

# Learning about Trees in a Quechua-Speaking Andean Community in Bolivia

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Citation: Bentley, Jeffery W. & Jorge Valencia 2003 "Learning about Trees in a Quechua-Speaking Andean Community in Bolivia," pp. 69-134. In Paul Van Mele (ed.) *Way Out of the Woods: Learning How to Manage Trees and Forests*. Newbury, UK: CPL Press. 143 pp.

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## Acknowledgements

This study has been commissioned by the FAO Forests, Trees and People Programme, Community Forestry/FONP, Rome, Italy. The Swiss Development Co-operation (SDC) contributed to the publication of this study through the Technical Support Group to the Global IPM Facility run by CABI Bioscience.

## 1.1 Background

### 1.1.1 Country and Area

Bolivia, Department of Cochabamba, Province of Tapacarí, Community of Apharumiri

**Altitude:** 2,660 meters above sea level (on the river) to 3,484 meters (Patiño 1987)

**Rainfall:** 660 mm; 570 mm falls during a 5 month rainy season (Deheza *et al.* 1986)

**Mean annual temperature:** 11° C (Deheza *et al.* 1986)

### 1.1.2 Profile of Forest Users

#### Wealth and land tenure

Most families own 3-4 small adobe houses, with electricity but not running water. Fixed capital is limited to 20-30 goats and sheep, a pair of oxen, a horse or donkey, some chickens, guinea pigs and home-made wooden tools. The diet includes potatoes, grains, vegetables, some eggs and little meat or cheese. Wealth differences within the community are slight; all households benefited from the 1970s land reform. Land is owned by the community as a whole, administered by the *sindicato*, a farmers' union established in Bolivian villages after the 1952 Revolution, so workers could run the expropriated haciendas. Each of the approximately 50 families in Apharumiri has use rights to irrigated land near the river, and to rain-fed wheat fields.

#### Size of farm and farming system

Each family has about half a hectare of irrigated land in the **pampa** for potatoes, maize, broad beans, carrots, and onions. In the village or **llajta**, just above the main canal, each family has a small house site with corrals, fruit, timber, and haystack trees (Box 0-1). A typical household has 2-3 hectares of rain-fed fields planted in wheat and oca (*Oxalis tuberosa* Molina)—a tuber. Farmers plough with oxen and fertilise fields with goat dung. Few use pesticides or chemical fertilisers.

#### Tenure and management of the forest

The community (*sindicato*) owns several hundred hectares of *monte*, the remnant semi-arid native forest away from the village on the canyon walls, where villagers graze livestock and cut firewood. The *monte* is dotted with small wheat fields (about 2,000 m<sup>2</sup> or less); most fields have one or 2 shade trees in the middle of the field where oxen and people can rest. The *sindicato* manages the willow trees on the **pampa** that help keep the river out of the irrigated bottom lands.



FIGURE 0-1 BOLIVIAN GIRL TENDING GOATS. GOATS ARE IMPORTANT FOR MANY PRODUCTS, ESPECIALLY THEIR MANURE. WOMEN AND GIRLS SPEND MORE TIME HERDING, AND ARE MORE KNOWLEDGEABLE ABOUT GOATS' HABITS.

### 1.1.3 Brief History of Autonomous Knowledge Generation in Apharumiri

There have been at least 3 initiatives: 1) The local generation of folk knowledge (ethnobiology). 2) Since about 1900, local people have built rock walls and planted trees to protect and enlarge river beaches of prime farmland. 3) From 1985 to 1997 the Bolivian Forestry School and the German Forestry Mission introduced new tree species, planted a pine-&-eucalyptus grove and taught people in Apharumiri to make nurseries.

### 1.1.4 Institutional Context

Each of the 3 initiatives outlined above has a unique institutional context: 1) Local knowledge is acquired spontaneously as people work and play, and does not involve outsiders. 2) Building new lands is managed by the *sindicato*. Since 1985 the *sindicato* has received help from institutions for buying the cement to make the walls: the German Forestry Mission (1 year), CIDRE—a local NGO (5 years), Food for the Hungry International (FHI)—with funding from USAID (6 years). Since 1999, the mayor's office in Tapacari has paid a 20% counterpart for the cement. 3) The German Forestry Mission (1985-1995) and the Forestry School (1985-1997) no longer work in Apharumiri, but locals continue some of the practices.

