wet forest transition has average annual rainfall between approximately 3200 mm on its boundary with the Tropical moist forest and 3800 mm where it adjoins the Tropical wet forest life zone. While it is measurably superior to the Tropical wet forest in terms of agrarian use and development, the climate it represents is nevertheless limiting and confronts the agriculturalist with significant problems. These problems, which will entail considerable investment and technical competence to overcome, are engendered by a surfeit of water in the form of precipitation over normal requirements of evaporation and plant growth. Given a rainfall total for the year of 3500 mm, for instance, scarcely 1000 mm will actually be needed for evapotranspiration in cultivated or pasture land and the balance, some 2500 mm rainfall equivalents (25,000 cubic meters per hectare) per year, will constitute runoff to streams and groundwater. Such an excess, particularly when it is concentrated in a few months of "rainy season" as is the present case, is a potent force for leaching of chemical nutrients to the subsoil and groundwaters, for rapid oxidation of soil humus, for acidification of soil and the weathering and translocation of primary soil minerals, for maintenance of a saturated soil condition and consequent unworkability in tillage, for compaction and erosion under grazing use, and for surface soil erosion on unprotected slopes.

Directly, such a climate is favorable to the proliferation of pathogenic organisms affecting crops while it is implicitly accompanied by a greater incidence of cloud cover, higher relative humidity, lesser evaporation after rainfall, and a lower range of maximum and minimum air temperatures as compared to the moist and drier climatic formations with which most Peruvian agriculture and agricultural experience has been associated. Finally because the climate is a pre-existent condition which has endured for millenia, its influence is already evident in the native productivity and texture, hence workability of the soils, in terrain and landforms, and even in drainage conditions. Native fauna and flora have evolved to adapt directly to the conditions created by the climate and , while highly adaptive to it, are ordinarily different from the biotas encountered in less humid environments. Few of the biological elements in domestication, especially plants, have been taken from the wet life zones and most either do not succeed when transplanted there or if they succeed biologically, may not be sufficiently productive or will require so many costly inputs to sustain growth as to be essentially uneconomic. When domesticated animals are introduced and encounter no problems in adaptation to the climate, the kinds and quality of food supplies which can be produced for them are more limited in variety and usually much lower in quality. For instance, pasture grasses in this and other wet bioclimates tend to be either woody from rapid overgrowth or low in net energy value per unit volume as a consequence of high water content. Pastured animals may literally be underfed and undernourished in the midst of seemingly verdant forage. Experience with beef production in the area of this life zone in the valley indicates that the attainment of high productivity in grazing through the use of intensified technology may be uneconomic due to the high cost of the inputs necessary to offset environmental restraints on plant growth and nutritional quality of forage.

The Tropical Premontane wet forest life zone, in transition to Tropical wet forest , occupies over 50 percent of all the land in the Palcazu - lower Pozuzo Valley under study for development. Although no data are available to indicate the seasonal pattern of rainfall distribution, the normal or "zonal" climate of this life zone has an average of one effectively dry month per year. There is little reason to believe that this area is an exception. Local inhabitants report that some rain falls in every month, although the months from June through September have lower total amounts. The driest month is probably August, at the end of the period of lesser rainfall when stored soil moisture will have been drawn down to its lowest point and prior to the onset of heavy rains in September.

In the rainiest period of the year, the region as a whole is often _incomunicado_ for days at a time and rains may last for days or even weeks with only brief periods of sunshine. In the so-called winter months, cloud cover may be persistent as the southeast trade winds are wedged up by their contact with the Andean mountain which this valley adjoins.

These climatic conditions impose severe restraints on the production of open-tilled annual field crops.

Climatically-speaking, the _Premontane wet forest_ life zone area in the Palcazu valley is best-suited to the production of permanent crops, that is to say, crops which fully occupy the ground and receive no major tillage for years at a time. These are mostly large herbaceous perennials, such as sugarcane and the musaceae (banana, plantain), bush crops (coffee, tea, coca, barbasco) orchard and tree crops (citrus, rubber, various nuts), and harvested forage grasses for the stable-feeding of penned livestock. Pasture grasses although they often grow well, do not stand grazing pressures on the often-saturat and imperfectly-drained soils nor are they a source of nutritious feed for livest due to overgrowth in the wet climate. And even despite the higher suitability of this climate for permanent crops, the number of adapted species is less than in the humid and drier life zones of the tropical lowlands and the problems and costs of production are generally greater.

In their report, Bolaños and Watson have estimated the temperature aspects of this life zone, which are well within the ranges considered optimal for the production of most lowland tropical crops: 25.7°C, at the lowest elevation (270 meters) to about 24°C at the highest (about 400 meters).

Temperature extremes in this altitudinal range (18°- 33°C) as reported by them would not be limiting in any way to the production of crops normally adapted to the moisture regime.

Topographical influence over rainfall is marked in the Palcazu region, as can be appreciated from the life zone map of Bolaños and Watson. Even slight general elevational increases are correlated with significant increases in total annual precipitation. In the Palcazu Valley area, the Tropical wet forest life zone appears wherever appreciable areas of land in the high hill and mountain slope landform categories are encountered. West of Puerto Esmeralda on slightly higher land between the Mairo and Chuchurras rivers in the center of the valley and, again, between Iscozacín and Shiringamazu in the south where the two mountain ranges approach each other, the Premontane wet forest transition to Tropical wet forest is replaced by the Tropical wet forest life zone itself.

This is a very wet environment and has extremely limited potential for agricultural development. The total area is, moreover, significantly large, with the life zone occupying more than 30,000 hectares in the area mapped for soils alone. The total area, up to abut 700 meters elevation where this life zone meets the lower elevational limits of the Premontane rain forest, is considerably greater, possibly as much as 45,000 hectares.

Much of the foregoing commentary on environmental constraints due to climatic conditions in the Premontane wet forest is obviously applicable to this life zone but in much greater degree. Areas in this bioclimate receive, at lower elevations, approximately 3800 mm of rain per year at the "dry" boundary with the Premontane formation. At higher elevations (above about 400 meters) more than 4000 mm. are encountered at this same boundary, but throughout the body of the area indicated on the life zone map, rainfall exceeds 4000 mm and may average somewhat more than 4500 mm (177 inches) per year. On the boundary with Premontane rain forest, somewhat more than 5000 mm falls in the average year. These are enormous amounts of rainfall by any standards and lead to runoff totals three to four times greater than all the water utilized in evapotranspiration.

Except on very shallow soils, there are essentially no effectively dry months, inasmuch as soil-stored moisture is ordinarily adequate to cover water needs during the short period of rainfall deficit in July-August. Even during this period, in fact, there may be appreciable cloud cover and intermittent periods of fine rain over much of the life zone area due to the orographic effect of the Andean front upon the flow of southeasterly trade winds. Pilots of SASA report that virtually no month is cloudless in this area during the so-called "dry season" or "verano".

In the Warm and Cold Temperate regions of the earth, where most of the world's high yielding agriculture is concentrated, areas with more than 80 or 100 inches of rainfall a year are invariably allowed to remain in forest. Forest-based industries are concentrated in such areas. Experience has shown that there can be no successful and sustainable agriculture or grazing activity in the wettest parts of the Pacific northwest, in western Japan, or in eastern Formosa, or in any other area falling in the perhumid or superhumid humidity provinces upon the life zone chart. This fact should not be lost on those who plan for the development of analogous climatic regimes in the tropical parts of the world.

The superiority of the wet forest life zone climates for forestry is in fact, such as to make forestry very attractive as an economic alternative to agricultur

The natural forest vegetation being relatively highest in biomass and potential growth rates, indicates a potential for timber production at a very high level given even a modicum of adherence to modern technical principles of silviculture and forest management. Contrary to much popular myth, the natural forest itself is capable of sustained high yields without marked suppression of its original species richness when harvested in a timely and regular basis under supervision and within silviculturally-oriented systems.

Moreover, the retention of appreciable species-richness will be found to be both economically desirable and ecologically necessary in future years if the lowland wet tropical areas are to play a continuing role in Man's industrial economy. Additional commentary on these points may be found in the Forestry Report (G. Hartshorn).

The climatic limitations presented by this climate, on the other hand, are so great that only the flattest best drained, and naturally fertile soil can be utilized for agricultural pursuits. Excessive rainfall and associated impacts of the moisture regime on both plants and soils makes the production of open-tilled field crops virtually impossible. Very few species are adapted to and will produce profitably under these conditions, while grazing of livestock will be economically tenuous. Permanent crops, especially tree crops, are best adapted to these conditions and a few species, such as the oil-bearing palms (Bactris gasipaes, Jessenia spp., Cocos nucifera var.) rubber (Hevea brasiliensis), nuts (Caryodendron oronicensis, Canarium spp., Caryocar sp, Artocarpus spp.) and fruits (Citrus spp., Chrysophyllum spp. Artocarpus spp, etc) may be grown successfully and to economic advantage. However, the best overall production option for even the better lands in this life zone appears to be timber, either planted on the better land or as managed natural stands on poorer sites.

This life zone is generally characterized by a large proportion of lands unsuitable for any direct economic usage due to terrain factors. Because it occurs in foothill and mountain areas where rainfall totals are much higher than upon the adjacent wide plains, its high runoff feature leads to the dissection of these uplands with the creation of steep to very steep natural slopes within an extremely dense local framework of major and minor streams, as needed to carry off the great runoff totals. Moreover, major streams crossing the area tend to be very deeply entrenched, carrying, as they do, great amounts of runoff water from the even-wetter upstream life zones, especially the Premontane and Lower Montane rain forest life zones.

The steep slopes and usually shallow, erodable soils associated with them are unable to sustain even production forest and the logging of such old-growth timber as may exist in commercial size and form carries the hazard of landslide, aggravated erosion, and soil wasting unless there is exclusive reliance on aerial cable extraction practices. Much of the steeper land on the mountain foothill long slopes must be retained in unexploited natural forest as a simple protection measure or because sustained-yield forestry upon them will be uneconomic.

The areas above the lower valley itself are almost all in superhumid climates: Premontane rain forest, Lower Montane rain forest, and Montane rain forest. These altitudinal belt formations are "tropical" in the context of thermoperiodism, light-quality, and similar latitudinally-related atmospheric conditions. But they are also cooler, progressively, with elevation, with a number of implications that the temperature reduction has for plant growth, soils, and climate itself.

The amount of rainfall in these life zones, which predominate in the Yanachaga range, is unknown. Bolaños and Watson have estimated peak rainfall as somewhat more than 5000 mm. per year in the <u>Premontane rain forest.</u> This life zone lies between about 600 and 1600 meters above sea level. Instrumented stations in similar locations of Peru (Quince Mil) record more than 7000 mm. in this life zone at about 1000 meters elevation, with a gradual reduction inland and uphill. It is conceivable, then, that rainfall in such an order of magnitude may be experienced in the more exposed positions facing east and northeast at or near this elevation in the <u>Premontane</u> formation with a gradual reduction to about 3000 mm in the <u>Montane</u> formation. The high density of major streams and the extreme dissection to which the mountain front of the Yanachaga has been exposed is suggestive of very great total rainfall. At any rate, none of these life zones have climates suitable for sustained agriculture, even were reasonably low - slope land with deep soils to be present, which they do not appear to be from the Radar-imagery.

Both the <u>Lower Montane</u> and <u>Montane rain forest</u> life zones should receive probably significant additional water over ordinary precipitation in the form of mist-condensation on leaf surfaces. Following its condensation from cloud-borne moisture, this water drips to the ground in coalescent droplets wherever the native forest remains intact. Investigations in other countries have shown that loss of the native vegetation curtails this phenomenon in large part greatly reducing the amount of cloud-water captured. Because most condensation-drip takes place in the drier months of the year, it is a major source of water for maintenance of minimal stream flow on the rivers during this period. Loss of the forest by ill-conceived harvesting of timber, shifting agriculture, or attempts to pasture livestock on the slopes of these life zones could lead to an irreversible reduction of low-water stream flow during these months, directly decreasing the potential for hydropowerdevelopment,blocking navigation, harming fisheries and even reducing high-quality domestic water supplies. Given the characteristics of climate alone, then, none of the land in these three life zones would be considered suitable for any agrarian or production forestry use and should be retained in undisturbed natural vegetation to perform essential hydrological functions. So preserved of course, the areas would simultaneously provide habitat for a myriad of rare and unusual animals and plants, of interest to science, future plant domestication, and to the public at large for possible recreation and scenic enjoyment.

2.3. Soils

The National Office fcr the Evaluation of Natural Resources (ONERN) a dependency of the Presidential Ministry under the National Planning Office of Peru, was given the task of preparing a soil survey of the Palcazu valley, as part of a larger project to map soils in the Pichis-Palcazu. Draft copies of the report and map, at 1:25,000 scale, are available for a semi-detailed soil survey over 95,000 ha.,approximately, of the valley. The final corrected report on this survey plus a map and report for 12,230 ha. mapped at detailed scale were not available and could not be evaluated.

The ONERN study is the only professionally conducted soil survey for the area and does not include the totality of the valley "floor" area potentially usable for agriculture and forestry activities. The geographic limitations appear to be due to the lack of aerial photographs on the western margins of the valley, where this abuts the steep lower slopes of the Yanachaga range.

However, a major part and possibly the best part of the area is included in the survey.

The ONERN study was initiated in 1979, interrupted briefly, and continued in late 1980 and early 1981. It is apparently still undergoing final drafting.

This study is "semi-detailed" showing the areal distribution and providing written descriptions of 20 soils series and three series-complexes found within the lowland area between the Codo del Pozuzo and Sta. Rosa de Pichanaz. It is part of a larger study by ONERN for the project which includes land capability classification, forestry potential, actual land use and some supplementary information of stratigraphy, lithology, and the location of construction materials, plus recommendations concerning the best use and development of the forest and soil resources of the area. Special attention is given to development of forest resources. A forest-type cum actual land use map at 1:25,000 and report is also available in draft form.

In evaluating the soils survey, an interview was held with the director of the soils department at ONERN and personnel assigned to the project. Apparently, only one soils surveyor worked in the area, accompanied by three "natural resource" specialists. Following preliminary reconnaissance of the area, soils series were photointerpreted in the Lima office and initial determinations made by reference to previous work on the 1970 reconnaissance soil study: Villa Rica- Puerto Pachitea, of ONERN. This was followed by field verification or rather partial verification of the detailed pattern of soil determinations made on the (1977) aerial photographs. Due to the difficulties of terrain and transport, systematic coverage of the area was not attempted.

Rather transects were made on existing foot trails between settlements and by disembarking from canoe along the river banks. The soil pit and augering density was rather low for this intensity of survey, the accuracy of which depends more on the experience of the lone soil surveyor than on any normative soil sampling detail on the ground.

