

Riparian Zone Land Use in indigenous and Colonist Communities of the  
Palcazu Basin, Peruvian Amazon

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## **Abstract**

Riparian environments, the ecotone between terrestrial and aquatic ecosystems, provide services on which the ecological integrity and health of rivers and uplands depend. Humans have historically utilized floodplains because of the many services they provide, however unplanned use of these areas, has caused disappearance of many of them in North America and Europe. The extent of degradation of riparian zones in the Peruvian Amazon not well documented.

The purpose of this study was to compare outcomes in riparian zone land use in communities with indigenous (Yanesha) and colonist forms of land tenure, but where each community is somewhat mixed in its social composition, of the Palcazu basin in Peru.

Data were gathered through a survey of 79 settler households in the two communities and an ethnographic study. The results showed that riparian zones are highly valued for the conservation of fertile lowland soils by both communities. Statistical tests showed that riparian and non-riparian zone land use practices in both communities are similar; only significant differences were found in the percentage of protection fringe forested, in the area of riparian zone under use and in the importance of riparian zones for the householders.

Social and economic conditions in the communities are similar and markets are distant. My research suggests that there is nothing inherent in the culture of either the Yanesha or colonists that leads them to open more or less agricultural land in riparian zones, but that both are conditioned by similar material conditions and distance from markets, and that these are more significant than any ethnic or social differences in riparian zone land use.

## INTRODUCTION

Riparian environments, the ecotone between terrestrial and aquatic ecosystems, provide very important services on which the ecological integrity and health of rivers and uplands depend. These services include protection of surface water quality, stream-bank protection, attenuation of floods, regulation of temperature by vegetation on stream-banks, habitats, and corridors for the migration of plant and animals species (Welsch, 1991, Schiemer and Zalewski, 1992, Naiman et al., 1993, Bjorkland, 1997).

Humans have historically utilized floodplains because of access to transportation, water and fertile soils. In remote places of the Amazon basin, riparian zones are used principally for traditional agriculture because of the renewable fertility of soils. Rejuvenation of riparian soils allow higher yields than is typically achieved on upland sites. The higher fertility of riparian zones allows the cultivation of more demanding crops (beans, peanut, rice, corn, etc.) which are important sources of protein and minerals, and provide a variety on the diet of poor rural riparian inhabitants. Logging and cattle ranching are other human activities carried out in riparian zones (Albernaz and Ayres, 1999, Anderson et al., 1999), however these activities have been reported to cause disturbances to these environments, affecting the ecological services these areas provide.

Worldwide, riparian zones are becoming increasingly endangered. Because of unplanned use of these areas, more than 80% of North American and European riparian zones have disappeared in the last 200 years (Naiman et al., 1993). The extent of degradation of riparian zones in the Peruvian Amazon is not well documented, but it is assumed that there riparian environments are more intact. Land use in riparian zones of the Peruvian Amazon however differs from that of the floodplains of the lower Amazon. Most research on land use in the Andean Amazon has focused on the differing patterns of natural resource use by natives and colonists, as well as the important impacts of access to markets and roads on both groups. Although there is substantial literature on ribereño land use much of it focuses on upland land use with little attention to riparian zones. This makes it crucial to understand the use of riparian zones and the emergent threats in this region as a baseline for understanding losses in other areas in the Amazon basin, and to begin to raise consciousness about the consequences of habitat loss.

In this paper I report and discuss the results of an ethnographical study and a survey of land use in riparian zones of the Palcazu basin in the Peruvian Amazon. I examine how farmers in riparian communities use riparian zones for production, what are the behavioral patterns and community rules that regulate riparian zone land use, and the recognition of the importance of intact riparian vegetation for protection of adjacent aquatic ecosystems by the riparian communities. This study was conducted within the context of a larger investigation (The Andean Amazon Rivers Analysis and Management AARAM Project), with support from the Mellon Foundation, the InterAmerican Institute for Global Change Research, and the InterAmerican Foundation, addressing the influence of land use and climate variability on riverine ecosystems of the Andean Amazon.