## 1.2 System and Characteristics of Knowledge Generation

### 1.2.1 Institutionalisation of Knowledge Generation

The guidelines for this study assume that a community has an active, knowledge-generation activity. Apharumiri seemed like an ideal case. German and Bolivian foresters had worked there intensively for 10 years. Since the foresters left, 6 years before the present study, foresters had not visited the community. In previous experience, we have found that rural people often experiment on their own (Bentley and Andrews 1996). Our hypothesis was that the people of Apharumiri would have conducted several interesting experiments on their own, using concepts and new tree species introduced by the foresters. We hoped to document these experiments and the new knowledge they generated. This was to be made easier by the fact that one of the authors (Valencia) was the last forester to live in the village (a 2-year stay). We were quite surprised to learn that in fact, the local people had done little experimentation with the new concepts (although they had continued to make nurseries for institutions, and had planted some new trees, mostly eucalyptus). Planting a bit more eucalyptus is only an experiment in the most generous sense of the word.

Given the low level of experiments, we have chosen to describe the local generation of ethnobiological knowledge about trees, which should be interesting because most communities have trees and knowledge of them, so the processes we describe here can be compared to those elsewhere. We also describe a case in which the people of Apharumiri manage trees to conserve soil, and have incorporated outside institutions in that process. Unfortunately, this may be a bit confusing for the readers, who expected a more straightforward case of local people experimenting with forestry. We think there are still some insights to be gained, from the following 3 cases:

1. Traditional ethnobiological knowledge about trees, and how it is generated.
2. A local plan to manage trees to manage farmland, generated over several generations by local people, recently incorporating outside donors.
3. A formal infusion of new knowledge and new tree species, which we expected would have led to further, spontaneous experiments conducted solely by local people. Some modest experiments were performed.

#### Folk knowledge is experiential

“Half an hour after the goats ate the wilted leaves of the **lluq’i**<sup>1</sup> (*Kageneckia lanceolata* Ruiz & Pav.) tree, we could hear goats scream. They soon died and as we butchered them, their hair fell out. The lining of their stomach had been burned off. When we tried to eat the meat, it had a bad taste. We have found that the fresh green leaves of **lluq’i** are not poisonous, nor are the very dry leaves. But if we cut a **lluq’i** tree, and a day or 2 later the goats eat the wilted leaves, they die.”

Three different people in Apharumiri described the above scene. The details were vivid and explicit, obviously based on personal experience. In each case, they had cut a large **lluq’i** branch to work it into a tool handle. They had not meant to leave the leaves within reach of the goats. Later they had talked about the experience with their parents or grandmothers, but personal experience was more important than the words of elders.

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<sup>1</sup> We write Quechua names in bold and Spanish terms in italics. Words of mixed origin are italicised and in bold.

### **Sacred knowledge**

Sacred knowledge, on the other hand, is passed on from one generation to the next. The molle (*Schinus molle* L.) tree has several ritual uses. Molle branches and leaves are used for the bowers of weddings “so the couple will never separate, just as the molle is always green and never loses its leaves.” People said their fathers taught them to leave an offering of cigarettes, coca and molle leaves, wrapped in a handkerchief and placed under a rock for the Mother Earth (*Pacha Mama*). Farmers leave this offering on the threshing floor in the *monte*, when they load the winnowed, bagged wheat onto the backs of donkeys. It is a way of thanking the Earth for the harvest and insuring that future harvests will be good. This is the exception that proves the rule. Since the spiritual world is not as amenable to direct observation as the material one, spiritual and ritual knowledge must be passed on from one generation to the next. On the other hand, much of the information about the natural world (e.g. which wood makes the best fires) can be learned fresh by each generation. These ritual practices may actually be eroding, rather than being generated. Most people who told us about them were shy about admitting that they practised them. They told us that their *fathers* had made offerings to the *Pacha Mama*. One older man told us that all but the youngest people still make an offering of molle leaves on the threshing floor, but were reluctant to admit it.

### **The *sindicato* manages the building of new walls and the planting of willow**

Every year during the dry season, the community builds one more wall in the river bed. The *sindicato* meets to decide when and where to build it. They dig an enormous hole, through hard-packed rock and gravel, by hand, 3 meters deep, 2 meters wide and 25 meters or more long, and gather the rocks. If possible, the community induces an outside institution to buy the cement. Otherwise, the local men gather limestone and fire it into lime, in a wood-fuelled kiln. After several years, there is a long enough line of walls to add a new strip of beach to the **pampa**. When the river floods in November, December or January, the men guide the muddy waters behind the walls, where the silt settles, forming a meter or 2 of new soil. The *sindicato* plants trees behind the wall. Everyone recognises that the *sauce* (willow, *Salix humboldtiana* Willd.) grows a thick clump of roots “like hair” that eventually helps stabilise the stone walls.