Physical and chemical determinations made on samples from the area were undertaken at the La Molina Laboratory. Atomic absorption techniques are not yet in use there and many tests needed to appraise the real productivity potential of these soils could not be made, as for instance, base saturation, total bases and minor elements. Soils were classified by the United States Department of Agriculture, Soils Taxonomy, and also by the FAO Soils Classification system.

Evaluation of the study suggests that it is of generally good quality for general planning purposes. Its geographic detail is extremely high relative to ground verification hence many errors in local detail may be expected. It is probably not an acceptable document for local planning purposes. Soils profile descriptions lack information on permeability and water-retention capacity, stoniness, and rooting depth of native vegetation, and should be complemented with minor element determinations before recommendations on fertilizer requirements can be safely made. There is an assumption throughout the text that liming and normative fertilization practices will overcome both fertility limitations and aluminum toxicity. Such an assumption is scarcely warranted for so wet and unknown a soil area and in the light of experience elsewhere with the aluminum problem.

Except for the five or six soil series located on low terraces and subject to stream overflow and fertility renewal, almost all soils demonstrated great acidity and moderate to very high percentage of exchangeable aluminum.

This fact does not auger well for the agricultural future of the valley in general. Even if the fertility and aluminum toxicity problems can be overcome in a strictly technological sense, as is suggested throughout the text and recommendations, it is quite doubtful that these problems can be overcome economically or in relation to the probable cultural background, resources, education and habitual agricultural practices of the majority of the present and probably future colonists and inhabitants of the area. That is to say the level of technology required for success may not be achieved even with the best official intentions.

2.4. Vegetation and Actual Land Use

The forestry department of ONERN has produced a forest-type map of the same area covered for soils, and this at the same scale and on the basis of identical aerial photographs. This forest map and its accompanying report covers ground-cover characteristics in a general way, showing forested and non-forested areas. Non-forested areas are divided into agricultural usage and unused or waste lands such as islands and sandbars. Much of the young secondary forest in abandoned agricultural clearings is included, apparently, with agricultural land. Under forest, there is recognition of primary and secondary forest by "types" named after the three most voluminous, frequent, or common tree species present in the stands and these types are described in some detail, as commented upon in the forestry report by G. Hartshorn. For each type of primary forest, classes are established and mapped indicating physiography of the land they occupy and production potential.

It is unfortunate that more recent aerial photographs were not taken for this work, as the photographs are from 1974-1977 (mixture). Very considerable increases have apparently taken place in the area of land used for agricultural purposes, including grazing since that time and this information would be helpful in determining just what areas remain for forest production and for agriculture in relation to land capability as determined by the ONERN and other classifications.

It is of some interest to compare the forest-land-use map with the map of soils of the area. There is remarkably little coincidence between the boundaries shown for soils and those for forest types, although both maps are based upon interpretation of a largely vegetation-covered terrain on identical aerial photographs. The forest map appears to be the less-detailed of the two and suggests less-intensive field work or grasp of its subject matter.

Actual land use in the area at the time the photographs were taken is of some interest also, verifying as it does the assumption that much of the best alluvial land along the Palcazu and its major tributaries is already deforested and in some form of agricultural use (not specified on the map), except in the sector north of Puerto Mairo, precisely where the best soils, terrain, and climate are to be found.

3. MAJOR LAND CAPABILITY IN THE PALCAZU VALLEY

3.1. Definitions

Land capability, sometimes referred to as potential land use, may be defined as the maximum level of exploitation recommended for a given unit of land, particularly as regards soil use in agrarian and forest production, under the natural environmental conditions prevailing thereon. By "maximum" we imply that there is an upper permissible limit of intensity (energy-input) and of manipulation of natural soil and vegetational growth processes on the land.

Amongst the so-called "major" categories, clean-tillage of annual or row crops is ordinarily the most intensive use. Clean-tillage, with its great requirement for energy inputs, the severity with which it represses natural succession in vegetation, insects, and disease organisms, and its tendency to alter the structural, biological and chemical nature of the soil, is obviously more intensive a use than pasture or permanent crops and much more intensive a use than forestry.

In naturally forested regions, the maintenance of a low herbaceous cover (pasture) for the grazing of livestock may be considered a more intensive use than permanent crops. Permanent crops require less energy to maintain against the invasive forces of nature and maintain soil fertility at a normal level with less fertilizer and human effort than do acceptably productive pastures under identical environmental circumstances.

Amongst all agricultural uses, permanent crops, most nearly imitate the natural secondary and even high forest vegetation and require remarkably little effort for their maintenance, health and productivity.

Forests, particularly natural forests, under management for sustained timber production, are in naturally forested regions, lowest in use-intensity and require very little energy for their maintenance as production units, even when regular harvest of forest products takes place.

Finally, where natural vegetation is never utilized or removed for any soil-based economic production, the land is unused and there is no energy cost for soil and vegetation maintenance but the land may perform some socially useful functions, as in hunting, fishing, recreation, or water production and hydrological regulation. If classified specifically for such non-economic uses, it is designated as protection land.

It is an accepted principle of land capability classification that the foregoing hierarchy of uses permits any and in most cases, all uses lower on the scale of use-intensity when economic or social circumstances do not require exploitation at the highest permissible level. However, the reverse is not true: uses higher than the recommended maximum are all excluded no-matter how great the demand may be for intensification of production activities. The principle involved is fundamentally ecological: each land-use capability category represents an upper limit of tolerance in terms of such factors as soil productivity maintenance, erosion hazards, and risks associated with external (indirect) costs of the use, on the one hand, and of sustainable productive capability within the physical and biological constraints imposed by the environment on the other. As use-intensity increases, there is a corresponding increase in the requirement for a "quality" environment as measured by slope and surface configuration, soil fertility, depth, drainage, arability, water-holding capacity, permeability, and the physical requirements of terrain and soil for the operation of machinery, animal or human power in the conduct of production activities. Natural biological elements already present which offer an economic opportunity if correctly utilized or husbanded from the start should also be considered in classifying land capability.

Beyond the ecologicial considerations, moreover, it is not possible to rationally classify land use capability without a clear statement of the techno-cultural standards to be applied in the area classified. People exploit their physical resources base only within a fairly rigidly-defined cultural framework which embraces their felt-needs, beliefs, knowledge, skills, and the tools,genetic and energy resources available to them. The same set of physical resources will be developed quite differently by people of different techno-cultural configurations and recognition of this fact is absolutely essential to the design and applications of any truly worthwhile classificatory system for land-use capability.

Techno-cultural considerations are implicitly built into a few existing classifications, as for instance the U.S.D.A. Soil Conservation Service 8-Class system, often promoted in tropical Latin America although designed for high technology farming regions in the temperate United States, and the official Peruvian classification (1975) which was designed in its original version for application to traditional agricultural societies in this country. But the majority of existing classifications either fail to take techno-cultural limitations into account in any formal sense or presume that highly advanced technology and capital resources for the purchase of sophisticated and costly inputs, energy, credit, and agricultural research and extension services will be fully available and availed by the people whose actual or future land resources are being classified.

Finally it should be noted that economic factors, <u>per se</u>, do not enter directly into the classification criteria or decision. Economic factors will to a large degree, however, determine which level of permissible land use will be instituted by the producer or land owner at a given point of time on a given unit of land. <u>Land use planning</u> based on capability classification is designed to insure that such use will not exceed the limits established by the classification for that land. <u>Zoning of permissible land-use</u> and <u>farm plans</u> are direct means to this end and might be instituted in the Palcazu Valley development program.

3.2. <u>Evaluation of Official Studies by ONERN and Unpublished Report of the Ministry of Transports</u>

Two groups are currently producing finalized versions of land capability and forest classification maps for the PEPP project. Both include the Palcazu Valley in the area classified and, in the case of the La Molina forestry map, part of the adjoining steep mountain lands of the Yanachaga and San Matías ranges.

The La Molina forestry map is not yet publically available, even in draft form, but reports and maps have reached a borrador stage and were available for examination. Some preliminary conclusions can be drawn after seeing the maps on the drawing board and discussing the contents of the draft reports with the two authors.

Two separate studies are actually involved. The first is an inventory of forests and a forest-type land use map prepared under the National Forestry Inventory Program and made at La Molina for the Ministry of Agriculture.

In it, land capability is generalized by forest-type and is based upon physiography alone. Land capability designations on the forestry map bear no recognizable similarity to those described in a companion draft study of soils and potential land use prepared by a consultant to the Proyecto de Transportes, Selva Central, of the Ministry of Transport and Communications. The detailed and voluminous report on this latter survey which, according to its introduction, required only 75 man-days of work to study an area of 2,080,261 hectares, illustrates how highly subjective and biased a capability survey can be, depending on whose particular interests and technical predilections are being served.

In the Ministry of Transport land capability report, climate is discussed at considerable length with reference to the Thornthwaite System of Climatic Classification, despite a paucity of the station data required to make this system effective. Climate is in no way referenced to the predictions on land capability, however, or is it otherwise related to development potentials in the Palcazu valley. The life zone map of Peru based directly on the vegetational-climatic relationship (ONERN, 1976) is not mentioned.

The soils data for the Palcazu valley section of the Ministry of Transport study were taken mostly from an early ONERN soils and land capability map of this area, made at a reconnaissance-level, in 1970, rather than from the as yet unpublished study of ONERN, at semi-detail, of 1981. However, the Ministry of Transport consultant chose to adopt, unquestionably, the original ONERN land capability classification of 1970 when developing his conclusions and recommendations concerning the area, while also gratuitously upgrading some soils sub-groups from ONERN's original Class V rating to Class III.

Unfortunately, the original ONERN classification (1970) employed the U.S.D.A. Soil Conservation Service's 8-Class System of Land Capability Classification (Klingebiel and Montgomery, 1965), rather than the now-official Peruvian land capability classification (Ministerio de Agricultura, 1975) used by ONERN in its more recent study (1981). This last did not exist at the time of their earlier survey effort.

Inasmuch as the two capability classifications (and the two soils maps also) differ very much in concept, terminology, and findings, comparison of the two survey results would ordinarily be very difficult. However, the differences are so gross that they stand out anyway, as can be appreciated from the following comparison for the area lying between Pichanaz and the Codo del Pozuzo (96,000 vs. 95,000 hectares):

Villachica (1) 1981		ONERN - 1981	
Cropland:		**Cropland:**	
Class II -	9.4%	A2s	3.5%
Class III-	24.3%	A2i	1.3%
Class IV -	8.1%	A3s	12.0%
Total:	41.8%	Total:	16.8%
Pasture:		**Pasture:**	
Class V-	16.0%	P2s	4.1%
Class VI-	37.1%	P2es	4.8%
		P2sw	0.2%
		C2s	13.0%
		C2es	5.7%
Total:	53.1%	Total:	27.8%
		Permanent Crops:	
		C2es	5.3%
Forestry:		**Forestry:**	
Class VII	4.1%	F1	33.7%
		F2	3.0%
		Total:	36.7%
Protection:		**Protection:**	
Class VIII	1.0%	X	13.4%

(1) Classed for permanent crops with pasture as an alternative use. Given the fact that pasture is a higher use than permanent crops, these lands are effectively classed as pasture lands.

When comparing the two surveys, it is necessary to understand that the U.S.D.A., Soil Conservation Service C.S. 8-Class system includes no exclusive class for forest use, this being optional for either pasture or forestry even in Classes VI and VII. Neither is there a separate class for permanent crops, nor does the system employ objective, quantitative criteria from the soil survey for formally distinguishing between classes themselves. This last is always a subjective decision on the part of the land classifier. Furthermore, this system is based, implicitly, on the modern high-technology standards of agriculture as practiced and promoted in the energy-intensive economies of the temperate United States and Europe and can scarcely be considered a realistic measure for appraisal of land capability in the wet, low-tropical Palcazu valley or for the more primitive and traditional cultural context which prevails there and will continue to prevail even after development has taken place.

The text of the study states that 60 percent of the Palcazu valley is suitable-indeed, promising-- for high level agriculture and that practically all the remainder can be used for pasture given soil conservation measures and fertilizer, improved pasture grasses, and the like. Forestry is not mentioned in the report. Pastures are recommended as the principal crops to be established in the valley, (26,500), and rice would be the second crop with 9000 hectares. The remainder of the area would be used to grow 4,000 has. of maize, 8,000 of peanuts, 500 of tobacco, 4,000 each of coffee and cacao, and the remainder in smaller areas of yuca, achiote, oil palm, and plantains.

In terms of land utilization, such conclusions and recommendations are patently ridiculous. Pastures would presumably be located on the rougher hill land, being removed from their present location on the best flat alluvial terraces to the low and high hills to make room for cultivation. Such rough land will not support pasture on any continuing basis under the soils (let alone climatic conditions) which prevail and the erosion provoked should it be attempted would be horrendous. No responsible crop ecologist, moreover, would recommend the majority of open-tilled crops suggested for any but the well-drained alluvial lands in the less wet areas and north of the Rio Huampumayo (Tropical moist forest). Coffee does not produce an economically acceptable product under roughly 500 meters elevation and suitable land does not exist above this elevation. Moreover coffee is already in excess supply on national and world markets. Of the crops selected, in fact, only cacao on the better soils in the less-humid parts of the area, and oil palm, plantain (and banana) and yuca, would be acceptable for the better soils in the two wetter life zone areas. All are permanent crops and most are "tree crops" normally components of "agro-silvicultural" production systems.

Passing on to the ONERN Land Capability Classification of the Palcazu Valley (ONERN, 1981), much more favorable comments can be made. This study has yet to be finalized and published, but the map is finished, at 1:25,000 scale, and a well-written draft report is available. The basis for the capability map is the soils map at semi-detailed intensity, evaluated separately in a previous section of this paper. The capability designations are included as part of a fractional-code key written into each soils series/slope phase unit distinguished upon the map: that is to say, the soils and land capability map are one and the same and the data concerning them may be cross-referenced for more detailed planning.

Land capability has been determined by referring the soils data for each series/phase to the regulation Land Capability Classification System of the Peruvian Government (Ministry of Agriculture, 1975). This system was originally devised by a select technical group in 1970 and officially promulgated a year or two later. At the insistence of ONERN, however, the original classification was modified in terms of some of the quantitative criteria applied (particularly pH and slope limits) and officially re-decreed in 1976.