## STUDY SITE

This study was conducted in the Palcazu sub-basin, one of the four major sub-basins of the Pachitea basin (29,000 Km<sup>2</sup>) in the Central Andean Amazon of Peru, which covers an area of 3,041 Km<sup>2</sup> and ranges in elevation from 300 to 3,800 masl. The Palcazu basin is formed by the rugged Yanashaga range to the west and the lower San Matías range to the east. The weather is warm and wet, with temperatures fairly constant throughout the year and an annual average of 24.3°C. Precipitation exceeds 2,000 mm/yr (Ordoñez, 2001). Wet months are from October to April; from May to September it is drier.

There is not much flat land in the Palcazu valley. Most of the flat land is from natural terraces along the larger streams and rivers (Palcazu, Iscozacín, Chuchurras, and Mairo). Soils tend to be highly acidic and infertile with high concentrations of aluminum, however some of the alluvial soils are slightly more fertile than the upland soils (JRB Associates, 1981). Lowlands have sandy soils with high lime amounts, relatively moderate pH, and low aluminum saturation. Uplands have clay-gravel textures, with low pH and high saturation of aluminum (Salick, 1986).

Most of the land within the Palcazu basin is best suited for protection forests because of its rugged terrain, fragile soils and high rainfall. Nearly half of the land at low elevations is suitable for forest production, and it is not suitable for most agricultural uses (JRB Associates, 1981).

There are three protected areas in the Palcazu valley that in total occupy 122,999 ha, of which approximately 50% are located in the headwaters of the Palcazu basin. The Yanachaga-Chemillén National Park is 111,978 ha and protects high tropical forests. There are no human settlements in the park, however its northern and western boundaries frequently are crossed by landless Andean immigrants, in search of agricultural land, and by occasional hunter, fishermen and loggers. The San Matías-San Carlos Protected Forest comprises 145,818 ha. A diverse population lives in this area, mainly settled along the Marginal road, which from the beginning made it very difficult to guarantee the protection of the area's vegetation coverage and the illegal use of its lands. Finally the Yanesha Communal Reserve, with an area of 34,745 ha, acts as a buffer zone between the Park and the local population (10 Yanesha communities) located to the east of the Park, and was established to protect fauna for the benefit of the local population (Plan Maestro Parque Nacional Yanashaga-Chemillén, 1997).

The Palcazu population, estimated in 8,000 inhabitants (INEI, 2001), consist of three social groups: Yanesha native communities, descendants of German Swiss, and Austrian colonists who arrived to Peru in the 1850's, and more recent colonists (mestizos) from other parts of Peru.

Two small communities of the Palcazu valley were selected to conduct my interviews: Laguna-Raya and Santa María. Laguna-Raya with a population of 343 (INEI, 2001) is one of the three sectors of the Yanesha native community of Loma Linda-

Laguna, at an altitude of 307 masl. Raya is also the name of the stream that runs through this sector. The stream, bounded by gentle slopes, is relatively narrow (20m in average) and shallow. Santa María with a population of 353 (INEI, 2001) is a colonist settlement considered as an annex of the town of Iscozacín. It is a little higher in the valley (393 masl), and its topography is more rugged than in Laguna-Raya. The Palcazu river, which runs through Santa María, is wider than Raya (35m), and it is deep.

## **Social Context**

The town of Raya, within the Laguna-Raya sector, was settled in 1982 approximately, when the Pichis-Palcazu Special Project (PEPP), a large-scale colonization and development project in the Palcazu valley, established its base on the road (Marginal Villa Rica-Puerto Bermudez), and formally recognized in 1994.

Loma Linda-Laguna, with a unique communal title, is the only Adventist community in the Palcazu valley (Personal communication, Richard Smith, 2001). It is directed by a Communal Chief (Jefe), and administered by a Delegate, who is chosen for a period of 2 years. There is an internal statute that governs the community, and there are communal assemblies, of variable frequency, where the Communal Chief discusses pending topics with the participation of the entire community.

The social composition of Loma Linda-Laguna has shifted in recent years. Not all the population in Laguna-Raya are natives. With the construction of the road (Villa Rica-Puerto Bermudez) and the presence of the PEPP, colonists came from other parts of the country. Some of these people settled in Laguna-Raya and married native women. After 5 years of living in the place colonists could become comuneros, and after 2 or 3 years they may have asked for a parcel of land.