FIGURE 0-2 THE PAMPA AS SEEN FROM THE VILLAGE PROPER. THE RIVER IS BEHIND THE ROW OF TREES. ALL OF THIS LAND IS MANMADE, FROM THE SHADOWS IN THE FOREGROUND, TO THE OLD WILLOWS IN THE BACKGROUND, TO THE ROW OF EUCALYPTUS BEHIND THEM. THE KNOWLEDGE OF HOW TO MAKE NEW LAND IN THE RIVERBED WAS PERFECTED OVER THE PAST 2-3 GENERATIONS, BY LOCAL PEOPLE.

### The community picks and chooses from formal forestry knowledge

After some 12 years of experience with foresters, little of that information has proven relevant. People in Apharumiri had been planting **urqu kalistu** (*Eucalyptus globulus* Labill.) on canal banks for as long as they can remember, but “the foresters brought a lot more,” and encouraged people to plant it on field edges of new river beaches. By the late 1990s, the *sindicato* decided that the 10-meter strip of land behind the oldest wall of willows could be planted in eucalyptus. That strip had been held in common, by the *sindicato*, but the men decided that they would take better care of it if they split it up. Each household got a little plot about 10 x 20 meters, at the edge of the **pampa**, behind the large, old willow trees. They could either plant trees or leave it in natural vegetation, but they could not plant crops on it. About half of the men planted eucalyptus on their strip, but no one has planted any other trees.



FIGURE 0-3 VÍCTOR CHINCHILLA SHOWS THE AUTHORS THE 10 METER WIDE STRIP OF EUCALYPTUS BEHIND THE DEFENSIVE WALLS ON THE RIVER.

### 1.2.2 Access to and Relevance of External and Internal Technical Knowledge

#### Locals say they need a resident forester

“To teach us the names of new trees,” although this is probably an exaggeration. It is more likely that the community liked the foresters (who were nice, friendly people) in part because it meant having access to an institution that brought material benefits. For 10 years, the Forestry School sent a dump truck and a crew of students to Apharumiri to help gather rocks for a week, for that year’s river wall. The foresters taught the local people to make tree nurseries, but the villagers now only make nurseries if an outside institution (like FHI) commissions them to do so. Locals say that they like the little black plastic bags (for planting tree seedlings) that the foresters taught them to use, but only bags if an institution (like FHI) buys them.

During our visit in July, 2001, the people of Apharumiri demanded information on the control of diseases in fruit trees (especially peach), and the control of the blue gum borer in eucalyptus (discussed below). They also expressed interest in growing more eucalyptus trees in the **pampa**, and more native trees in the village proper and in the *monte*. But there are no longer any formal links between the community and the forestry school. Some community members still visit the last

resident forester, Jorge Valencia, at his home in Quillacollo, near the city of Cochabamba, but these visits become fewer every year, and are personal i.e. not to ask about forestry.



FIGURE 0-4 FORESTRY NURSERY IN APHARUMIRI

### Relevance

Certainly some of the new knowledge is relevant. Three or 4 people have planted molle seedlings near their homes. In the rainy season of 2000-2001 the river changed course and gouged out part of one of the new sections of **pampa**. Early in the year 2001 the community planted trees<sup>2</sup> where the land had been washed away (and in the bed of the Pucara River, which drains into the Tapacarí at Apharumiri. They did this to protect the exposed cropland, using seedlings they had reared in 2000 as part of an FHI project. On the other hand, much of the new, formal knowledge has been irrelevant to community members. Foresters induced local men and women to plant a grove of eucalyptus and pine (*Pinus radiata* D. Don), both introduced species. But the grove is several kilometres away, at the crest of a steep mountain. It was chosen to be far away from goats which would have eaten the little trees. But now that the trees are immature, villagers are totally

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<sup>2</sup> Retama (*Spartium junceum*), ceibo or **chilijchi** (*Erythrina falcata*), aliso (*Alnus acuminata* H.B. & K.), willow (*Salix humboldtiana*), molle (*Schinus molle*), **chhina kalistu** (*Eucalyptus camaldulensis* Dehnh.), **urqu kalistu** (*Eucalyptus globulus*), and *Atriplex* sp.