The modified regulations now in use are generally far-more permissive in terms of physical limits to high-intensity land uses than those of its predecessor, although the former was drawn up by a national interdisciplinary committee of agricultural, soils and forestry experts. Both versions, but especially the first, recognized the constraints on technological change inherent in national culture and traditional agricultural techniques. Each version calibrates quantitative limits to specific uses in terms of these constraints, of specific opportunities lying within the traditional practices of the nation's farmers, and of the possibilities for institutionally-promoted improvement in agricultural practice. The system is based, furthermore, on strictly objective numerical criteria and is fundamentally ecological, recognizing the overt influence of climate as well as soils and terrain factors in agricultural and related agrarian land uses. Life zones as portrayed on the revised ecological map of Peru (1:1,000,000) (ONERN, 1976) are introduced in this classification as a major factor for the determination of terrain and edaphic-factor limits for each given major land use capability class, of which there are oficially only five (clean-tillage, pasture, permanent crops, production forests, and protection). Given all these considerations, it would be reasonable to conclude that a map drawn up under this officially-sanctioned system would provide a reasonably accurate and acceptable measure of real land capability in the Palcazu valley, presuming that accurate information on the life zones and their distribution there is available.

As mentioned earlier, however, ONERN did not possess accurate or detailed data on life zones. Consequently, in classifying the land capability of the area under the official methodology they would have erred on the side of higher agricultural suitability in accepting the entire lowland areas bein classified as Tropical moist forest life zone, as shown on their own small-scale ecological map for this valley. They would have used,therefore, the incorrect table of values in their classification of lands in the Tropical wet forest life zone.

ONERN, moreover, apparently under pressure to demonstrate a higher agricultural suitability than results when the official classification system is strictly applied, has tended to apply this system most leniently in the Selva in general. Upon finding in their original classification that only 4.8 percent of the total area of the Palcazu fell into the highest, Clean-tilled crops category (A) they simply transposed 12 percent of the total area, correctly classified under the regulation system as (C) Permanent Crops, into Class A 3, a very low-intensity or restrictive division of the Clean-tilled crops (A) class and one which they apparently invented for this purpose. Similarly, a significant part of all lands officially classifiable as Permanent Crops (C) were indicated as suitable, also, for Pasture (P) despite the presence in part of the area of very steep and erodable slopes. Because of the ONERN failure to recognize the climatic limitations present over much of the area, such arbitrary changes and additions to the official classification added to my distrust of their findings.

After having re-classified some of the lands, as described, the ONERN (1981) capability survey resulted in the percentage of area, by capability class, listed in the preceding comparison of the Ministry of Transport and ONERN reports. Given the great disparity between the two sets of results plus the proposal, made by Bolaños and Watson, that the ONERN survey findings should be revised in light of the newly available life zone data, a decision was made to act on this recommendation using all available data.

3.3. Methodology and Procedure

As a first step, the ONERN (1981) soils survey data were analyzed carefully to abstract the quantitative values for terrain and edaphic factors in each soils series and slope phase, and then classified individually in all sub-groupings by life zones, (a) with strict adherence to the official Peruvian Land Capability Classification (Ministry of Agriculture, 1975) and (b) in terms of the FAO-sponsored Land Capability Classification System developed by this author for Colombia in 1972 (Tosi, 1981). The Colombian system is similar to the Peruvian classification in format and philosophy, but represents a refinement of the same inasmuch as it established separate classificatory criteria for each life zone, is calibrated to accept limits set by the Universal Soil Loss Prediction Equation of Wischmeir and Smith (1965), and recognizes four separate levels of techno-cultural capacity, called "Technological Management Systems", under which the same land unit may be classified with possibly different capability results (Primitive, Traditional, Artesanal-advanced, and Mechanical-advanced). The Palcazu soils data were evaluated in terms of both the "Traditional" and the "Artesanal-advanced" management classes by the Colombian system and the results were compared with the results of both the strictly official Peruvian and the ONERN classifications.

It is significant that application of the Colombian criteria resulted in the virtual elimination of high-intensity land uses on all but the very best soils except in the one humid climate area. It also significantly reduced the area as compared to the ONERN estimates, for both lower-intensity agricultural uses (P) and (C). Moreover, even when the higher technological levels accepted by the "Artesanal-advanced" management system were applied to the data, the Colombian-system diagnosis was not significantly improved. The Peruvian classification consistently gave higher ratings to the capability of soils of the Palcazu valley.

On the basis of these findings, this consultant undertook to reconcile the ONERN findings in terms of the detailed life zone map, with the official Peruvian land capability classification considering, also, the possibility for intensification of technological levels as the area entered into development. The comparison of the three classificatory attempts: (a) ONERN, (b) consultant's recommended classification, and (c) classification with strict adherence to the Peruvian official classification, for each soil/slope class shown on the ONERN Soils map (1981), with observations on the consultant's recommended classification, are listed in Table 1. It should be noted that the consultant's recommended classification takes its cue from the ONERN classification, which subdivides each major capability class (A, P, C, F, X) into quality sub-classes (1,2,3) and further indicates limiting factors: (i) = susceptibility to flooding surface drainage; (s) = soils fertility, aluminum toxicity; (e) = erosion hazard, slope; and (w) = internal drainage of the soil. These latter divisions are acceptable inasmuch as they add precision and explanation to the major class designations of the official system.

Employing as a base map the original 1:25,000 scale semi-detailed soil map of ONERN, the values for land capability recommended by this consultant (Table 1) were then transferred to each separate soils-slope phase subdivision marked thereon and the map was colored-in to reveal the geographic pattern of capability classes. A reduced scale version of this map accompanies this report and a full-scale version may be prepared by the same technique using the values presented in Table 1.

There is little difference between the consultant's map and a map prepared by the same method but in which the official Peruvian classification values were substituted except for minor areas in the Om, Hu, and Ca series affected by annual stream overflow which have been down-rated to Pasture in the wet climates, Ag and Ca-Ag which have been raised from Protection to Permanent Crops (on the grounds that the aguaje palm is already present or could be planted as a potential tree crop in these swampy lands), and the uprating of Pu and Mo in the Tropical wet forest from Forest to Permanent Crop use.

Two considerations are of special note in regards to these departures from the official classification. The first is that the position of Pasture (P) and Permanent Crops should be reversed in the official tables, due to the more exacting ecological requirements of lands for pasture as compared to permanent crops, and second, that Permanent Crops (especially ONERN's "C2"), in this classification may be considered equivalent to what some authors call " Agri-Silviculture". That is to say, lands in the pasture class being higher on the use-intensity scale (assuming intensive and non-degrading grazing practices) than permanent crops, permit the alternative use of the pasture class lands for permanent crops while the reverse is not true: land classed for permanent crops in the Palcazu valley are categorically restricted to "agri-silvicultural" uses and production forestry.

3.4. Findings

Examination of the map as attached (Map of Major Land Use Capability in the Palcazu Valley) and of Tables 2 and 3 the data in which has been derived therefrom,is compared with the ONERN map and its derived data and shows the following:

Percentage of Total Land Area in:

		ONERN Map	Consultant's Map
Clean-tilled Crops	(A)	16.8	7.6
Pasture	(P)	27.8 *	13.3
Permanent Crops	(C)	5.3	14.4
Forest Production			
Intensive	(F1)	33.7	20.3
Extensive	(F2)	3.0	25.9
Protection	(X)	13.4	18.6

* Included 18.7% of total area classified for both pasture and permanent crops)

Summarizing the above, we may say that the area of land recommended at some level of agricultural potential in the consultant's interpretation of the Regulation Peruvian classification and by applying same to the new life zone map of the area (Bolaños and Watson) is 35.2 percent of the total land area or 33,554 Ha, while the ONERN map which applies only the Tropical moist forest key of the official classification to the same data and somewhat loosely interprets the regulations class-definitions, is 49.9 percent or 47,405 Ha., there being a reduction of 14.7 percent overall, equivalent to 13,965 hectares.

Not only is there a significant reduction of about one third of the total area proposed as suitable by ONERN for agriculture, but the quality of that land goes down very appreciably when climate is entered correctly into the classificatory process. Compared to ONERN's figures, clean-tilled crops drop more than 50 percent in area, pasture the same, while permanent crops increase almost three-fold at the expense of these two more intensive categories. Inasmuch as permanent crops will do even better on lands in the A and P category lands, the best overall regional emphasis for the agricultural lands in general would be permanent crops.

Given the adverse findings on application of the Colombian classification to the sama data, as mentioned previously, it must be presumed that the consultant's recommended classification for the area is extremely optimistic. It can be said, therefore, that

(1) no attempt should be made to utilize any land unit for higher uses than that for which it has been classified herein, under even the most pressing circumstances, until and unless full testing by practice in pilot projects and specific research have demonstrated the economics and ecological feasibility of such use;

(2) it will be preferable, at the outset, to "under-use" most lands in the A and P categories until such field trials and research demonstrates the optimal specific uses, crop species, and cropping practices for these higher categories;

(3) land in the two Forestry sub-classes (F1 and F2) be reserved from all entry and exploitation until an adequate program for their rational management under permanent, sustained-yield forestry principles can be instituted, including the provision of workable safeguards against entry and violation of standing timber capital resources by squatters, land speculators, or lumbering interests favoring destructive, one-time exploitation;

(4) lands in the Protection class (X) should be defended from all use. Their entry, whether for temporary cultivation or pasture or for the simple, one-time exploitation of virgin timber resources will have overall negative impacts on the development of the better valley lands actually classed as suitable for economic utilization.

4. OPTIONS AND OPPORTUNITIES IN LAND UTILIZATION

4.1. Yanachaga and San Matías Ranges

Comprising mostly superhumid climates and predominantly long, very steep slope. shallow soils, and a high density of fast-flowing, rock studded streams having little or no navigability, the largely inaccessible Yanachaga range above the valley "floor" is totally unsuited for agriculture or for economically rentable forestry. It is presently mostly unoccupied and should remain in that condition. Any attempt to colonize it, will not only lead to human hardship, frustration, and eventual abandonment but will, in the degree to which occupance is actually effected, result in the irreversible loss of many of its socially important resources (soils, wildlife, plant species, and virgin forest communities in cloud forest areas), while much of its potential for the eventual development of hydroelectric power will be seriously diminished. Upstream deforestation even if only through logging as a one-time proposition will increase flood peaks, adversely affecting the best downstream terrace soils, and might very well lead to periodic catastrophes through landslide, temporary damming of rivers, and the abrupt release of massive heads of water as these dams break ("huaycos") with destruction of downstream infrastructures, loss of agricultural crop soils, livestock and even human life.

In the lower San Matías range, climate is more favorable but soils are shallow and stony and slopes so steep as to be unsuitable for any economic exploitation. The area is totally unused at present and steps should be taken to keep it in this condition.

Recommendations regarding the protection of these areas, by Bolaños and Watson, Hartshorn, and Zadroga, are fully consistent with the view that land capability in all such areas, including the so-called San Carlos range to the southeast, where the Yanachaga and the San Matias join, is overwhelmingly absolute protection, Other consultants, (Brack and Dourojeanni) have elaborated on the desirability of establishing a National Park in the Yanachaga and a Protection Area in the San Matías and San Carlos ranges.

Only in a few small pockets in sheltered mid-altitude valleys, as at Bocaz for instance, and along very narrow and intermitent terraces of the major rivers, are there limited settlement opportunities. Because the occupation of these lands would be conducive to the expansion of settlement therefrom onto adjacent steep slopes, and because the relative land area available is both negligible and divided into small, scattered, and largely isolated small tracts, the entire area would preferably be left as protection land. The highway to Pto. Bermudez passes, unavoidably through this land type. Steps should be taken to proscribe settlement and logging on steep lands throughout this section.

Amuesha communities at Puerto Laguna, Santa Rosa de Pichanaz, San Pedro de Pichanaz, Unión de la Selva Cacazú, Machca Bocaz, Yuncullmas, and Alto Lagarto, appear to be located within this land type area. Loma Linda at the narrow southern head of the valley-plain is drastically confined to stream terraces surrounded by it. It would be wise to make lands available and encourage these people to move out of the mountainous region and onto the valley floor, allowing them room for the natural expansion of their populations in the years to come and eliminating the hazard they pose to the longer-term integrity of wild-land in these two ranges.

An excellent location for these communities would be the presently unoccupied, nearly level, outwash plain in Tropical Moist forest just south of the Codo de Pozuzo on the right bank of the Pozuzo river. Amuesha subsistence agricultural practices which favor basic grains such as rice, peanuts, and maiz, would prosper there and far less land per capita would be needed for their economic needs.

4.2. Palcazu Valley

Major attention is to be given by the project to the planned and regulated development of the lowlands area between the San Matías on the east and the Yanachaga range on the west. This is the area which has been studied in detail and through which the highway proposed for financing by AID will pass.

Development potentials in this area, which include a total of somewhat more than 105,000 has. can best be viewed and discussed within the framework of the Land Capability, Ecological and Soils Maps as developed specifically for the project and evaluated already in this report.

4.2.1. Proposed highway route from Loma Linda into the area, when overlain on the Land Use Capability Map is seen to provide access to most of the better lands, except that it fails to reach into the very best lands which lie north of the Huampumayo river. However, a simple extension from Km. 83 (Access Road No. 9) would rectify this defect.

A more serious locational error appears where the proposed highway passes from Loma Linda at K. 15 to the junction with access road No.2 at Km. 36. Here we have 21 kilometers of highway running unnecessarily deep within or close to lands unsuitable for any use (Protection lands) presumably to avoid the cost of bridges. This is an area of Tropical wet forest life zone and the proposed location in steep, high hills and mountain terrain will lead to serious problems of an edaphic, hydrological, and eventually socio-economic nature. Lands in this stretch are simply not suitable for agriculture or for production forestry.

The proposed road alignment will encourage logging and spontaneous settlement in such lands, provoke massive landslides onto the highway itself and fails serve the best lands and the already-established native communities along the river between Loma Linda, Shiringamazu, and Alto Iscozacin. At little additional construction cost and with probably much lower long-term maintenance costs, the highway could be realigned here to run closer to the Palcazu river through, or close to, lands marked as suitable for permanent crops or intensive production forestry on the Land Capability Map.

To the north, the road with its secondary feeder roads, is less badly laid out. Presuming that the feeder roads <u>are</u> constructed, the highway layout will provide access to most of the better lands. If the feeder roads are not constructed, on the other hand, the rigid, straight-line approach favoring vertical over horizontal curves will be less advantageous to the efficient development of the agrarian economy of the area in general. It will, in any case, be less aesthetic as well as a monotonous and possibly dangerous road to drive.

A straight-line, vertical-over-horizontal road layout in hilly country will require massive cut-and-fill operations, as well. These are highly detrimental to minor stream drainage (which they often block entirely), and create problems due to sedimentation on all streams, especially small streams of local origin, over which the road passes. Such streams are conceivably the future source of high quality water for domestic use and even for mini-hydropower development for local community energy supplies.