Laguna-Raya lacks basic services. There is no electricity, running water, or sewerage. The scarcity of latrines in most houses is noteworthy. There is a health post without basic medicines. There is a kindergarten, a primary school and an agricultural vocational school, the only secondary school in the community. Religion is an important aspect in Laguna-Raya people's lives. Most are Adventists and because of this they do not eat the meat of animals that have cloven hooves, such as collared peccary (*Tayassu tajacu*), white-lipped peccary (*Tayassu pecari*), lowland tapir (*Tapirus terrestris*), paca (*Agouti paca*), or fish without scales and fins.

Santa María was a colonist settlement for several years, but in 1998 it was assigned as an annex of the town of Iscozacín with a *Teniente Gobernador* as the authority of the place, responsible for enforcing laws and representing the community in many of its dealings with other communities. Most of the members of this town hold titles for their individual parcels of land. The first colonists who took possession of Santa María were people from the highlands and lowland rainforest, but lately some Yanasha in the area left their community and asked for a land in Santa María. At the beginning no towns or nucleated settlements were formed by the farmers. Rather a pattern evolved in which the chacras of the colonist were spread along the river, so each farm family lived

and worked on a single plot of land. Today this pattern continues, but also some people build their houses close to the health post and primary school, which are on the road. By 1999 the *Teniente Gobernador*, associated Santa María with FECONAYA (Yanesha Native Communities Federation) as a way to receive support for development.

The Yanesha from Laguna-Raya and the colonists from Santa María have both maintained a subsistence economy based on the cultivation of a small number of crops. Agriculture is restricted by the lack of land in floodplains and thus depends on the use of more abundant uplands but that have poorer soils, and also by the high transportation costs. Raising of chickens, fishing, hunting and gathering are complementary activities, and cattle raising is of relatively little importance.

## **METHODS**

Data were gathered through a survey of 79 settler households (58 in Laguna-Raya and 21 in Santa María) and ethnographic study in both communities between May 18 and July 17, 2001 (see map 1). The entire population from Laguna-Raya and Santa María (81 families) was interviewed, except for 2 of them that did not want to be interviewed.

The ethnographic study consisted of observations, informal conversations and unstructured interviews with householders about their conceptions, classification, and use of riparian zones, and in general about all their activities. In Laguna-Raya, more ethnographic data were collected because upon my arrival in Raya, I met the Communal Chief who introduced to me to the community, and also because of the fact that most of the people in this community live in town. In Santa María the reality was different. I did not meet the authority of the community (*Teniente Gobernador*) when I arrived there; the General Secretary gave me information on the number of households in the area and their location. There, colonists are dispersed and they had just enough time to answer the questionnaire, but not for informal conversations.

The survey was based on structured interviews and householders were interviewed concerning their use of riparian zones, economic activities and factors affecting these activities, and respondent's data (social group, education, occupation, land tenure). Because of the occasional long distances between interviewees, I could interview on average 5 people per day in Laguna-Raya and 3 people per day in Santa María.

Collected data were processed using SPSS statistical software. Descriptive statistics were derived for all quantitative variables, and frequencies (percentages) for all qualitative variables. An Independent Sample T-test, with a significant level of 0.05, was used to compare variables between the two communities. Some qualitative variables expressed as proportions were recoded as dummy variables (householder education levels, crops in riparian zones, crops in uplands and percentage of people with access to riparian zones, people that develop agriculture in uplands, and importance of riparian zones), and then compared through an Independent Sample T-test to check for significant differences between proportions in these two communities.

## **RESULTS**

### **Householder characteristics**

The social composition of Laguna-Raya has shifted in recent years. Eighty-six percent of the inhabitants are Yanesha natives, 34.5% of them were born in the Loma Linda-Laguna native community and another 51.7% are Yanesha who migrated from the Pozuzo, Oxapampa, and Chanchamayo valleys because of colonization pressures. Fourteen percent are colonists who arrived in the community since the opening of the Marginal Villa Rica-Puerto Bermudez road in 1983. Most of these people were employees of the Pichis-Palcazu Special Project who married native women and became comuneros. In Santa María, 71.4% of the inhabitants are colonists who arrived mainly from other parts of the lowland rainforest with the opening of the Marginal road; only one person was born in the community (4.8%) and 28.6% are Yanesha natives who left their community, mainly Loma Linda-Laguna, in search of their own land, and because they did not want to continue participating of the communal works, which they considered not to be for the future benefit of their children.