uninterested in them, because the trees are too far away to be harvested. The foresters introduced a few species of other trees in Apharumiri

- **Tipa** (*Tipuana tipu* (Benth.) Kuntze)
- *Retama* (*Spartium junceum* L.)
- *Ceibo*, or **chilijchi** (*Erythrina falcata* Benth.)
- Brachichiton (*Brachichiton populneum* (Schott & Endl.) R.Br.)
- **Sawsaw** (*Tecoma stans* (L.) Kunth)<sup>3</sup>
- *Jacarandá*, or **tharku** (*Jacaranda mimosifolia* D. Don)
- *Pino silbador* (*Casuarina equisetifolia*) (coast she-oak)

The men who collaborated most closely with the foresters showed us those trees. Only one of the men could remember the names of the trees, and neither showed any interest in them. They had not noticed anything interesting about them in 10 years.

### Men and women know slightly different things

There are no occupational specialities in Apharumiri: no storekeepers, blacksmiths, ritual specialists etc. All men learn to cut trees or branches and work them into tools; the most difficult one is the ox plough, and most men only learn to make it well after they are mature. Girls and women spin and weave, and also tend to spend more time herding sheep and goats, and so although men know which tree and shrub species goats eat, the women seem to know them better. For example, men and women told us that if goats eat the leaves of the **japa japa** bush, the animals go blind. But the women added that if it rains, and the goats walk under the wet **japa japa**, the leaves will burn the goats' hide. The men told us that goats ate the small, green leaves of the **alqu thaqu** (*Acacia macracantha* Humb. & Bonpl. ex Willd.), which surprised us, since the shrub has such long, sharp spines. The women clarified the issue: goats do eat the leaves, but many injure their mouths on the thorns while eating. Still, there is a large overlap between men's and women's knowledge. Men know which wood makes the best firewood, but there are slight rhetorical differences. Men told us which species were "useful as firewood" (**sirvin llant'apaj**) while the women tended to say that such-and-such a wood "burned well" (**sumaj lawran**), reflecting that the women spend more time actually cooking than the men do. The women could easily name the species of trees used to make hand tools, although it is the men who work the most with those tools and hence they could describe those trees in more detail. Again, these cases illustrate how folk knowledge is built by the personal experience of work.

### 1.2.3 Characterising the Knowledge Generation System

#### People learn about practical, easily observed topics

The first thing that people told us about every tree, shrub, vine, herb, or grass was whether or not goats would eat it. The goats are gradually eating what is left of the forest on the steep slopes away

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<sup>3</sup> Although, during fieldwork for this report, locals said that there were wild populations of this species on the canyon walls above the village, and that people wove baskets from the plant.

from the village. People collect the manure in corrals for fertilising fields, especially in the high-value, nearby **pampa**. People told us that manure for agriculture is the most important product from goats. People also told us which other livestock would eat the plant, whether it was useful for firewood or for making tools, roof beams, lumber or lintels (see Appendix 5A). They also told us which trees could be deformed into haystack trees.

#### BOX 0-1 HAYSTACK TREES (KALCHAS)

In Apharumiri, fodder is scarce, and crop residues (mostly dried maize stalks) must be stored away from the goats, to save them for the oxen. Trees are useful places for keeping things away from goats, but trees are not, by nature, shaped for holding large amounts of straw and stalks. The people in the semi-arid valleys of Bolivia mould young trees into **kalchas**, living haylofts with the branches spreading out and up, like a cradle, like fingers on an out-stretched hand. The most suitable species are **mulli** (*Schinus molle*), **thaqu** (*Prosopis alba* Griseb.), **jarka** (*Acacia visco* Lorentz ex Griseb.) and **tikira** (*Schinopsis haenkeana* Engl.), because the wood is strong and the trees can be shaped. First, a person finds a young tree on his or her house-site or near one of the family wheat fields. When the sapling starts to branch, the person leaves a small bundle tied into it, forcing the branches to spread out, instead of up, and bending the trunk at an angle. Every year a larger bundle of maize stalks is placed in the branches, until the canopy is splayed out almost flat, and the trunk is bent and easy for a person to climb.