A compromise solution would be to make minor adjustments in alignment based upon the Land Capability Map, with the main highway running centrally through the best agricultural and forestry lands, close to its present proposed location, but favoring horizontal curves to a much greater degree than at present and swinging laterally to enter the best lands locally wherever possible.

As for feeder roads, Caminos Nos. 4, 6, and 7 all run through low-intensity forest land and Nos. 4 and and 7 both run directly through some of the highest hills and poorest soils in Tropical wet forest life zone, these being classed as purely Protection lands. Realignment of these proposed feeder routes, or their elimination, is suggested.

4.2.2. Tropical moist forest areas

Agricultural lands comprise three major land-use capability classes. Because of climatic constraints, lands classed as suitable for clean-tilled crops (A) do not appear in the Tropical wet forest life zone at all and only 2297 ha. in all are found, mostly on low stream terraces, in the Premontane wet forest life zone areas. Lands suitable for this use, with continuous, open-field production of low herbaceous plants, especially grains such as rice, and corn and pulses such as peanuts, beans, plus many vegetable crops favored by traditional Peruvian farmers, native communities in the Selva, and even professional agronomists currently enthusiastic over the crop production potentials of the Selva, are concentrated in one large block north of the Huampumayo river on fertile alluvial outwash in the Tropical moist forest life zone. There we find 4400 hectares classed for this use and virtually all the intervening tracts of lower-quality land in the area are suitable for either pasture and/or permanent crops (Table 2), giving a total of 6168 hectares of good-quality agricultural land.

The land should be carefully husbanded because it represents essentially the only block with high agricultural development potential in the entire Palcazu valley. A detailed soils survey should be undertaken immediately as the basis for land-use and sub-division of the entire area into, preferably, small family-sized farm lots to be exclusively on crop production. Large grazing properties should not be permitted. Entry should be restricted to bona-fide settlers and to native community peoples currently on poorer land.

In addition to traditional grains, pulses, vegetable, and root crops (sweet potato, yam and aroids), the land classed for pasture and/or permanent crops interspersed in the area will provide opportunities for the production of high-quality horticultural and tree fruits, as avocado, and mango and possibly others which require a lower rainfall and an assured, marked dry season in which to flower and bear fruit, and also for the more moisture-tolerant fruits, such as plantain, banana, maracuya, granadilla and citrus in general but specially grapefruit, tangelo, and other citrus hybrids which prefer a warmer climate than that available to fruit growers in the Chanchamayo valley. African oil palm would prosper on these sites, but being a large plantation crop, is not recommended if the objective of settlement is to provide living and producing space for many families of independent small farmers.

Finally, this is the only land with an acceptable climate for commercial production of cacao in the valley. Elsewhere, excessive humidity will lower fruit-set, encourage pathogens and epiphytic growth, while soils are generally too poor for high production. Moreover, several tropical exotic fruits, spices, and nut trees will find the best conditions for their growth in this block of land, and across the Pozuzo river outside the area in study where the site and environmental conditions appear to be essentially identical over even larger areas of land in this life zone.

This Tropical moist forest area also includes some 1575 hectares of lands suitable only for forestry aggregated in blocks mostly along the western margin of the area where the Yanachaga foothills touch the plain. These lands will serve principally as a source for the domestic wood needs of the farming population proposed for planned and directed settlement on this plain, and will also insure that domestic water supplies are adequate and of good quality. A communal forest under management for these ends alone would be recommended there.

This life zone is also present in the form of a perhumid transition to Tropical wet forest in two small areas to the south, one embracing the Puerto Mairo section of the Palcazu river valley and the other in the region of Fundo San Juan and the lower Chuchurras river. These areas include together another 1548 hectares of agricultural-quality land but this land is dispersed as small tracts scattered along the river banks. Elsewhere, the land is preponderantly covered by forestry and protection lands. The climate moreover, being perhumid, makes these lands marginal for production of many of the clean-tilled crops recommended for the non-transitional sector of this life zone. The following commentary on the Premontane wet forest life zone is therefore, more appropriate to understanding both these areas.

4.2.3 Premontane wet forest and climatically-related areas

Half or more of all the land in the lowlands valley area under study falls into this bioclimate or in the two closely-related perhumid transition areas of the Tropical moist forest life zone. Taken together, these comprise more than 56,000 hectares of which 51,000 ha. represent all usable land and 22,000 ha. agriculturally-usable land in those two related life zone areas. The difference, some 34,000 hectares or 61 percent is suitable only for forest production (F1 and F2).

These life zone areas derive their importance, in part from their very large overall extension within the valley and, in part, from the fact that the climates, while wet, are not as markedly wet as that encountered in the Tropical wet forest life zone area to which both are transitional. Given fertile soils and well-drained but not steep terrain, many of the climatic liabilities of these life zone transitions can be overcome by judicious application of advanced technology at not-too-great sacrifice in purchased inputs and additional energy. Such favorable conditions are encountered, unfortunately on only a small fraction of all the lands: there are are only 2767 hectares suitable for clean-tilled crops due to soils and terrain limitations. This being only 5.0 percent of all area and 12.6 percent of all land in the three agricultural quality land classes life zones (Table 2).

Examination of the attached evaluation-team Land Capability Map reveals the presence of three large blocks suitable over most of their extension, for some form of agricultural production. Undoubtedly, the best of these, lies on the northern limit and consitutes an extension into the wet forest life zone of the good agricultural lands described previously lying north of the Huampumayo river. This block will be relatively the least wet in the life zone area, has better-than-average soils, and might therefore be included in a project for the planned and controlled settlement of the adjacent moist forest area.

In contrast to the nearby lands in the Tropical moist forest, however, none of the land in this block is classified as suitable for clean-tilled crops(A).More than half is acceptable for intensive pasture (P), and all may be used for permanent crops (C). A permanent crop option seems to be the more desirable in view of the value of the alluvial outwash soils for small-farmer, intensive agricultural production. Lands classed for pasture (P) are not only suited for permanent crops as an alternative use but are superior in potential productivity for this use when compared to lands classed as suitable only for permanent crops (C).

Without more-detailed study it is not possible to specify which permanent crops would do best here, but certainly cacao, plantains, citrus, rubber and possibly oil palm should be considered. Alternatively, cut-forage grasses for stable-feeding of livestock could be grown on the better (P) soils. Several species of exotic tropical fruits, nuts, and spices, (e.g., nutmeg,rambutan, pili nut, cinnamon, cola nut), are also possibilities. Yuca will prosper as a subsistence crop or for industrial starch, and pineapple, as a permanent crop for export to the coast, could be grown on the better high terrace soils.

Southwards, within the great continuous area of Premontane wet forest climate, two other, large, nearly-uninterrupted blocks of land with moderate-to-low agricultural capability may be discerned. The first of these occupies an extensive series of low, medium, and high terraces in the basin of the Mairo River, including some tributary low hill-and-valley areas. Here, small scattered patches along the river are rated as suitable for clean-tilled crops (A) but the total area is small and these lands are included in larger areas already occupied by colonos practicing extensive cattle-raising. Intensification of the existing cattle-raising practices on lands classified for this and the highest use would obviously be the first priority here inasmuch as the reduction of large ranches to small farms does not appear to be an element of the development philosophy for the region. However, an appreciable percentage of the land in this block is too poor for pasturing but will produce permanent crops of the P2 variety (Agri-silviculture) in which tree crops are favored.

To develop this latter use where lands so-classified are found to be currently in extensive pasture or in forest, might be another priority objective of the project. The area is quite large and could support farms of small-to-medium size, specialized in mixed-cropping of bush and tree crops, on a combined family subsistence-commercial production basis. Yuca, with intercropped corn and beans and small fields of plantain and banana on the best soils could subsidize progressive development of permanent, mostly tree crops on the poorer C2 lands which predominate here. Such trees as the "ungurahui" and "pijuayo" palms (Jessenia sp, Bactris gasipaes) produce both human food and raw materials for oil, animal feed-concentrate, and heart-of-palm canning plants which might be established in the area, and dwarf coconut for oil or direct feeding of small animals (chickens, pigs) could be combined with breadfruit, sapote, guava, and several other tropical fruits and nuts, including several varieties of citrus, to market outside the area or to be used as direct food supplements for intensive small-scale production of pigs and fowl. Cashew, with its great variety of industrial subproducts and tolerance of poor soil might adapt here. The details of such agri-silvicultural systems, which might also include high-value timber trees in the mixture, would be worked out as part of a program to be set up by the project to experimentally develop and demonstrate these possibilities in model farms.

Smaller areas suitable for similar permanent crop production lie along the mid-and-upper valleys of the Lagarto and Comparachimas rivers. Further south, in a broad trough between the Chuchurras and Iscozacin rivers, a similar and possibly even larger block is encountered having lands most of which are classed as suitable only for permanent crops (C). Much of this land is already in extensive grazing use on native pasture grasses, but should be progressively withdrawn from such use before the soil is irretrievably lost to erosion and other forms of deterioration provoked by treading, leaching and absence of needed organic matter supply. The recommendations made for the Mairo area, above, with respect to permanent cropping systems, might be applicable here, too.

As in the case of the agricultural areas in this life zone, the lands classed for forest use tend to be united in generally large and continuous blocks. This will favor their eventual management for sustained-yield production of timber products. Four essentially large blocks of forest class land, separated by the agricultural-class blocks discussed, include the greatest part of the 28,776 hectares classed for this use (F1 and F2).

Timber volume estimates based on low-intensity inventory are found in reports and maps for this valley (Malleux, 1981; ONERN, 1981). However, management principles and silvicultural practices in their relation to possible socio-economic production units must still be worked out. Forest production can and must be an important element in any economic and social development of the region but there is still very substantial disagreement amongst the several forestry groups consulting on the PEPP project as to just how this may be best organized with respect to small-farmer production, linked to industry, and to markets. Hartshorn has elaborated on some of the problems and discussed possible solutions. A specialized, more-intensive study by an outside group familiar with management and silviculture of mixed natural tropical forests appears to be needed to resolve the issues and might be made an integral part of the project itself, with AID funding.

Overall, the Premontane wet forest life zone area, because it is essentially marginal for agriculture and because it comprises by far the largest part of the valley land area, will be the most problematical sector and requires critical attention on the part of development planners.

4.2.4. Tropical wet forest

This bioclimate comprising a total of 29,422 hectares, includes no land classed as suitable for clean-tilled crops and only 5,316 hectares in total apt for less-intensive agricultural uses. Most of the limited agriculturally-suitable area, in fact, is only rated capable for permanent crops in the C2 (Agri-silvicultural) sub-class. The areas in this life zone tend to lie close to or within the mountain front of

The Yanachaga range or else in lands where high hills (80-300 meters relief) are encountered. Such terrain features combine with the excessively wet climate to produce soils which are shallow, highly infertile, subject to erosion on even moderate slopes if subjected to grazing or clean-tillage, and to compaction under grazing on flat-lying terrain.

Because of excessively steep terrain combined with very shallow soils, more than a third of all the land in the life zone area falls in the Protection class (X) (Table 3). The total area available for forest production, (F1 and F2) is only 13,446 hectares, substantially less than that available for this use in the Premontane wet forest area. The largest continuous, single block of forest production capability lies in the high hill area on the wester side of the valley between the Mairo and Comparachimaz rivers. Smaller areas interspersed with protection land are found in the south on the lower mountain slopes on either flank of the Palcazu river south of Shiringamazu and Alto Iscozacín. Only the northern block offers a really good potential for the introduction of sustained-yield forest production in natural forest growth. Most of the remaining area is included in Amuesha reserve lands.

Agriculturally, this life zone area is, without doubt, the least promising in the entire valley. Mostly suited to permanent tree crops, the variety of adaptable crop species is much less than even the Premontane wet forest Life Zone areas to the north and east. Climatic and soils conditions indicate that the best crop portions are palms, particularly the pijuayo (*Bactris gasipaes*) and ungarahui (*Jessenia* sp). These are well adapted to the climate and are capable of giving high sustained yields of nutritious and industrially usable fruit with little attention or cost. The pork production potential of the pijuayo is particularly interesting. On alluvial soils the tree begins to yield in three years, produces up to 30 tons per hectare or more of fruits annually with little or no fertilization, and the fruits have more and better-quality protein than maize, plus oil, carotene, and carbohydrates in a mixture which can be used to provide a balanced diet for the commercial production of swine in enclosure systems. Animals may also be turned loose to feed on the falling fruit directly. With pijuayo providing the protein requirements ordinarily met by corn, additional carbohydrates may be derived from such tree fruits as breadfruit, plantain, guava, and the abundant and oil-rich seeds of the rubber tree (Hevea spp), all adapted as permanent crops to the climate and soils present on the lands classed for permanent crops. Pituca (Cálocasia esculenta), a large aroid grown in boggy areas, also provides large quantities of high-energy starchy food used not only in human nutrition but also for the feeding of pigs. It can be grown without difficulty on poorly-drained soils in this climate. Swine may also be grazed on Indian wheat, a tropical grain which tolerates high rainfall and forms dense permanent swards on fertile low terraces.

What is important in all the foregoing is simply that agriculture in this life zone must be adaptive to high rainfall and generally low fertility soils and thus excludes the majority of traditional crops with which both farmers from drier regions as well as most Peruvian agronomists are accustomed. Major stresses will occur unless non-traditional crops and thinking are introduced into the development process for the valley at an early stage. This may become the most difficult "development" of all.

A final word about agriculture and forestry. The native peoples of the region must be considered as authorities on many aspects of the agriculture of the region. They possess not only special knowledge acquired and passed on over many centuries on survival in these difficult environments but also have highly selected plant cultivars adapted to the environment. Agronomical specialists from outside as well as new colonists will do best if they respect the indigenous tradition and attempt to learn all they can from it. Before introducing plant varieties and cropping systems from dissimilar environments into the region as a whole, they should seek out the Amuesha and Campa cultigens and cropping traditions for adaptive, high-yielding species and varieties and learn the practices with which they may be successfully grown, on their own farms or in experimental and extension activities.

4.3 Regional research findings

Claims have been made and heralded in the press that the Palcazu is about to become the breadbasket for Lima. Speculation in land is already beginning as outside hopefuls buy lands in the valley or prepare to move in when the road provides access. Not a small part of this optimism has been engendered by popular reference to the North Carolina State University experimental results with high-fertilizer technology at Yurimaguas on the lower Huallaga river far to the north. Agronomists from La Molina, trained in North American Universities, express belief that the findings from Yurimaguas illustrate what is possible in the Selva Alta.