In Laguna-Raya the average household size is 5 members, ranging from 1 to 11, while in Santa María the average is 4 members, ranging from 1 to 8. Thirty-three percent of comuneros in Laguna-Raya have completed primary school and in average they have 6.7 years of schooling. In Santa María only 24% have completed primary school and they have 4 years of schooling.

Laguna-Raya has a unique title for the entire community (communal land), however each comunero has a parcel that averages 22.7 ha, ranging from 4 to 80 ha. In Santa María, each colonist has an individual land, and 90.5% of the surveyed householders have a secure title. Average land holding in Santa María is 49.3 ha, ranging from 0.03 to 197 ha.

### **Agriculture**

Agriculture is the most important economic activity, and uplands as well as riparian zones are used. In Santa María all householders are dedicated to agriculture as their main activity, while in Laguna-Raya only 75.9% are, because the activities are more diversify.

Agricultural land size, which is the land farmers can use for agricultural purposes, averages 9.4 ha among comuneros in Laguna-Raya while in Santa María it averages 17.3 ha. Most people in both communities cultivate in uplands (80.4% in Laguna-Raya and 76.2% in Santa María). The general system of cultivation in uplands is that farmers cut an area, sow it and after an average of 1.5 years, in the case of the native sector, they move to another area, having a rotation period of 4 years. In Santa María 1.4 years is the average time farmers use a plot, leaving this in fallow during 3 years. The main crops sowed in uplands are manioc (95.1% in Laguna-Raya, and 75% in Santa María) and

plantain (56.1% in Laguna-Raya, and 93.8% in Santa María) in both communities. Other crops sowed in uplands are pituca, citrics, and coffee as the main cash crop.

### Agriculture in Riparian zones

In Laguna-Raya 55.2% of the comuneros had access to riparian zones and were using them at the moment of the interview (32 comuneros), and 10 of them (31.3%) were using communal riparian zones. All comuneros with access to riparian zones use them for agricultural purposes, just one person in Laguna-Raya does not use it, because he is dedicated to commercial activities. In Santa María 76.2% of colonists have access to riparian zones, and all of them use these areas for agricultural purposes (Table 1).

Table 1: Number of people with access to riparian zones (RZs) (N=49)

	Laguna-Raya		Santa María		P-value (T-test)	95% Confidence Interval
	Freq	%	Freq	%		
# people with access to RZs	33	56.90	16	76.2		
# people using RZs	32	96.2	16	100.00	0.09 (ns)	-0.45_0.04

\* significant differences at  $\alpha=0.05$

People with access to riparian zones at their arrival to their respective community found these areas with abundant vegetation, 93.9% of people in Laguna-Raya, and 87.5% of colonists in Santa María. Most people, 78.8% in Laguna-Raya and 68.8% in Santa María, left riparian vegetation for protection of their lands.

Comuneros in Laguna-Raya have an average length of river in their properties of 315 meters, while in Santa María, the average length was almost double (656 meters). Table 2 shows that in both communities a great percentage of people, 87.9% in Laguna-Raya and 75% in Santa María, leave a fringe of trees as protection of their lands in riparian zones. This fringe is not so variable between these two communities, the mean is 22.1 meters in Laguna-Raya and 27.5 meters in Santa María. A big percentage of the protection fringe is forested in both communities (99% in Laguna-Raya, and 82% in Santa María). The area of riparian zone under use among comuneros in the native community is in average 1.1 ha, ranging from 0.2 to 3 ha. For colonists in Santa María the area under use is 1.8 ha in average, ranging from 0.2 to 5.7 ha.

Table 2: Mean values and percentages-Riparian zones characteristics

	Laguna-Raya	Santa María	P-value (T-test)	95% Confidence Interval
Lenght of river in property (meters) (N=46)	315.2 (sd=278.9) (N=31)	1) 656.3 (sd=698.4) (N=15)	0.02 (*)	-630.42_-51.93
		2) 488.9 (sd=269.5) N=14 (2. Exclude one extreme value)	0.06 (ns)	-354.08_6.54