#### People also learn about pain and death caused by trees

Besides the example of the poisonous **lluq'i** tree, one woman told us that wilted peach leaves were toxic to livestock. People have also observed the “nests of caterpillars” (**sika thapas**) (actually egg cases and pupa cases) in molle and **thaqu** (*Prosopis alba*) trees. By accidentally touching the urticating hairs of these Lepidoptera larvae, people have learned that they are quite irritating to touch, especially the caterpillar in molle (**mulli sika**).

#### People do not learn about things that are difficult to observe

Although the people of Apharumiri can easily identify caterpillars with stinging hair, the locals deny that the creatures hatch from eggs laid by butterflies. One man suggested that the caterpillars came from the urine of cicadas (**t'isikira**), because the **sikas** appear about the time when the cicadas disappear. When the caterpillars pupate, the villagers think they have died.

#### Epiphytes and lichen

The people of Apharumiri are well aware of the other organisms living in trees. They know that the clumps of Spanish moss (**chuchuruma**) are the same kind, no matter which tree they grow in. But there are different types of **jamillo**, parasitic plants which people know “graft themselves” into the trees. **Thaqu** has a **jamillo** (*Tristerix penduliflorus*) with a yellow flower. Molle has a **jamillo** (*Phrigilantus cunaecifolius*) with a red flower, and that **jamillo** can be dried, burned to ash and mixed with boiled potatoes for making an ash cake (**llijt'a**) used to chew with coca leaves. Lichens and mosses are abundant on tree bark, but people dismiss them by saying that it is “tree bark” (**sach'a qara**), “just bark” (**qaralla**) and that trees get like that “when they are old” (**machuxtin**).

### Contempt for birds

Quechua-speaking people feel contempt for small birds. When we told one man to tell us about things that lived in trees, he answered (jokingly) “even the birds in their nests?” He was surprised when we said yes. People would dismiss a plant by saying “only birds eat it its seeds” (**mujun p’isquslla mikhunku**). People in Apharumiri have cut down some of the trees still left in what was the forest, specifically because wild birds were attracted to the trees. The men said the birds ate the ripening grain in nearby wheat fields.

### Pests and diseases

Besides the caterpillars mentioned above, people told us about a few other pests and diseases, collectively called **unquy**. The most important of these they called by the Spanish name *polvillo*, meaning “little powder”. By their description (we could not see it, because we visited the community during the dry season), *polvillo* labels various fungal diseases as well as aphids in peach, apple, grapes, fig, broad beans and other plants. People were not sure why the disease appears, “it just appears” (**rikhurinlla**). *Taladro* (drill) is considered a pest in eucalyptus. It is probably the blue gum borer (*Phoracantha semipunctata* (Fabricius)), a cerambycid beetle. People know that the borer is a small creature (**khuru**); they are not sure if it spends its whole life in the tree or if it migrates from the ground. Locals are not aware that the adult is a beetle. **K’asparilla**, or **k’asparillo** (from the verb **k’aspay**, to singe) refers to the burned appearance of black, necrotic tissue on any tree (especially fruit trees) or crop (especially broad bean). People said that it is caused by humidity, especially by rain or heavy irrigation, followed by sunny weather. Villagers were concerned about these 3 tree health problems, but expected us to tell them “what we can spray them with?” (**imawan fumigayku**) (see Appendix 5B).

### Pest control

People in Apharumiri make little or no active effort to control pests in trees, even fruit trees. One reason is that each family has only a few fruit trees, mostly peach. People in Apharumiri use fewer pesticides on row crops than do farmers in other communities in the Andean valleys of Bolivia. Perhaps the main reason for this is that they grow few potatoes here (they grow a few irrigated potatoes on the **pampa**, but the *monte* is too warm and dry for potatoes to thrive). In other communities farmers apply chemical fertiliser, fungicides (for late blight, *Phytophthora infestans*) and even insecticides on potatoes. In Apharumiri, people apply hearth ashes to bushes of hot peppers (*Capsicum* sp.) for the control of an insect described as a “black grub” (**yana laqatu**) and to discourage a bird (local name *coquero*).

## 1.2.4 Effectiveness of Knowledge Generation

### Expected impacts are pragmatic

In 2000-2001 FHI brought black plastic bags and tree seeds and paid people in Apharumiri to collect mulch from under wild trees (e.g. *molle*). This was part of a formal project between FHI, the community and the mayor's office of Tapacarí to make a nursery for tree seedlings which FHI would donate to various communities, not just to Apharumiri. The people of Apharumiri planted their donation (several hundred individuals of *Spartium junceum*, *Erythrina falcata*, *Alnus acuminata*, *Salix humboldtiana*, *Schinus molle*, *Eucalyptus camaldulensis*, *E. globulus*, and *Atriplex* sp.) in two places on exposed river beds, where the river erodes farmland. The intention is to prevent the river from eroding more land.