Peruvian specialists in livestock, long familiar with the dry Punas and Altiplano regions of the country and seemingly unaware of the most elemental principles of ecology, propose that the meat production problems of the nation can be met by improved livestock breeds and pasture management techniques in the Palcazu valley. Heat-tolerant breeds of sheep are enthusiastically proposed for introduction to replace cattle on the compacted and overgrazed pastures established by colonos whose own technology stems from Germany and has been transferred via the cooler and less-humid highlands of the Oxapampa valley. Above all, no one wants to be informed that environmental conditions in the Pichis-Palcazu are adverse to temperate-climate crops, livestock, and production schemes or that the land is poor, largely inappropriate for agriculture, and will not support many more people than are there already.

The facts, however, are otherwise. Yurimaguas, Tarapoto, Tulumayo, even wet Monson and Tingo María are more favorable to agriculture than this valley. Yurimaguas experiments guided by a "green revolution" philosophy are rooted in a climate with only half the rainfall. Experiments there have been conducted on high-terrace alluvial soils, still relatively fertile, deep, and well-drained as compared to those in the Palcazu. They have not and do not suffer excessive leaching by an annual excess of 2500-3500 mm of rainwater over crop evapotranspirational requirements. Yurimaguas receives about 2000 mm of rain in the average year. Sunshine hours are much greater and relative humidity - so highly related to pathogenic attacks on crop plants - are far lower at Yurimaguas as well.

The inapplicability of the Yurimaguas findings or even of their more general implications as to the feasibility of high technology "cures" for the Palcazu "problem" is well evidenced in the formal publications on the project conducted over several years now by the Tropical Soils Program of the North Carolina State University (1980). Research results at Yurimaguas in general show that greater and even continuing yields of open field crops can be achieved on terrace soils under the moist-dry environmental conditions of that locality providing that large quantities of lime and fertilizer are applied to the fields and specific multiple-cropping and crop sequences are institued on lands traditionally used in slash-and-burn shifting cultivation. (These lands fall in capability class (A): clean-tilled crops.) Only selected farmers participate in the tests and they are not only subsidized for imputs but are guided almost daily by the project scientists. Where production is for subsistence while credit is costly and where there is no cash money available to purchase the repeatedly-needed fertilizers to make this system work, where considerable doubt exists as to the ability or even willingness of unsubsidized and unguided colonist or native people with other agrarian traditions to participate fully and consistently in the new high-level technological system, then it is unrealistic to assume that favorable development can be achieved on this basis even where climate and soils are much more favorable than they are in the Palcazu valley.

As a measure of the inapplicability of the Yurimaguas data to Palcazu soils, a preliminary analysis of soils collected from the Pichis-Palcazu area, the Upper Huallaga area, and Yurimaguas (Sánchez, Bandy and Van Diepen, 1981) is appended as an exhibit. The table lists the chemical analysis data for soil samples at three depths in the profile taken at Chorrillos (Palcazu), Iscozacín (Palcazu), Puerto Bermúdez

(Pichis), and the experimental sub-stations at Tulumayo, Aguajal, Tingo María and Yurimaguas. By all measures, the Palcazu and Pichis data show soils significantly poorer on all counts than the Huallaga locations. Unfortunately, the one Yurimaguas soil sample, taken from "monte virgen" may not even be representative of the soils actually being tested in the agricultural experiments there.

5. CARRYING CAPACITY ESTIMATE

It is undoubtedly premature to attempt a determination of the human carrying capacity of the area. However, a rough "guesstimate"has been made on the following assumptions:

1) Average conditions in the most prevalent life zones (Tropical moist forest transition to Tropical wet forest and Premontane wet forest transition to Tropical wet forest) and compensating for the smaller areas of the other two extremes (Tropical moist and wet forest) suggest that, one hectare of land suitable for clean-tilled crops (A) will be needed per person on farms in the area. One-half hectare would support family subsistence, one-half ha. commercial production.

2) Due to lower productive potential, three hectares of lands in the pasture class (P) and six hectares in the permanent crops class (C) will be equal in carrying capacity to the one hectare of land in the clean tilled crop class.

If all land having some agricultural suitability is converted to A-class unit-equivalent, then there will be a maximum of 4834 A-units or people in the Tropical moist forest(non-transitional)area, 7802 in the combined Tropical moist to wet transition and Premontane wet forest life zone areas and 1063 supported in the Tropical wet forest life zone area for a grand total of 13,699 people or 2740 families of five members, less if families are larger.

The forest lands, can conceivably support only a smaller number despite their larger total area. Presuming that ten hectares per person of originally virgin forest in the F1 and F2 classes, intensively worked by family labor, will provide a minimally acceptable income from labor and stumpage, then the productive forestry lands of the valley area would support somewhere around 900 to 1000 families on farms of 50 has. This calculation can be considered very optimistic at least at the outset of development.

Environmental conditions overall, ignoring present land tenure, would provide for the subsistence of roughly 18,000 people distributed through the valley, presuming the use also of such areas as lie in the valley floor the area actually mapped for land capability herein.

TABLE 1

COMPARISON OF LAND CAPABILITY DETERMINATION FOR THE PALCAZU VALLEY, SOILS SERIES AND SLOPE PHASES, BY LIFE ZONES, AS MADE BY ONERN, THIS CONSULTANT, AND ASSUMING STRICT ADHERENCE TO THE OFFICIAL PERUVIAN LAND-CAPABILITY SYSTEM, FOR THE ONERN SOIL SURVEY OF 1980 - 1981

ONERN ** Soil Series	Slope Phase	ONERN Classification	L I F E Z O N E — Consultant recommended classification (2) / Official Peruvian Classification (3)						OBSERVATIONS on the consultant's recommended classification
			T-mf*		TP-wf*		T-wf*		
		(1)	(2)	(3)	(2)	(3)	(2)	(3)	
Om	A	A2i	A2i	A	Pli	A	C2ic	C	Seasonal grazing, soil conservation necessary
Pa	A	A2s	A2s	A	A2s	A	Plsc	C	
Hu	A	A2i	A2is	A	Plis	A	-	-	Seasonal grazing, soil conservation necessary
Pc	A	A2s	A2	A	A2	A	Plc	C	
Lr	A	Xs	Xs	X	Xs	X	Xs	X	
LR	G	Xes	Xes	X	Xes	X	Xes	X	
LR	H	Xes	Xes	X	Xes	X	Xes	X	
Ag	A	Xsw	C2w	X	C2w	X	C2w	X	Production of Aquaje under management
Ca	A	A3s	A3s	A	P2s	A	-	-	
Ca	B	A3s	A3s	A	P2s	A	-	-	
Ca	C	C2s	P2s	C	C2s	C	-	-	

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ONERN ** Soil Series	Slope Phase	ONERN Classification	L I F E Z O N E						OBSERVATIONS on the consultant's recommended classification
			Consultants recommended classification (2) Official Peruvian Classification (3)						
			T-mf*		Tp-wf*		T-wf*		
		(1)	(2)	(3)	(2)	(3)	(2)	(3)	
Mo	A	P2s	-	-	P2s	A	C2se	F	
Mo	B	P2s	-	-	P2s	A	C2se	F	
Mo	C	P2s	-	-	C2s	C	Fls	F	
Mo	D	P2s	-	-	C2s	F	Fls	F	
Qi	D	P2es	C2es	F	C2se	F	Fls	F	
Qi	E	Fle	Fle	F	Fle	F	F2e	F	
Qi	F	Fle	Fle	F	F2e	F	F2e	F	
Sn	A	A3s	A3	A	P2s	A	C2se	C	
Sn	B	A3s	A3	A	P2s	A	C2se	C	
Cl	F	Fle	F2e	F	F2e	F	Xes	X	
Cl	G	F2es	Xes	X	Xes	X	Xes	X	
YA	H	Xes	Xes	X	Xes	X	Xes	X	
Pu	A	A3s	A3s	A	P2s	A	C2sc	F	
Pu	B	A3s	A3s	A	P2s	A	C2se	F	

ONERN** Soil Series	Slope Phase	ONERN Classification	LIFE ZONES: Consultant's recommended classification (2) / Official Peruvian classification (3) — T-mf*		TP-wf*		T-wf*		OBSERVATIONS on the consultant's recommended classification
		(1)	(2)	(3)	(2)	(3)	(2)	(3)	
Pu	C	C2s	P2s	C	C2s	C	Fles	F	
SP	E	Fle	F2es	F	F2es	F	-	-	
SP	F	Fle	F2es	F	F2es	F	-	-	
PB	A	C2s	Pls	A	P2s	A	C2sc	F	
PB	B	C2s	P2s	A	P2s	A	C2sc	F	
PB	C	C2s	C2s	A	C2s	C	Fles	F	
PB	D	C2es	C2es	A	Fles	F	Fles	F	
Lb	A	C2s	A3s	A	P2s	A	C2sc	F	
Lb	B	C2s	P2s	A	C2s	A	C2sc	F	
Lb	C	C2s	C2s	C	C2s	C	Fls	F	
Lb	D	C2es	Fles	F	Fles	F	Fles	F	
EC	E	C2s	C2es	P	Fle	P	Fle	F	
EC	F	Fle	F2e	F	F2e	F	F2e	F	
CR	E	Fle	Fles	F	Fles	F	F2es	F	
CR	F	Fle	F2es	F	F2es	F	F2es	F	

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ONERN ** Soil Series	Slope Phase	ONERN Classification	LIFE ZONE: Consultant's recommended classification (3) / Official Peruvian Classification (3)						OBSERVATIONS on the consultant's recommended classification
			T-mf*		TP-wf*		T-wf*		
		(1)	(2)	(3)	(2)	(3)	(2)	(3)	
Va	A	Xsw	-	-	F2sw	F	Xsw	F	Management for Aguaje
Va	B	Xsw	-	-	F2sw	F	Xsw	F	ditto
Ca-Ag	A	A3s-Xsw	C2sw**		-		-		** Plantation of aguaje Ungurahui
Td		Xe	Xe		Xe		Xe		

* T-mf = Tropical moist forest
TP-wf= Premontane wet forest
T-wf = Tropical wet forest

** - Om - Omaiz; Pa-Palcazu; Hu - Huampumayo; Pc - Palchuisco; Ir - Islería; LR - Ladera Roja; Ag - Aguaje;
Ca - Carachama; Mo - Molino; Qi - Quintora; Sn - Shiringamazu; Cl - Colina; SP - San Pedro; YA - Yanatías;
Pu - Pucacunga; PB - Puerto Bermudez; Lb - Llobera; EC - El Carmen; CR - Colina Roja; Va - Varillal;
Td - Tierras diversas.

TABLE 2

AREA IN HECTARES BY LAND CAPABILITY CLASS FOR LIFE ZONES AND TOTAL AREA, ADJUSTED TO BIOCLIMATE AND SLOPE PHASE IN 95,000 HECTARES SURVEYED BY ONERN (1980)

CAPABILITY CLASS*	L I F E Z O N E **				TOTAL AREA
	Humid Climate	Perhumid Climates			
	T - mf	T-mf	P-wf	T-wf	
A	4413	490	2297	0	7200
P	774	464	10375	1058	12671
C	981	594	7820	4258	13653
A + P + C	6168	1548	20492	5316	33554
F1	568	490	11588	6504	19150
F2	1006	2168	14530	6942	24646
F1 + F2	1574	2658	26118	13446	43796
Total Usable Land (A,P,C,F1,F2)	7742	4206	46610	18762	77350
X	955	826	2529	10531	14841
Riverbeds	1213	155	1342	129	2839
Total Non-usable area	2168	981	3871	10660	17680
Total Area	9910	5187	50481	29422	95000

* A = Land suitable for continuous cultivation of clean-tilled and row crops, pasture, permement crops or forestry.
P = Land suitable for intensive grazing of livestock, permanent crops, or forestry.
C = Land suitable for permanent crops or forestry
F1 = Land suitable for high-level forest production with limited soil erosion hazard.
F2 = Land suitable for low-level forest production with significant soil erosion hazard.
X = Land not suitable for economic uses.

** = See explanatory note on Table 3.

TABLE 3

PERCENT AREA IN MAJOR LAND CAPABILITY CLASSES BY LIFE ZONES AND TOTAL LAND AREA, ADJUSTED TO BIOCLIMATIC AND SLOPE PHASE, IN 95,000 HA. SURVEYED BY ONERN (1980)

CAPABILITY CLASS *	L I F E Z O N E **				TOTAL AREA
	Moist Climate		Wet Climates		
	T - mf	T-mf↘	P-wf▽	T-wf	
A	44.5	9.4	4.5	0.0	7.6
P	7.8	9.0	20.6	3.6	13.3
C	9.9	11.4	15.5	14.5	14.4
A + P + C	62.2	29.8	40.6	18.1	35.2
F1	5.7	9.5	23.0	22.1	20.3
F2	10.2	41.8	28.8	23.6	25.9
F1 + F2	15.9	51.3	51.8	45.7	46.2
Total Usable (A+P+C+F1+F2)	78.1	81.0	92.5	63.8	81.4
X	9.6	15.9	5.0	35.8	15.6
Riverbed	12.3	3.0	2.6	0.4	3.0
Total Unusable	21.9	19.0	7.5	36.2	18.6

* See explanatory note, Table

** T-mf = Tropical moist forest (non-transitional)
T-mf↘ = Tropical moist forest, transition to Tropical wet forest
P-wf▽ = Tropical Premontane wet forest, transition to Tropical wet forest
T-wf = Tropical wet forest

EXHIBIT A

Preliminary chemical analysis of soils collected from the Pichis Palcazu/regions & Alta Huallaga by P. A. Sanchez, [illegible] E. Bandy and J. Van Diepen May 19, 1981 (physical and mineralogical analysis pending).