# people leave a protection fringe in RZ (N=49)	29 (87.9%) (N=33)	12 (75.0%) (N=16)		
Meters of protection fringe in RZ (N=41)	1) 22.1 (sd=21.5) (N=29) 2) 19.3 (sd=15.7) (N=28) (2. Exclude one extreme value)	27.5 (sd=27.3) (N=12)	0.50 (ns) 0.24 (ns)	-21.55_10.76 -21.97_5.62
% of protection fringe in RZ that is forested (N=42)	99 (sd=3.1) (N=30)	82.5 (sd=24.5) (N=12)	0.001 (*)	7.44_25.56
Area of RZ under use (ha) (N=45)	1.1 (sd=0.79) (N=30)	1.9 (sd=1.5) (N=15)	0.04 (*)	-1.42_-0.04

\* significant differences at  $\alpha=0.05$

### Crops in riparian zones:

Riparian zones are sowed once per year (Feb-Sept). The high fertility of these areas induces farmers to plant crops of short growing season that mature in 3 to 4 months, such as: corn, peanuts, beans, manioc, plantains, and pituca. Table 3 shows the percentages of producers of these crops. There are significant differences in the production of peanut and beans in both communities, and they are sowed for more people in Laguna-Raya. Even though coffee is not a crop for riparian zones, one person in Santa María is growing it in these areas.

Table 3: Principal crops in riparian zones (N=48)

Crops	Raya (N=32)		Sta María (N=16)		P-value (T-test)	95% Confidence Interval
	Producers #	Producers %	Producers #	Producers %		
Corn	23	71.9	9	56.3	0.289 (ns)	-0.14_0.45
Peanut	15	46.9	1	6.3	0.004 (*)	0.14_0.68
Bean	13	40.6	1	6.3	0.013 (*)	0.08_0.61
Manioc	17	53.1	9	56.3	0.842 (ns)	-0.34_0.28
Plantain	24	75.0	8	50.0	0.087 (ns)	-0.04_0.54
Pituca	7	21.9	3	18.8	0.807 (ns)	-0.22_0.29
Citrus	1	3.1	2	12.5	0.214 (ns)	-0.24_0.06
Rice	1	3.1	3	18.8	0.067 (ns)	-0.32_0.01
Coffee	0	0	1	6.3	0.160 (ns)	-0.15_0.03
Other	6	18.8	6	37.5	0.164 (ns)	-0.45_0.08

\* significant differences at  $\alpha=0.05$

For 39% of respondents in Laguna-Raya the main reason for sowing these crops in riparian zones was because these crops grow better there. For 37.5% of respondents in Santa María, the main reason was fertility of soils. The high fertility of these areas induces farmers to plant crops of short growing season there; crops that mature in three or four months.

## **Importance of riparian zones**

People in both communities recognized the importance of riparian zones as a component of the overall landscape. In fact, all the interviewed comuneros in Laguna-Raya answered that riparian zones are important because of soil protection (60.6%), soil fertility (30.3%), existence of more flora and fauna (6.1%), and esthetics (3.0%) (Table 4). In Santa María, 81.2% of the householders consider that riparian zones are important for protection of soil (62.5%) and soil fertility (18.8%); however 18.8% of those interviewed said that these areas are not important, by the contrary, they are a risk for their crops and property.

Table 4: Number of people for whom riparian zones are important and the reasons of importance (N=49)

	Laguna-Raya (%) (N=33)		Santa María (%) (N=16)		P-value (T-test)	95 % Confidence Interval
	Freq	%	Freq	%		
Riparian zones importance	100		81.3		0.01 (*)	0.05_0.33
Protection	20	60.6	10	62.5		
Fertile soil	10	30.3	3	18.8		
Fauna & life	2	6.1	0	0		
Esthetic	1	3.0	0	0		
No important	0	0	3	18.8		

\* significant differences at  $\alpha=0.05$

Considering 50m as the ideal width that householders should leave in the protection fringe along riparian zones, more people in Santa María are closer to the ideal protection fringe than people in Laguna-Raya.

1. Real Area Protection Fringe = Meters of protection x Length of river in property
2. Ideal Area Protection Fringe = 50m x Length of river in property
3. % of Ideal Protection Fringe = (Real Prot. Fringe/Ideal Prot. Fringe)\*100

Table 5: Pearson correlation-Ideal protection fringe

Location	Ideal Protection Fringe	% Ideal Protection Fringe
Pearson correlation	-0.337*	-0.191
P-value	0.022	0.245
N	46	39

## **Other economic activities**

**Livestock:** Particularly backyard animals, is the second economic activity for both subsistence and income in both communities (79% of the population in Laguna-Raya and 95.2% in Santa María). Because the area has been over-hunted, population has developed the raising of small livestock such as chickens, turkeys, ducks, pigs, and goats. The main animal raised is chicken (98% in Laguna-Raya and 100% in Santa María), and it is the

principal source of cash in Laguna-Raya. Some people in Laguna-Raya (15.6%) are raising pigs as a way to get income, because their religion does not allow them to eat pork. Twelve people in Laguna-Raya possess cattle (20.7%), a mixture of Brown Swiss with cebu, while in Santa María just one person (4.8%).