During the stay of the foresters in Apharumiri, they tried to plant a few molles near people's homes, but the seedlings died. The foresters also taught people to make a mixture of sieved soil, wild tree mulch and animal manure to plant tree seeds. In 2000-2001, when local people made nurseries for FHI, they noticed that molle often sprouted in the black plastic bags, from the molle seeds present in the wild mulch. Perhaps 3 or 4 people have taken a few molle of these seedlings and planted them at home, or on canal edges. The expected impact is "for shade, so the women can sit under the trees while they do their weaving."

In the late 1980s a boy watched the adults planting several thousand eucalyptus trees above the village. When his father brought home 10 seedlings from the worksite, the boy went home and imitated the grownups as he played, digging little holes around the house, and planting the 10 seedlings. In the year 2001, the trees that boy planted as play are now tall and healthy, while the trees the adult planted were all long dead. The villagers now realise that this is because the trees the boy planted were in moist soil. Trees planted on the hillside will not survive without water. Children learn about insects while they play (Nazarea-Sandoval 1995), although this is one of the first cases we have seen where adults may also learn from children playing.

***The above expectations are not significantly different user by user.***

### **The criteria for useful new knowledge are: food, shelter, fuel, but especially money**

Of the new forest species and practices, the only one being adopted spontaneously is the increased planting of *Eucalyptus globulus*. Although people appreciate eucalyptus for its timber and firewood, locals mainly discussed it in terms of something to sell. People said that the grove of pine and eucalyptus (which foresters encouraged them to plant on a distant peak) was useless, even though the trees were growing straight, tall and pest-free, because the trees were too far from the road to harvest for sale. Another man showed us a tall, mature eucalyptus he had planted as a boy. "I wish I had planted 30 more, now I could sell them for a lot of money." Another day we sat on the edge of the **pampa**, watching a truck, laden with eucalyptus logs, creeping along the river bed towards the city of Cochabamba. Two farmers stared at the logs and said "if we had lots of large trees like those, we could sell them and have lots of money. That's why we want to plant more trees."

### **Required environment for joint learning**

There must be a local demand and a supply of outside knowledge (see Table 0-1). The local, ethnobiology of trees has generated much knowledge about using them. The local initiative to build new land, incorporating outside institutions has also incorporated trees (willows, but also eucalyptus, **ch'illka** and **luyu luyu** and others). The formal forestry initiative introduced nurseries and more eucalyptus. In spite of these successes, there are still several unmet research needs in Apharumiri. The most important one is that rural people want more native trees on the slopes above the village. The foresters made some effort to plant irrigated molle near the village, with little success. Most foresters work with a limited tool kit (pine, eucalyptus, a few other species). The foresters made no effort to plant native species on the dry slopes, and no effort to manage health problems of fruit trees. Both of these topics were important to local people, and they may have collaborated in research on them. If foresters had worked on these topics, local people may have continued working on them on their own, the way that many people have planted eucalyptus, and a few have continued trying to plant molle on irrigated land.

Some of the new species that the foresters did introduce seem irrelevant to the local people, and there has been little continued local experimentation with them. One reason that people have expanded eucalyptus plantations (an innovation, if not experimentation) is that the trees are not only

useful, they are *fast growing*. After seeing how fast the eucalyptus seedlings from nurseries grew, several other people began planting them. Víctor Chinchilla recalls how one neighbour mocked him for planting eucalyptus, saying "are we ever going to see those trees?" When the trees grew large enough to use in 10 years, the neighbour also planted some.

TABLE 0-1 OVERLAP OF THE SUPPLY AND DEMAND OF KNOWLEDGE

Local Demand	Outside Supply	Outcome	Examples
YES	NO	Unfulfilled local expectations	Failure to plant native trees or to manage disease in fruit trees.
NO	YES	Irrelevant knowledge, no adoption	Introduction of new tree species for which local interest is limited.
YES	YES	Learning and behavioural change	Planting more eucalyptus, learning to manage seedbeds.