Site	Depth	pH	% C	Exchangeable Al	Ca	Mg	K	ECEC	Al Sat.	Available (Mod. Olsen) P	Zn	Mn	Fe	Cu
	cm			meq/100 cc					%	ppm				
Chorrillos (Palcazu V.)	0-8	4.6	0.95	6.55	0.45	0.24	0.12	7.36	89	3.1	1.1	2.6	[illegible]	0.7
	8-20	4.7	1.05	2.05	1.57	[illegible]	[illegible]	[illegible]	52	6.4	1.4	[illegible]	[illegible]	2.1
	20-50	4.9	0.80	2.28	0.97	0.34	[illegible]	[illegible]	62	7.3	1.1	[illegible]	[illegible]	[illegible]
Iscozacín (Palcazu V.)	0-25	4.4	1.25	12.99	[illegible]	[illegible]	[illegible]	[illegible]	86	1.4	[illegible]	31.4	[illegible]	[illegible]
	25-50	4.5	0.55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]8	[illegible]	[illegible]	[illegible]	[illegible]2	[illegible]	[illegible]
	50-80	4.4	0.31	16.43	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.7	[illegible]	[illegible]	[illegible]	[illegible]
	80-100+	4.5	0.12	13.85	0.53	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.1	34.7	[illegible]	[illegible]
Puerto Bermudez (Pichis V.)	0-15	[illegible]	[illegible]	1.69	2.43	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.5	[illegible]	[illegible]	[illegible]
	15-40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	40-60	4.5	1.03	6.02	0.37	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.9	[illegible]	[illegible]
	60-120	4.6	0.41	6.39	0.37	0.14	[illegible]	[illegible]	92	[illegible]	1.2	[illegible]	[illegible]	[illegible]
	120-200	4.3	[illegible]	7.17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	523	[illegible]
Tulumayo Station	0-17	5.7	[illegible]	0.44	16.61	[illegible]	0.14	[illegible]	2	[illegible]	2.1	[illegible]	511	3.6
	17-40	5.7	0.31	0.06	13.81	1.86	0.14	15.87	0	[illegible]	0.6	16.3	121	1.5
	40-60	5.5	0.33	0.33	14.58	1.93	0.12	[illegible]	2	[illegible]	[illegible]	[illegible]	125	1.8
	60-78	5.5	0.12	0.45	13.81	1.78	0.14	16.18	3	[illegible]	0.7	11.2	150	1.3
	78-100	5.5	0.27	0.75	19.15	2.61	0.12	22.63	3	[illegible]	1.5	13.7	196	2.6
Aguajal (Monzón V.)	0-30	5.0	[illegible]	0.92	1.57	0.90	0.29	3.68	25	10.0	2.5	6.8	532	4.7
	30-43	5.5	0.37	0.43	0.45	0.13	0.09	1.15	37	7.2	0.6	0.2	125	1.3
	43-60	5.6	0.21	0.10	0.42	0.17	0.10	0.79	13	11.8	0.8	0.2	121	1.3
	60+	5.5	0.14	0.08	0.37	0.15	0.14	0.74	11	23.5	0.6	0.2	101	1.0
Tingo María Km 9	0-10	4.3	0.37	6.49	1.02	0.25	0.06	7.82	83	137.1	1.2	2.0	427	2.9
	10-30	4.7	0.74	3.00	3.40	0.26	0.07	6.73	45	132.2	1.4	4.1	[illegible]	2.6
	30-70	4.3	0.24	7.47	0.68	0.12	0.06	8.33	90	121.5	0.8	1.5	318	2.6
Yurimaguas Monte Virgen	0-10	4.4	1.73	1.29	1.13	0.60	0.28	3.30	39	29.5	1.7	7.7	934	1.3
	10-30	4.4	0.45	3.31	0.29	0.14	0.08	3.82	87	2.5	0.9	1.5	544	1.0
	30-50	4.6	0.41	3.87	0.29	0.22	0.07	4.45	87	4.1	0.8	0.8	494	1.3
	50-70	4.5	0.27	4.26	0.29	0.16	0.07	4.78	89	1.6	1.1	0.2	309	0.7
	70-100	4.4	0.37	4.80	0.29	0.13	0.14	5.36	90	0	2.0	0.2	83	1.5
	100-150	4.3	0.12	6.15	0.16	0.05	0.09	6.45	95	0	2.6	0	23	.7

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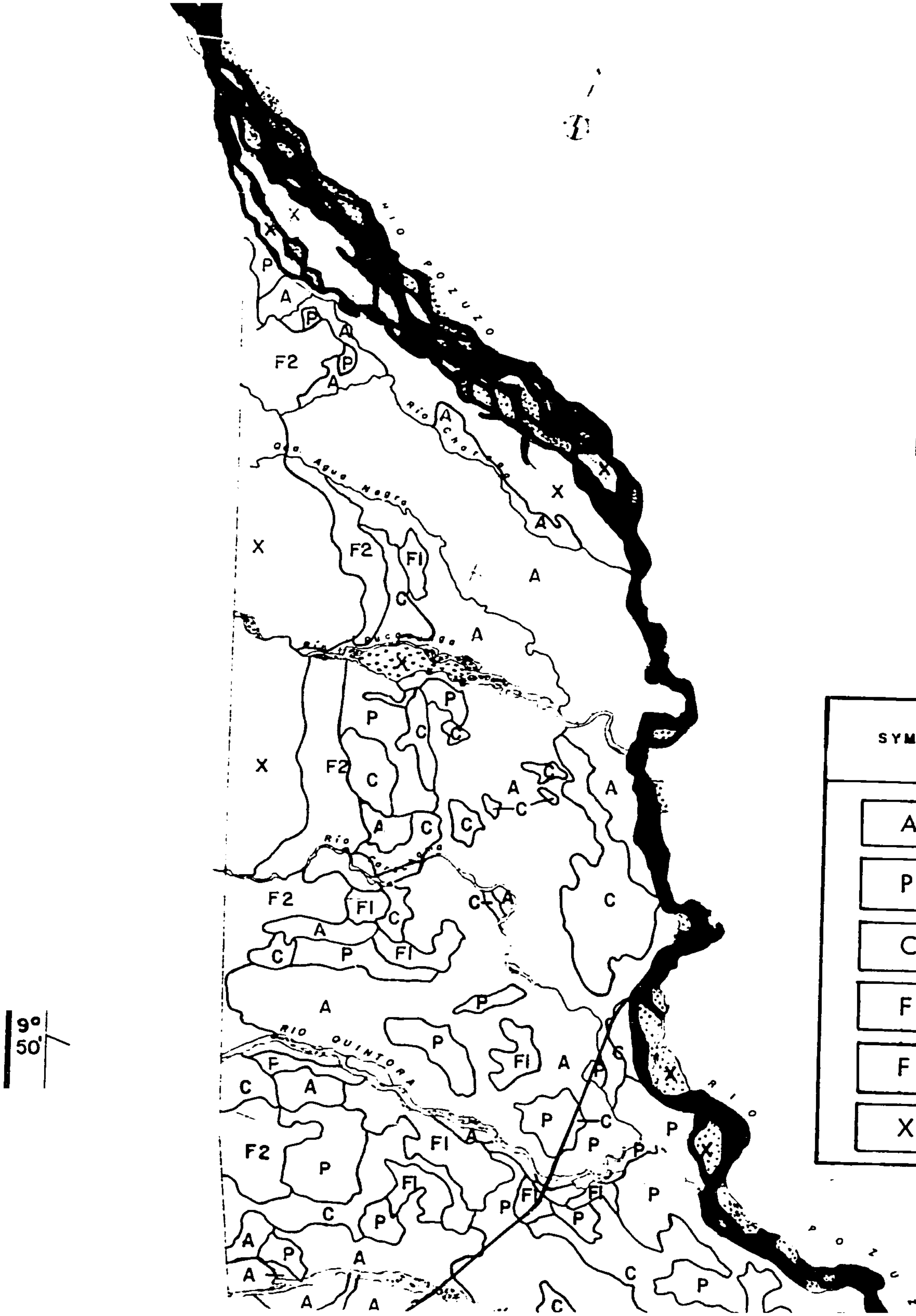