Hunting: Even when the amount of animals has decreased with time because of over-hunting, a variety of game is hunted by members of these communities (54% in Laguna-Raya, and 52% in Santa María). This activity is carried out mainly for consumption and most of the people in both communities hunt significantly more during May-September (74.2% in Laguna-Raya and 72.7% in Santa María) than during December-February. The most frequently hunted species in Laguna-Raya are paca (*Agouti paca*) (70.9%), birds (58.1%), agouti (*Dasyprocta sp.*) (22.6%), and deer (*Mazama americana*) (19.4%), and in Santa María, paca is the main game hunted (100%).

Fishing: Constitutes the third most important economic activity for subsistence in both communities. In Laguna-Raya 85% of people practice this activity and all of the respondents in Santa María. The most used fishing tools in Laguna-Raya are hook-line (77.6%) and cast-net (77.6%); also some people fish by hand (32.7%), use arrows (12.2%), and use small amounts of *barbasco* or *huaco*<sup>1</sup> (39%). In Santa María the most used fishing methods are hook-line (81.0%), and cast-net (76.2%).

In Laguna-Raya, carachama (*Pterygoplichthys multiradiatus*) is the most abundant and consumed species, followed by chupadora or boquichico (*Prochilodus nigricans*), sabalo (*Brycon sp.*), and corvina (*Salminus affinis*). In Santa María the main fish caught are corvina (*Salminus affinis*), carachama (*Pterygoplichthys multiradiatus*), and sabalo (*Brycon sp.*).

Gathering: Forty-seven percent of respondents in Laguna-Raya collect a large variety of plant parts, wood, and fruits mainly for subsistence, while in Santa María 52% of them. People in this valley collect fruits (52% in Laguna-Raya and 36% in Santa María), medicinal plants from primary forest (55.6% in Laguna-Raya and 90.9% in Santa María). Some in Laguna-Raya (29.6%) are dedicated to sell timber from Loma Linda and Raya. This activity is done mainly during winter, and the most common marketed tree species are tornillo (*Cedrelinga catenaeformis*) and palos corrientes.

## DISCUSSION

The two studied communities, Laguna-Raya and Santa María, are socially mixed. However they are still characterized as native and colonist on the basis of land tenure. Even though most of the literature points out differences in behavior between colonists and natives, people from Laguna-Raya do not present that much differences. As Browder (1995) points out some colonists because of the interaction through time with their environment increase their knowledge about tropical environments and preserve it as natives do. In Laguna-Raya, colonists who were incorporated to the community behave

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<sup>1</sup> Barbasco or huaco: natural poison for killing fish

as natives, because from the moment they were accepted to be part of the community and they became comuneros, they had to follow communal rules established for all the comuneros without distinctions.

There are significant differences in the number of members in both communities. The high number of members per family is a common denominator in remote areas such as my study area, because of the necessity for more hands in agricultural labor. Typically, colonists have a higher level of education than natives because of more income and easier access to education in cities. However in my study population the level of education was higher among the comuneros in the native community (Laguna-Raya). Most of the colonists who arrived to Santa María were people with little education in search of land. In the case of Laguna-Raya, most of the people who migrated to the community, Yaneshas or colonists, lived close to cities before, so they received at least a primary education there. Most of the Yanেশা communities have a high index of literacy, and according to Brack (1987) at least 75% of the Yanেশা population has primary education.

Agriculture is the main activity for people in both communities, however activities are more diversified in Laguna-Raya where some people have temporary jobs such as agricultural labors in chacras of others, cattle raising activities on colonist ranches located close to the community, building, and saw mills. Others have more permanent jobs such as workman for the PEPP and Pronaturaleza, merchants, and teachers in the school.