We propose that local experimentation may be stimulated by a local demand for knowledge, and an outside supply of information. If there is local demand, but no outside supply of new ideas, people may have little to experiment with. If there is no local demand for new ideas introduced by outsiders, local people will not be stimulated to do further experiments (see Table 0-1). In the case of Apharumiri, the technologies introduced by the foresters were either irrelevant (new, slow-growing trees) or were so mundane (eucalyptus) that people tried them, were satisfied with the results and began growing more. This kind of local trial and adoption may be considered an experiment in the broadest sense of the word.

## 1.3 New Knowledge Adds Value and Security to the Forest

### 1.3.1 Type of Value and Security

In previous sections we have described how there are 3 types of knowledge generation in Apharumiri:

1. Spontaneous generation of folk knowledge (ethnobiology) through experience.
2. A local initiative since 1900 to expand and stabilise river bottom lands with stone walls, willows and eucalyptus.
3. New trees and new planting techniques introduced by the German Forestry Mission and the Forestry School.

The last section dealt mostly with traditional ethnobiology, which addresses pragmatic themes, and is based on personal experience, mostly linked to work. The people of Apharumiri value trees for their natural products and for sale.

### Making new farm land, and keeping it with trees

The Tapacari River floods for 5 months a year, and is nearly dry for the other 7. The early twentieth century hacienda owners forced the Quechua people to build river-walls of rock and lime, to protect the remaining beaches. By the early twentieth century, local people were skilled at building walls in the river bed during the dry season, to force silty flood waters into the edges of the channel, and

trap the water there long enough for the mud to settle out, creating new soil. The hacienda of Apharumiri had 3 contiguous, artificial beaches (totalling about 28 ha), all made during the early twentieth century. After the Revolution of 1952, the freed workers continued to repair the walls and make new ones, to protect the **pampa** of reclaimed land (see Appendix 5C).



FIGURE 0-5 AN OLD SECTION OF THE RIVER WALL, WITH MATURE WILLOWS AND OTHER SPECIES ON THE PAMPA BEHIND IT.

### **Interaction with outsiders**

Ever since the Revolution, the Quechua people of the Andean valleys have been suspicious of outsiders, and afraid that the old hacienda owners, or their children, will return to take the land away. The village *sindicatos* are powerful enough to expel unwanted outsiders. In the early 1980s, a German Catholic priest, named Axel “Padre Alejo” Guerling, had settled along the river, learned to speak Quechua and gained the trust of the local people. In 1985 the Reverend Guerling befriended a newly arrived German forester, Albert Hosius, who was looking for a project site. The priest introduced the forester to the villagers. Mr Hosius helped the villagers buy 500 bags of cement, enough for one small river wall. But the change in attitude was tremendous. Villagers in Apharumiri and all along the Tapacari River realised that accepting cement from “gringos” did not mean losing their land. Other institutions (e.g. CIDRE and FHI) began to donate materials. The forester, Hosius, brought the Bolivian national Forestry School to work with Apharumiri, and although the foresters donated no more cement, they did bring in a dump truck and students once a year to help make walls.



FIGURE 0-6 THE MEN OF THE APHARUMIRI SINDICATO DIGGING A NEW FOUNDATION HOLE FOR A RIVER WALL.

### **Villagers value agriculture more than forestry**

In 1987 the men of Apharumiri flooded the river bed behind the new walls with muddy water, and quickly built up a layer of new soil about a meter deep. The forester, Mr. Hosius, had said all along that the new land would be for planting forest trees. But once the land was formed, the *sindicato* met there, on 4 new hectares of prime bottom land. The farmers argued that they wanted to plant crops on the new land, not trees. “Are we going to eat eucalyptus?” one man asked. The German forester graciously gave in. As a compromise, he suggested that they plant a row of eucalyptus trees around each family’s new field, to mark the boundary. The community accepted the suggestion. Planting eucalyptus around the field edges was a kind of experiment: on older parts of the pampa, most individual fields are separated by bunds, not by hedges or trees.

### **A formal experiment that failed**

Each year, the community added a new section of a wall, until they had enough new river walls to add a second new strip of land, which they divided among all the families. Instead of planting a row of willow, as was their custom, the foresters convinced the people to plant a complex network of 3 rows of mixed species of *álamo* (poplar *Populus deltoides* Bartram ex Marshall), *saucé* (willow *Salix humboldtiana*) and *retama* (*Spartium junceum*). The villagers did this, but in the 2000-2001 flood season, the river overran the defensive walls and gouged out most of these new trees, and part of the new

strip of land. These 3 rows of trees, that washed away, were a kind of failed, formal experiment, introduced by foresters but with community participation. In spite of the disappointment of seeing the land with these trees wash into the river, the villagers continued to experiment in other ways. 1) Planting eucalyptus along the edges of the new fields, as plot boundaries. 2) Planting hundreds of new trees in the riverbed, where the new **pampa** washed away, using seedlings from the FHI nursery.