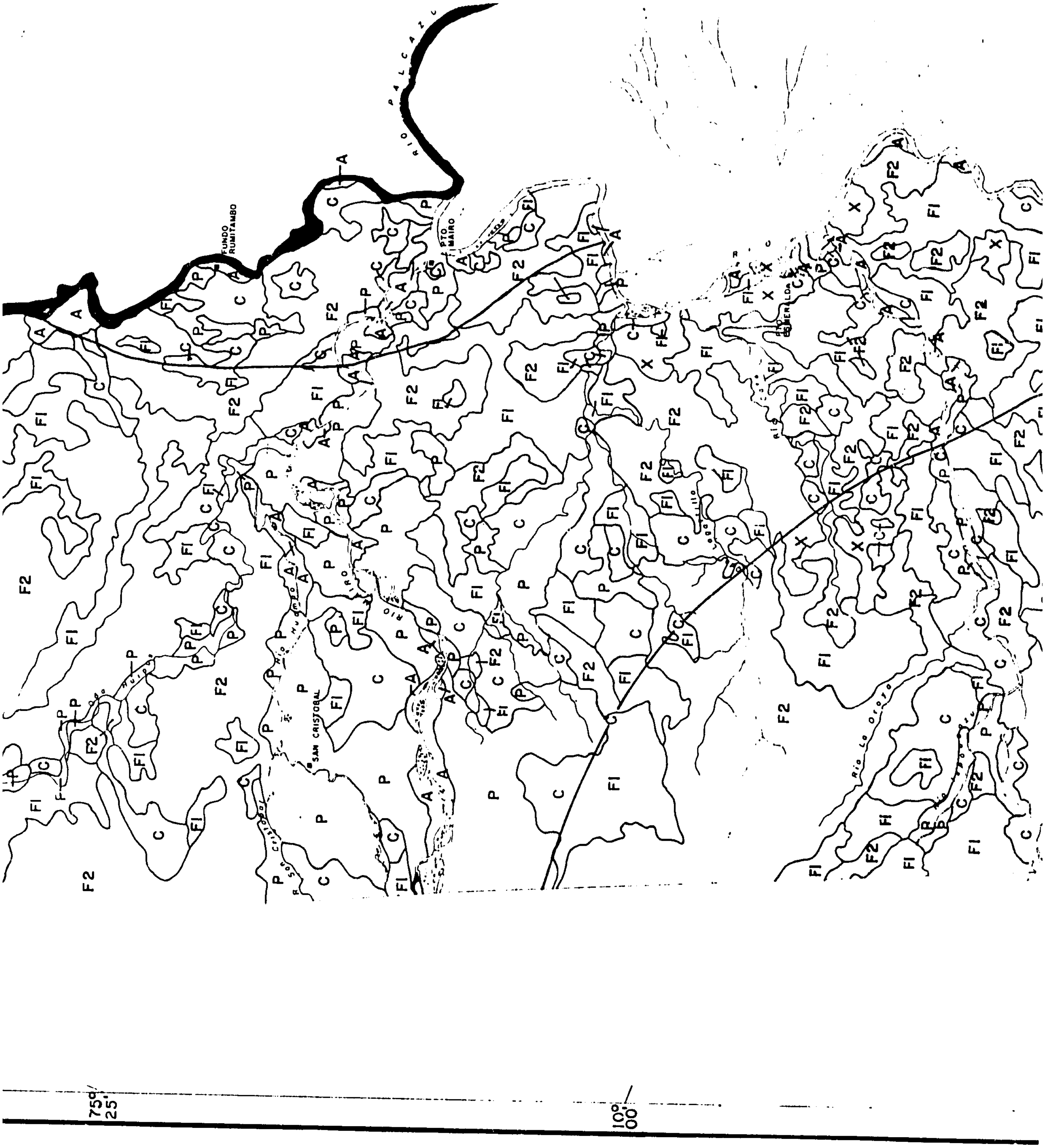
MAP OF MAJOR LAND
USE CAPACITY

by : J.A. Tosi C.
1: 100,000

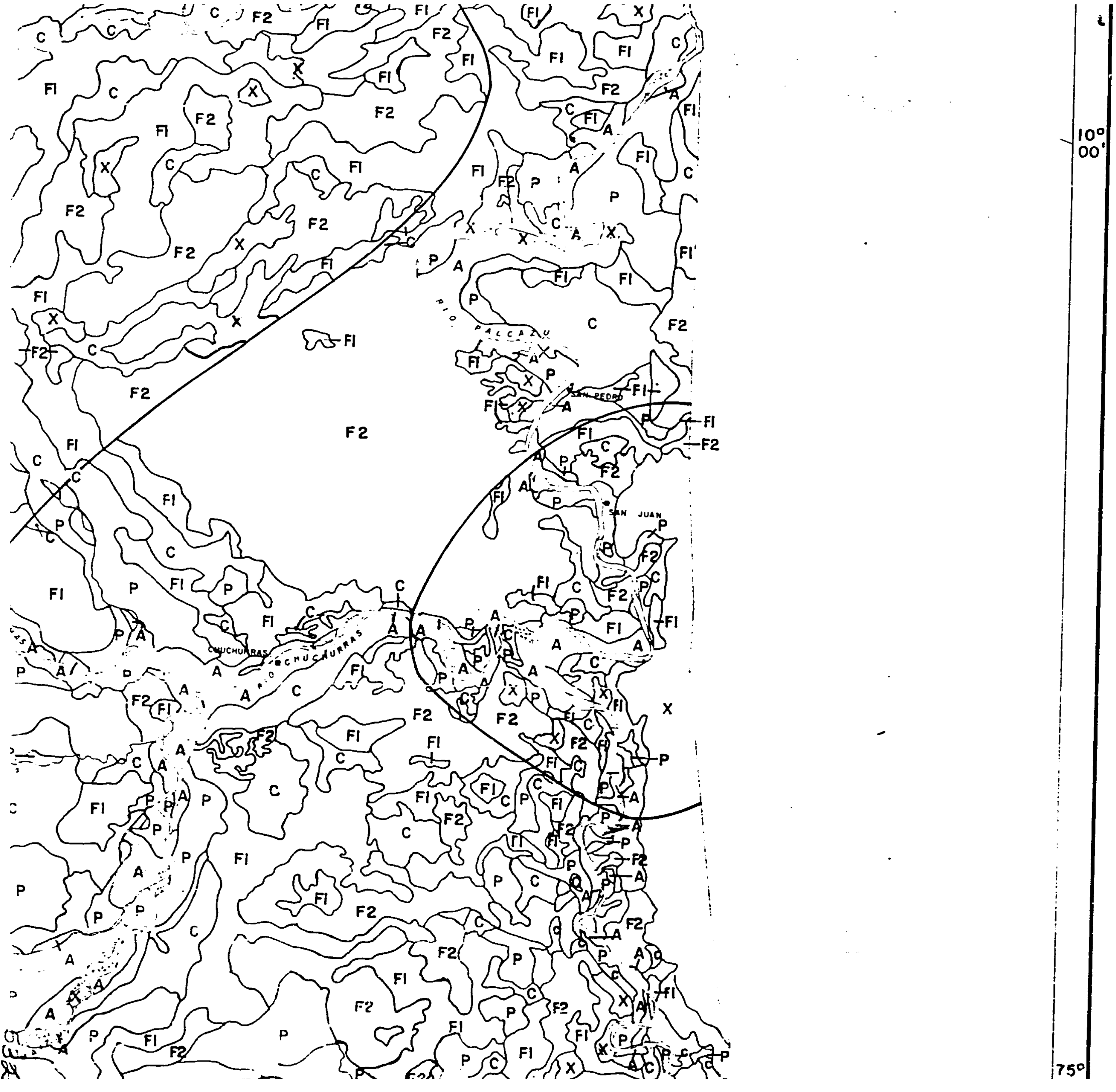
September 1981

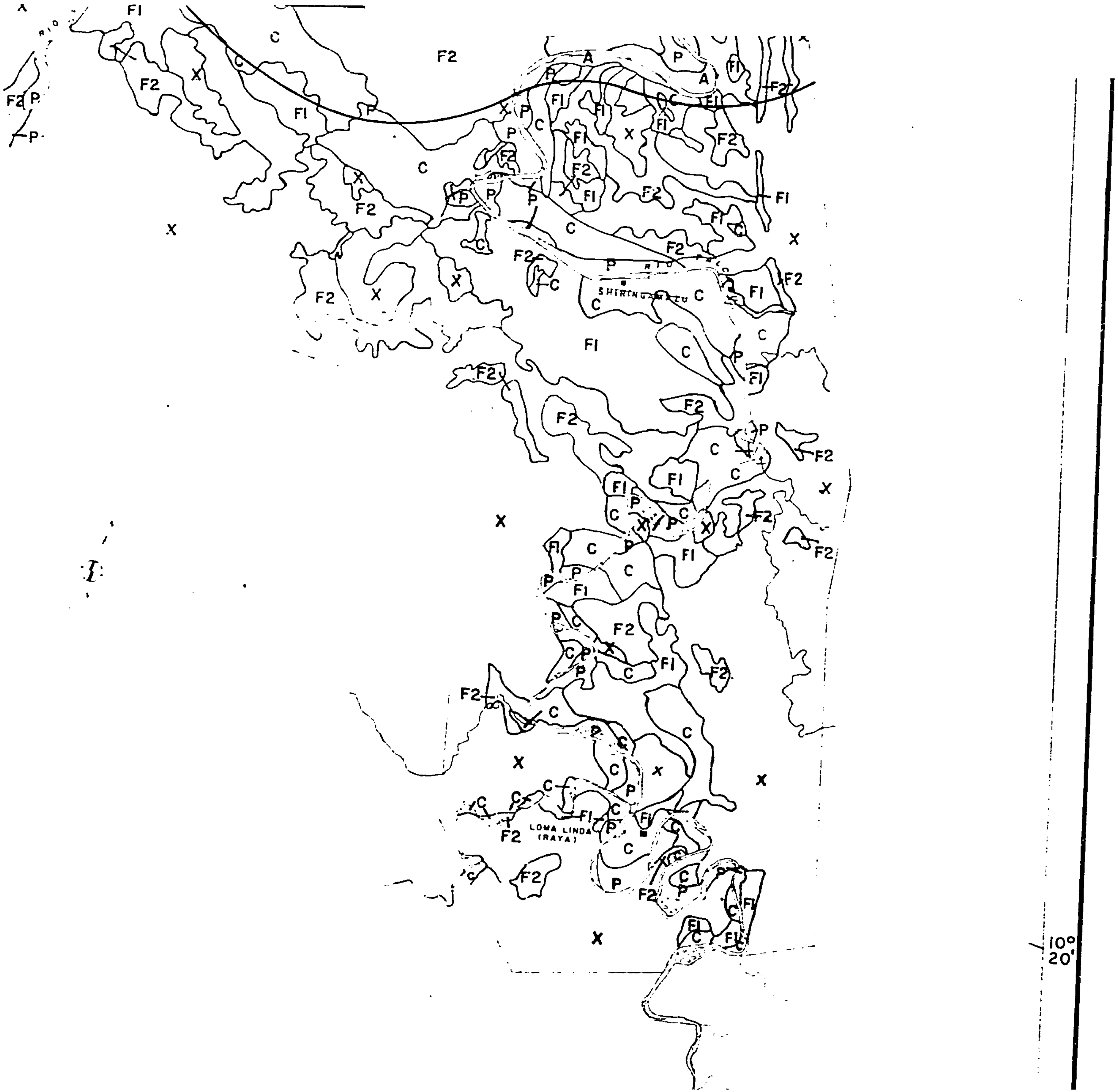
HIGHEST USE CAPACITY

SYMBOL	DESCRIPTION
A	Clean Cultivation
P	Pasture
C	Permanent Crops
F_1	Intensive Production Forest
F_2	Restricted Production Fores
X	Complete Protection



FUNDO RUMITAMBO
PTO MAIRO
SAN CRISTOBAL
75° 25'
10° 00'


10° 00'
75°
RIO PALCAZU
SAN PEDRO
SAN JUAN
CHUCHURRAS
RIO CHUCHURRAS


LOMA LINDA
(RAYA)
10°
20'

APPENDIX O

SOME IMPORTANT WATER AND RELATED RESOURCE CONSIDERATIONS

AFFECTING THE CAPABILITY AND SUITABILITY FOR DEVELOPMENT

OF THE PALCAZU VALLEY, PERU

Frank Zadroga
ROCAP/USAID

CONTENTS

1. SUMMARY

The water resources specialist evaluated the watershed characteristics of the Palcazu Valley and presented a preliminary assessment of the probable impacts on water and related resources of the proposed 527-0240 Central Selva Resource Management Project, including the proposed construction of the Rio Chuchurras - Rio Pozuzo road. This report is the result of a two-week visit to Peru in September, 1981, and is intended to complement the information presented by Gregory L. Morris in his paper "The Climate and Hydrology of the Palcazu Watershed, and Impacts of Agricultural Development" (24 pages and 2 maps, August - September, 1981).

Major conclusions drawn include the following:

1) The Palcazu Watershed is characterized by its steep and broken topography, soils of low infiltration and water retention capacity, and consequently very dynamic hydrological nature. Periodic extreme rainfall events superimposed upon the naturally wet to superhumid rainfall regime of the entire upland portion of the catchment give rise to major floods, and "flashy"flow regime. The high rates of suspended sediment and bedload production and transport apparent in the watershed are typical of its mountainous terrain and young geomorphological condition, even though the great majority of its slopes are still protected with dense tropical forests. Geological (normal) rates of erosion are high in the steeper flanks of the Valley and numerous landslides and slips are observable even under natural forest cover. Greatly accelerated rates of erosion appear as a result of recent land use changes in the form of forest clearing

and overgrazing on hillslopes. This erosion could reach catastrophic proportions when improper land use practices are extended over long periods of time and associated with extreme rainfall events and/or seismic disturbances-- both common in the area.

The aforementioned watershed characteristics give the Palcazu Valley abundant water resources, but at the same time present serious limitations with respect to the potential for development of its soil, water and forest resources. Improper land use, especially in the upland portions of the watershed, would undoubtedly give rise to flooding, erosion, sedimentation and runoff-timing problems that would foreclose optimum and sustained development of resources, not only in the Palcazu Valley but also downstream in the Pachitea floodplain. Every effort must be made to ensure proper land use throughout the Valley (see consultant report on land use capability, Tosi, 1981).

2) The road construction proposed for the Palcazu Valley represents a source of major hydrologic impact for two reasons:

   a. the construction and maintenance of the principal and secondary roads will contribute substantial amounts of sediment to the river giving rise to siltation of the channel and increased susceptibility to flooding (both in frequency and magnitude), as well as bank cutting and meandering, and related phenomena (i.e., channel instability);

b. to the degree that the road system opens up the Valley to increased colonization and improper land use practices, additional hydrologic problems concerning quantity, quality and timing of flow will occur. The negative impact of uncontrolled settlement resulting from the road is potentially much greater and much longer-termed than that of road construction itself.

3) The accelerated development of the Palcazu watershed with inadequate regard for and understanding of broader regional resource management, protection and development needs (i.e. the overall Ceja de Selva and Amazon region), causes inefficiencies and could give rise to unnecessary loss of resources and development opportunities. For example, the considerable hydro-electric potential of the Pozuzo River should have a great influence over how the Pachitea Basin is managed. From an economic point of view, it may be of much higher priority to,in a parallel manner,manage and protect the Pozuzo drainage than to accelerated-ly develop only the Palcazu. Likewise, it is probable that the agricultural potential of the lower Pachitea Valley be considerably higher than that of the Palcazu Valley, suggesting that development investments and efforts should be oriented towards agriculture in the lower Pachitea, and forestry and environmental protection in the Palcazu. A macro planning focus is needed to identify resource development cpportunities and protection needs on a regional basis, as well as critical upland interrelationships

between the Sierra, Ceja de Selva and lowland Amazonia environments.

4) The almost complete lack of basic hydrometeorological data for the Palcazu watershed makes natural resource planning and development both difficult and risky. Without basic climatic information on rainfall and hydrologic data on runoff, it is impossible to predict environmental hazards and recommend with precision key development elements, such as crop suitability and design specifications for water resources infrastructure, including dams and road construction. The road construction proposed for the PEPP Project is especially risky because of both the lack of data and a general ignorance of the hydrometeorological and erosional processes affecting the road corridor. This makes it essentially impossible to design and construct key road components (i.e. bridges, culverts,cut banks and fills, road surfaces, etc.) as needed, leading either to road failure or expensive over-construction, and sometimes both. If an appropriate and sustained development of the Valley is expected, climatic, hydrologic and erosional processes must be studied, quantified and understood.

2. CLIMATE

There is one rainfall station reported to exist within the Palcazu watershed at a place called Hacienda San Miguel, on the Bocaz River at 1050 meters above sea level, although the author did not have the opportunity to visit it and evaluate the quality of data recording. Seven years of record for this station gives a mean annual rainfall of 3,380 mm.

The general information and impressions presented by Morris, G. (1981) in sections 2.1, 2.2, 1-4, 2.3 and 2.4 of his report concerning atmospheric circulation, precipitation, temperature and solar radiation and evaporation, seem to adequately describe the operative climatic phenomena, given the scarce information base. The 1500 mm/yr evaporation rate estimated by Morris based upon biotemperature and Life Zone estimates, is in reality a total annual potential evapotranspiration (et) rate. This estimate likely approximates a maximum value for the Palcazu Valley with the upland portions of the watershed along the Cordillera Yanachaga and San Martin having reduced Et levels due to more persistent cloud coverages, lower temperatures and special atmospheric/cloud forest effects.

Although rainfall data is generally not available for the Palcazu watershed, observations of the vegetation and Life Zone mapping indicates that higher and more evenly distributed rainfall regimes occur in the headwaters portions, especially along the higher Yanachaga range which serves as an effective orographic barrier. The existence of Premontane, Lower Montane and Montane Rain forest vegetative associations indicate that annual rainfall totals occur between 4000-5000, 3600-5000, and 2,500-4000 respectively (See Life Zone Map of Palcazu Valley, Tosi, 1981).

Because of the poor information base, it is impossible to comment on or estimate total rainfall and its temporal and spatial variation over the watershed. Likewise important information on the characteristics of individual storms, probable maximum precipitations, total storm rainfalls and intensity, duration-frequency relationships for stations and the overall watershed are not available. Of importance, however, local farmers at Iscozacín reported that as the cause of the 1969 record flood, a 24 hours high intensity rainfall covered essentially the entire watershed. This spatial characteristic of storm rainfall for the Palcazu Valley apparently is not unusual since similar flood events were recalled by the farmers to have occurred in 1968 and at least twice before in the previous 20-25 years. Such high intensity, catchment-wide storms are especially conducive to flooding and should be of concern.

3. PHYSIOGRAPHY AND BASIN GEOMORPHOLOGY

As demonstrated in the report on the Land Use Capability of the Palcazu Valley, with few exceptions the physiography of the watershed is extremely steep and broken. The upland portions of the Yanachaga and San Martin ranges above the valley floor are so steep and dissected by streams as to make their only rational use that of forest and hydrologic protection.

This valley floor is made up of three basic geomorphological units which are high hills, low hills and alluvial flood planes (fans and terraces) adjacent to the main streams. Although the suitability for each of these formations is described in much more detail in the Land Use Capability report (Tosi, 1981), it is important to note that the hillslopes processes active on high and low hills (i.e. erosion by water, mass wasting and soil creep) impose serious constraints on their use. Only in the case of the flood-plain areas are topographic conditions amenable to land use other than those that assure a dense, protective vegetative cover with deep and vigorous root systems. (i.e production forestry and permanent crops). On the terraces and alluvial soils slopes and rainfall intensities (and perhaps compaction effects from grazing) still represent dangers in the form of accelerated erosion and appropriate soil and water conservation measures need to be used. Experimental rainfall/runoff and soil erosion plots should be established to assess the seriousness of the problem and assist in determining proper land use and soil and water conservation practices.

Both drainage-basin form and field observations made on the drainage density of the Palcazu watershed indicate its high susceptibility to flooding and high runoff vs. rainfall relationship The Palcazu drainage has a palmate dendritic pattern where three tributaries (i.e. the Bocaz, Cacazu and Pichinaz Rivers) merge at the upper end of the basin, and a primate network lower down the Valley (with predominance of the left bank tributaries)where strongly palmate parallel tributaries flow from the steep mountain slopes that flank the drainage basin, including the Palcazu River. This situation is a very hazardous one because simultaneous flooding in the tributary valleys often concentrate heavy runoff at the junctions and can cause backup and general flooding. Palcazu's dense texture of dissection is associated with various of its geomorphic and hydrologic conditions of interest to us in planning for its development. Areas with high drainage density such as that of the Palcazu Basin are associated with high flood peaks, high sediment production, steep hillslopes, general difficult of access, relatively low sustainability for agriculture, and high development costs for the construction of buildings and the installations of bridges roads and other facilities (Dunn and Leopold, 1978).

Flood-plain areas are topographic conditions amenable to land use other than those that assure a dense, protective vegetative cover with deep and vigorous root systems, (i.e. production forestry and permanent crops). On the terraces and alluvial soils slopes and rainfall intensities (and perhaps compaction effects from grazing) still represent dangers in the form of accelerated erosion and appropriate soil and water conservation measures need to be used. Experimental rainfall/runoff and soil erosion plots should be established to assess the seriousness of the problem and assist in determining proper land use and soil and water conservation practices.

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Drainage basin orientation is generally North-South. Such an aspect allows for maximum rainfall events and effects with the typical North-South storm displacement of the area.

4. HYDROLOGY

Although no hydrological or sedimentological data are available, wet and dry season flows, channel characteristics and other field observations give a general idea of hydrologic properties and behaviour.

The flow regime (i.e., seasonality of runoff) for the Palcazu is marked. Even under the well protected and principally forested condition of the watershed at present, flows vary from dry season minimums where light canoes can't pass rapids at Iscozacín and Loma Linda to minimum flood flows that have put the water 1-1/2 meters above the level of the floor at the SAHSA offices in Iscozacín and topped there both the 1st and 2nd level terraces. In addition abrupt fluctuation in water levels can occur in relatively short periods of time where minor storm discharges can occur in one day or less.