The entire Loma Linda-Laguna community, when it was named as a Native Community, received a fixed amount of land which was distributed among the male members of the community through an internal agreement among them (General Assembly). Comuneros who arrived first to the community received more lands, an average of 30 ha for agricultural purposes and 60 ha for pasture. Today average land holding in Laguna-Raya is below of what was established by General Assembly, mainly because of population growth, so people who arrived later to the community received less lands because of the less availability of them. In Santa María, the first colonists who arrived in the area took the land they wanted, and as part of the colonization process after some years working these lands they claimed them to the Agricultural Ministry. Here people who arrived first found more available lands, so they had the possibility to claim larger homesteads. Today the average land holding in Santa María is 49.3 ha. so significant differences were found between the amount of land possessed in the native and colonist community.

### **Agriculture**

Land use systems practiced by small farmers in the study areas involve the traditional farming patterns of the Yanেশা and the adoption of local farming patterns and the adaptation of their own past experiences in the case of the colonists in the colonist community. The majority of householders practice some form of polyculture. Now farmers have fields in uplands and in riparian zones, and agricultural practices and crop

choices differ between these two land types. Upland soils are infertile and when exposed are susceptible to leaching and erosion; riparian zones, because of the input of nutrients carried by water, can be used for production of more nutrient demanding crops.

In Laguna-Raya and in general in the Palcazu valley, Yanesha agriculture is for subsistence. It is restricted by the lack of land in floodplains and thus depends on the use of abundant but poorer upland soils. Smith (1982) notes that Yanesha household members plant up to three separate gardens per year: a small one (less than ¼ ha) planted with beans, a second one (up to 1 ha) planted with corn, banana, peanut, and taro on riparian zones, and a third one (1-2 ha) is planted with manioc on uplands. The smaller field may have disappeared from use, since informants in Laguna-Raya did not report it.

Agricultural production is basically for subsistence in both communities because this is a remote area far from markets and the costs of transportation are high. Some authors (Padoch and de Jong, 1995, Bedoya, 1995, and Sierra, 1999) indicate that natives clear smaller areas than colonists because of less accessibility to the market, so they produce mainly for subsistence. But in this case, as Sierra (1995) found, the strategies of use of resources by natives and colonists respond to the relative value of alternative activities and situations over time.

### **Agriculture in riparian zones**

According to the Yanesha natives from Laguna-Raya, riparian zones or “cementeras” extend from the edges of rivers until the high mark of water; there is not a specific distance from the edge of the river, but they are inundated zones (approximately 100 m of width) and these appears to be no further classification of riparian zones. For colonists in Santa María, riparian zones are beaches and the edges of rivers.

Richard Smith’s impression is that traditionally the Yanesha did not use riparian zones very much. In 1967 when he first entered Loma Linda, he saw a lot of forest along the Palcazu river. For Smith the Yanesha settlement pattern was not to be close to rivers, it was to look for some hill and build his house there, and below it establish his chacra growing mainly manioc and corn. The Yanesha with easy access to rivers built temporary huts on beaches during the summer for fishing, and probably they grew some fast-growing crops such as beans and peanuts (Personal communication, May 2001). However Bradley Bennett (Personal communication, November 2001) says that traditionally natives in the Amazon use riparian zones, so further research with respect to this needs to be done.

Today not all people in both communities have access to riparian zones; this does not mean necessarily that all these comuneros have riparian zones in their lands. In Laguna-Raya there are communal riparian zones accessible to every comunero that ask for them, generally for people who settled in Raya later and they did not have access to them in their parcels. In Santa María case, all colonists with access to riparian zones have had this access since they settled in the community.

Comuneros in Laguna-Raya have an average length of river in their properties of 315 meters, this is because the first settlers in the community by general assembly decided that their properties should have 300 meters along rivers. In Santa María, the average length was almost double that in Laguna-Raya, resulting in significant differences between these two communities. This difference is due to one person in Santa María who has 3,000 meters of river front on his property. I considered 3,000 as an outlier and dropped it. The new mean for Santa María was 489 meters and in this case there are not significant differences in length of river between these two communities. The length of river is important because it is a measure of riparian zone availability but topography is also important, and Laguna-Raya presents a flatter topography than Santa María.