"Flashy"flow regimes are characteristic of steep, compact and relatively impermeable watershed, such as that of the Palcazu River. The watershed characteristics of the Palcazu make it likely that even more stream storm-flow vs. baseflow contrast will occur if careless land use is practiced. For example, the elimination of forest cover and degradation of hillslopes on the watershed will lead to more and quicker stormflow in the form of surface runoff and less infiltration, reduced aquifer recharge and decreased baseflow. Floods will be higher and more damaging and dry season flows will be lower, resulting in negative impacts to navigation and ground water supplies.

4.1. Water Quality

The amount of sediment delivered to the Palcazu drainage and transported downstream increases dramatically during storm flows. Steep stream gradients and dynamic flow patterns cause the streams to contribute large amounts of sediment and bedload to the Valley floor as witnessed by the alluvial fans that build up at the entrance of all major tributaries as they come out of the mountains onto the Valley bottom. Field observations of the Palcazu and its tributaries during the storm flows from September 14 - 17, 1981, showed that tributary gravel beds and bottom deposits were fairly well sorted and clean and not subject to heavy sediment loading between Iscozacín and Puerto Mayro, in contrast the main channel at Iscozacín mudried quickly with storms and showed indications of sediment loading. Although the author could not verify these observations by means of field inspection, he suspects that the source of most of the Palcazu load comes from disturbances in the southern-most portion of the watershed, principally in the form of road construction maintenance (i.e. the road from Villa Rica to Puerto Bermudez) and agricultural and grazing activities.

4.2. Cloud Forests

In the Palcazu watershed cloud forests occur on the upper ridges of the Yanachaga Range, above 1000 meters in elevation, where cloud and mist belts are originated by moist orographically ascending masses (see Life Zone Map for the Palcazu Valley, Tosi, 1981). These highland forests occur most frequently in the Premontane and Lower Montane Rain Forest Life Zones and are characterized by a dense growth of trees and/or shrubs of varying but generally small stem diameters and heavily laden with epiphytic vegetation, including mosses, ferns, bromeliads and mossy liverworts. The average annual vertical rainfall of these areas is estimated to be between 3600 and 5000 mm and the humidity perpertually near the saturation point. In addition, to the vertical precipitation that reaches these areas, varying quantities of water are condensed or captured from the incident cloud and mist and reach the ground as stemflow or drip, little being evaporated from the foliage due to the long period of cloudiness. The additional precipitation that is provided to the local water balance in this manner is unknown but observations from other cloud forests of a similar nature in other parts of the tropics indicate that this horizontal precipitation may equal or even exceed the vertical rainfall of these areas.

The cloud forest ecosystems that occur in the upper Palcazu are particularly valuable resources from a hydrologic point of view for three major reasons: 1) their effect in increasing net precipitation, 2) their regulation of flow regime, and 3) their low evapotranspiration rates. Because of the naturally irregular flow regime of the Palcazu and its relatively poor retention capacity, it is likely that cloud forests play a key role in maintaining baseflow and regulating dry season discharges. For this reason it is critical that these special atmospheric forest associations be preserved.

5. WATER USES

In the Palcazu basin important existing or potential water uses include navigation, fishing and recreation, water supply and sanitation, and hydro-power generation.

5.1. Navigation (See Navigation Section of G. Morris's report, pages 10-11)

As G. Morris points out in his paper, navigation is an important use of the water resource of the Palcazu Valley since it constitutes the backbone of the local transportation system. Although freighting on the river is difficult and costly and will gradually be replaced by overland freight when road links are completed, such changes will likely come slowly and river transport will remain as an important alternative transportation system, especially for remote farms and isolated indigenous populations (i.e. the Comunidades Nativas). The difficulty and costliness of road construction in the area will make it necessary that river transport be kept as an important resource use.

5.2. Fisheries and Recreation

In his report on the fish resources of the Palcazu Valley,Bayley aptly describes the fishing potential of the Palcazu drainage, as well as related opportunities and impacts on fisheries of the proposed PEPP Project. Riverine fishing, aquaculture and rational uses of the streams and water bodies of the area (including its small lakes and waterfalls) as recreational sites consitute an important resource potential for both local protein production and tourism development. (See Dourojeani's report).

5.3. Water Supply and Sanitation

Important considerations and details of this water use are presented in Morris's report on pages 11 and 12.

5.4. Hydropower Generation

To date no hydropower development has occurred in the Palcazu Valley, although considerable hydroelectric potential probably exists in the Yanachaga Mountains. Electroperú is currently exploring and doing pre-feasibility evaluations of several potential mini-hydro sites in the watershed (Source: Ing. Julio Bustamente, 12th Floor, Division de Ingeniería Hidráulica, Tel. Of. 325280, Anexo 508 - Home 469343).

The remoteness of the Valley and consequently the high costs of alternative energy sources (i.e., thermal plants or transmission from outside systems)will likely dictate that local water resources eventually be exploited for energy production- probably in the form of small mini-hydro plants. Although much larger hydroelectric potentials apparently exist in the Pozuzo watershed (i.e. two different sites have been identified on its middle and lower stretches),the feasibility for the development of these resources has not yet been decided upon. Pre-feasibility determinations for the use of the hydro electric potential of the Palcazu Valley should be available from Electroperu by the end of 1981.

6. ROAD CONSTRUCTION AND MAINTENANCE IMPACTS

The main road projected to cross the Palcazu Valley from Rio Chuchurras to Rio Pozuzo and its 15 secondary access roads (See J. Miranda Patron y Asociados, 1981) will directly or indirectly be the largest cause of negative impact of the overall PEPP Project to the water and related resources of the watershed. The degree to which the road is properly constructed and access controlled into the valley in accordance with land use capabilities will largely determine the magnitude of negative impact.

Road impacts will result from two effects:

1) construction and maintenance
2) indirect effects from increased accessibility to the Valley and colonization

6.1. Construction and Maintenance Impacts

Sedimentation loading of the Palcazu river will occur as a result of road construction and maintenance activities. Heaviest loading will occur between kilometers 0 and 18, along the mountainous headwater portion of the route located adjacent to the main channel of the Palcazu. Through out the first 10 kilometers of this route as well as along much of the headwaters portion of the Villa Rica - Puerto Bermudez road (now under construction) canyon like relief features will cause high percentages of cut and fill materials to be deposited in the River. From kilometer 18 on to Puerto Mayro sedimentation and erosion problems will result principally from cut and fill slopes and from channel scour on the numerous streams and rivers coming down out of the Yanachaga crossed by the road. The degree to which appropriate erosion control measures are taken, such as cut bank and slope stabilization, landslide prevention, and the installation of adequate drainage structures under and on the surface of the road, sediment loading of the River will be reduced. The very rugged physiography, high material erodability and torrential rainfall regimes affecting the road corridor, however, will cause large amounts of sediment to be transported to the River system regardless of the precautionary measures taken.

Landslides along the headwaters of the Palcazu River occur with regularity on forested slopes and under natural conditions. The cutting of slopes by the road is expected to cause an increase in the frequency of landslides and slips all along the route but especially in the mountainous portion of the corridor between kilometers 0 and 18. Special efforts should be taken to control such problems to assure operability of the road and reduce sediment loading. The problems of mass movements and road surface erosion will be serious and will cause high maintenance costs that should be taken into consideration in the overall benefit/cost analysis of the road.

One of the most serious constraints to cost-effective road construction and a long useful life, is the almost complete lack of basic hydrometeorological data for those catchments to be crossed by the road corridor. For the proper design and location of bridges, culverts and drainage structures, it is necessary to know the rainfall and runoff characteristics of the catchments, slopes, etc. affected. The lack of basic data and poor understanding of the hydrometeorological and soils pehnomena affecting the area makes it likely that either costly over-construction or risky under-construction occur. This being the case for the Palcazu valley increases the probability that the Rio Chuchurras - Puerto Mayro road suffer interruptions in its service, be more costly to maintain and be much more expensive to construct from the beginning.

As the sections on climate, physiography and geomorphology and hydrology of this report indicate, the Palcazu watershed and its tributaries discharge larger amounts of rainfall and demonstrate a much more irregular runoff regime than one might expect. Engineers designing the road are likely to be fooled by field observations that take place during the dry season of the year, by stream channels masked by vigorous regrowth and dense tropical vegetation and by highland areas that produce much more water than those lands adjacent to the road corridor (and that may become even more torrential with unexpected changes in land use).

The bridges proposed for the main road not only are subject to the aforementioned risks but in addition merit special concern because of their location. According to the second progress report of J. Miranda Patron y Asociados, dealing with corridor location and general road technical specifications, bridge locations over three of the major tributaries to be crossed (i.e. Chuchurras, Lagarto and Mayro) occur at points just to the east of where their feeder streams break out of the mountainous Yanachaga Range and onto the valley floor, forming alluvial fans or outwash plains. These locations are subject to heavy bedload deposition, flooding and possibly changes in channels. The author did not have an opportunity to visit the proposed bridge sites in the field to verify such characteristics, but nonetheless suggests that these details be taken into account and field checked before final road design and bridge location decisions are made.

6.2. Colonization Impacts

The magnitude of the long-term hydrologic impacts resulting from the colonization of the Palcazu Valley basically will be determined by the degree to which proper land use practices are adhered to. The negative impact from uncontrolled settlement resulting from increased access to the Valley is potentially much greater and more serious than the road construction itself. It is critical that the highland protection forests of the watershed be maintained intact. In addition those major land uses recommended by Tosi (1981) for the Palcazu Valley should be implemented, along with their respective soil and water conservation practices. Mechanisms and provisions should be incorporated into the design and construction of the road whereby access into the valley is controlled in accordance with both proper land use and PEPP's institutional capability to handle the settlment phenomena. Included within these mechanisms should be guard stations and forest ranger vigilance to prevent incursion into protection lands. Also, well organized systems of land titling and control over land use and tenure need to be enforced for all people entering the Valley, in order to assure the desired land use and development effect.

It should be noted that road construction and maintenance is already occurring in the headwaters portion of the watershed affecting the Bocaz, Cacazu and Pichinaz tributaries and impacts will increase after the Villa Rica - Puerto Bermudez road is completed. All of the phenomena previously mentioned concerning construction, maintenance and colonization impacts are already operative in this headwater portion of the Palcazu and if effective resources conservation and optimum development is desired for the overall watershed, measures should be taken to incorporate this portion of the basin into the Project scope and to implement control mechanisms over this situation.

Funding of the road construction in the Palcazu is viewed as a major issue that needs urgently to be addressed in Project design. It is probable that AID's funding the road would lend more flexibility to the Project to provide technical assistance in the area environmental assessment and protection measures. The current practice of GOP's constructing the road piece by piece either through the Ministry of Public Works or the Military with the use of P.L. 480 funds is highly undesirable from an environmental point of view. This system, as it is being now carried out, generates little or no environmental concern and provides no control over the road construction and access phenomena. On the other hand, road construction and maintenance costs are likely to be so high that AID may not be able to justify funding the road under current benefit/cost and economic feasibility procedures and regulations. This issue is viewed as key to Project design as well as the overall success of the sustained development of the Palcazu watershed, and it merits close attention from USAID Peru.

7. RECOMMENDATIONS

In addition to the concerns and suggestions presented earlier in this report, the following recommendations are made to assist in Project design:

1) It is important to establish as soon as possible a basic hydrometeorological data collection network in the watershed. Rainfall gauges need to be installed at accessible points throughout the highlands portion of the Valley representative of all of the Life Zones present. Data from these gauges could be collected by the forest guards responsible for the national park/protection lands. Recording rain gauges along with hygrothermographs and max-min thermometers should be installed in the Valley at Loma Linda and Puerto Mayro. A class C weather station should be installed at Iscozacín.

A permanent stream gauging station should be set up at a suitable location near Puerto Mayro to measure streamflow from the Palcazu River. Sediment production should also be estimated at this location. Interesting research information could be obtained by establishing comparable stations to collect data from the Rio Pozuzo (i.e. to compare impacts of different land uses).

2) Research plots should be set up to assess rainfall/runoff relationships and soil erosion rates for the different major land uses and soil units of the Valley. Preliminary results should be used to recommend more appropriate soil and water conservation practices (See Dunne and Leopold, 1978, Chapter 15).

3) Palcazu settlements should be encouraged to establish and protect their own community mini-watersheds suitable for the provision of multiple

benefits in the form of potable water, fuelwood and saw timber, recreational areas and perhaps hydroelectrical generation. Environmental education programs should be designed around the planning and management of these important resources and offered to both adults and school children.

4) Gregory Morris's recommendations and concern on water supply, contamination and health (pages 14-16) are to the point, and should be considered in the Project design phase. The danger of contamination of ground water supplies from latrines and contaminated surface waters (i.e. pigpens, corrals, home sites, etc.) exists because of the porous nature of many of the aquifers of the area (i.e. gravel and sand strata interlaid with finer textured materials). Care should be taken in site selection for both waste water disposal and potable water supplies.

5) Flood hazards in the Valley will appreciably increase with road construction and changes in land use. The Pozuzo River, which drains into the Palcazu just below Puerto Mayro, contributes its own flood flows and some sediment load into the Palcazu and can therefore significantly increase upstream flooding impacts. It would be worthwhile to establish a simple flood warning system whereby Valley residents could be informed about impending flood events. A radio communication network could be established, perhaps using the SAHSA equipment and some additional capability. In past years considerable numbers of cattle have been lost to floods and dangers will increase. Certain flood-proofing measures could also be taken to safeguard both human and livestock lives in inhabited floodplain

6) In the Valley, in those areas to be use for annual or permanent crops, agroforestry, cattle grazing and forest production, it is important that riparian vegetation be protected to reduce flooding hazards and protect stream environments. Logging operations should likewise protect stream courses and take special care in the layout, construction, maintenance and "putting to rest" of logging roads. Site conditions are such that even in the low and high hill region of the Valley (i.e. colinas altas y colinas bajas) erosion potential is high and hydrologic distrubance and site degradation will be excessive if proper precautions are not taken. It may be necessary to use cable logging or other types of more protective extraction procedures for certain terrain conditions. These specifications should be incorporated into and required for the forest production component of the project.

7) Some range management techniques have been developed for tropical wet climates and erodable soils that reduce soil erosion and site degradation impacts. Experiences from such research stations as Pucallpa (IVITA) and Gualaca, Panama (IDIAP) concerning proper pasture management should be taken advantage of in the design of technical assistance for cattle production in the project area.

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