In both communities a great percentage of people leave a fringe of trees as protection of their lands in riparian zones. Here again there was an outlier value in Laguna-Raya data, and excluding it the new mean of protection fringe is 19.32 meters. People in Laguna-Raya leave a fringe of protection. The ethnographic research revealed that the General Assembly of the Laguna-Raya community had at an undetermined time in the past agreed to leave a forest fringe of 50 meters as protection (variable according to personal communications) along rivers, and beyond this fringe they establish their chacras of 25 to 50m long. Through social learning, comuneros understood the importance of leaving a fringe of protection; they also reported having heard about the practice from agronomists who have visited the place. According to law, land owners with properties close to rivers must leave a fringe of trees in riparian zones as a way of protection; the title of property states that the owner must leave a 50m wide strip, but some people in Santa María do not leave this width because in the last flood (1996) the river took part of their riparian zones (the river floods each 10 years, more or less 10 m).

Beyond the protection fringe in riparian zones, people in both communities establish their chacras. Riparian zones usually are much smaller areas physically as well, limiting the use to which they can be put. Although the Yanasha are traditionally said to not use riparian zones for agriculture, the Yanasha who settled Laguna-Raya apparently showed a preference for clearing lands in the riparian zone from the first settlement. Possibly the conversion to Adventism influenced some of their other cultural and agricultural practices.

Staver (1989) affirms that riparian zones are scarce in the Palcazu valley and most Yanasha community families there have a parcel from 1 to 5 ha in these areas. These ranges are between the ones found in my study (Table 2). Significant differences exist in the area of riparian zone under use between these communities. The reason for larger areas used by colonists is that they have a greater length of river in their property and for that more availability of riparian zones than comuneros.

Comparing the percentages of crop producers in riparian zones between these communities, I found no significant differences among the majority of these crops, however significant differences were found in the percentages of producers of beans and

peanuts between these communities. These differences are because Laguna-Raya riparian zones are flatter than Santa María riparian zones, and they are more appropriate for the cultivation of beans and peanuts which require sandy soils. In both places, people mostly produce in riparian zones for consumption. For the comuneros the most important agricultural production is in riparian zones because there people can sow subsistence crops, which are important sources of protein, vitamin and minerals, and provide variety in their diet. Also they are important crops for feeding poultry (such as corn).

According to Salick (1986) the distribution of crops in riparian zones in both communities, is because beans and peanut require the most fertile and fine soils, and they are sowed in riparian zones, close to the edge; corn and plantain are susceptible to aluminum toxicity, and sensitive to low pH and flooding, so these crops are limited to low lands or rich places in uplands. Manioc is a tolerant crop with wide distribution, however because it is a root and easily damaged by water it is cultivated farther from the edge. Pituca requires good and well-drained soils. Ph, aluminum, and nutrient compositions of riparian zones soils explain the concentration of crops that demand nutrient and are sensitive to pH/Al.

Members of both communities recognized the importance of riparian zones as a component of the landscape. Stronger communal structure in the native community results in a greater respect of buffer zones and awareness of their ecological value. All the comuneros in Laguna-Raya consider that riparian zones are important for protection of their lands and because of soil fertility. They said they learned this through experimentation, because their grandparents cut forest in riparian zones and later they realized that when the river rose it took part of their lands. Their parents and also professionals who were working in the place told them that it is a good practice to leave a fringe of forest as protection of their lands. For the colonists, most of them are aware of the importance of riparian zones because professionals told them and because by law it is established that they have to leave a fringe of 50 meters of forest, so formal education is not a factor that leads to conservation of riparian zones in these communities.

A basic conclusion of this research is that there is not a significant difference between indigenous and colonist households in these two communities with regard to riparian zone land use. Statistical tests showed that riparian and non-riparian zone land use practices in both communities are similar; only significant differences were found in the percentage of protection fringe forested, in the area of riparian zone under use and in the importance of riparian zones for the householders.

In the Palcazu basin, indigenous peoples in Laguna-Raya appear to have utilized the river's edge from a very early period. There are some reports that indigenous peoples in this area did not traditionally use riparian zones for agriculture, preferring upland areas. However in Laguna-Raya these converted Adventist Yanesha do appear to have shown a preference from the beginning. Recent colonists also showed a strong preference from the beginning for establishing agricultural plots in riparian zones, progressively transforming riparian forests into agricultural fields.

Contextual circumstances in both communities are similar and markets are distant. My research also suggests that there is nothing inherent in the culture of either Yanesha peoples or colonists that leads them to open more or less agricultural land.

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