### Modest experiments with trees

The people of Apharumiri began to appreciate eucalyptus almost as a row crop. Two men have planted small fields of it in the irrigated river **pampa**, and about half of the community planted small, private forests of eucalyptus when the *sindicato* divided the strip of land behind the old willow trees on the west side (the upstream side) of the half-moon shaped **pampa**. The villagers were delighted a few years later, when they had enough eucalyptus boles to build their own houses. They stopped buying timber from the city of Cochabamba. This case reveals several criteria for value and security:

1. The people of Apharumiri value farm land more than forest land. They value crops more than trees.
2. Forests (and trees) are valued if they can add security to farmland (in this case, physical security, preventing the river from washing out the bottom land).
3. Trees are valued if they can grow quickly and provide a product that people need.
4. The old willow trees were grown to stabilise the (artificial) river bank. These trees were managed collectively, by the village organisation (*sindicato*). Once people began to plant eucalyptus behind the old willows, they agreed to plant that land as individuals, because each family would keep the wood from the trees they planted.

### 1.3.2 Effectiveness of the Knowledge Generation System

Earlier sections describe how the traditional knowledge of ethnobiology allows villagers to use the remnant, semi-arid native forest for making tools, but mostly to feed the goats whose manure fertilises the man-made **pampa** along the river. It is as though the forest is a bank, and the people are drawing out its capital to invest in the farmland closer to home. The locals would not say it quite that way, but they know full well that there are fewer native trees every year, and they are not happy about that, but they do not see that they have any choice. They must feed themselves. The long-term local initiative to expand the land base with river walls and trees to stabilise them has been effective in meeting its goal.

The increased planting of eucalyptus has been so effective that local people have started planting eucalyptus in new areas. Formally, eucalyptus in Apharumiri was only grown along canal banks. Now it is being grown there, near houses, in 2 small fields on the **pampa**, as field boundaries on the newest fields, and on a 10-meter strip of land behind one of the old rows of willows, on the river edge. The community decided that this 10-meter wide strip of land should be converted from community tenure to individual control. The individual families were given a section of land behind the willows, on the river edge, to grow trees. Of 25 families with a piece of land on the strip, 3 planted eucalyptus in the mid 1990s, using seedlings from the Forest School nursery. Nine more families planted eucalyptus in 2000-2001, with seedlings from the FHI nursery. The others have allowed the land to grow in natural vegetation. This case shows that although the community is interested enough in eucalyptus to assign individual ownership to land for growing trees:

- People have planted their trees during the tenure of a project in the community: which provides the black plastic bags for the seedlings.
- Only a few people planted trees at first. The others have waited and seen how well the trees grew. Now about half of the community plants trees, if they have access to seedlings.

### **Locals want more trees**

When asked if the community could live without trees, one man said “If there were no trees, there would be no life. Besides, what would we cook with<sup>4</sup>.” Others emphasised the pragmatic, non-romantic view of trees. If one could wave a magic wand and reforest the native trees on the canyon walls above Apharumiri, the local people would be quite pleased to have a new supply of lumber, firewood and goat food. But the locals are at a loss as to how to reforest. They have tried. In about 1984, at the suggestion of the Reverend Guerling, the locals planted several thousand eucalyptus trees on the dry slopes above their village. The trees all died. The next year the German Forestry Mission arrived.

### **Effectiveness of new initiatives with trees per se**

After the German Forestry Mission gained local trust by helping build river walls, the Mission and the Forestry School began working with forestry *per se*. The School sent a young forester to live in the village and teach people to build nurseries, plant forest trees and learn about new tree species. The results have been uneven:

### **Nurseries**

The villagers describe in detail how foresters taught them to plant tree seeds in a medium of soil, ash, manure and forest mulch. Locals like to say that now they are foresters, and that no one collects eucalyptus seedlings from under trees anymore, because everyone knows how to plant and rear seedlings. It is true that many women and men have worked in the community nursery, and no doubt they do know how to run it. However, it is also true that the locals will not go to the expense or trouble of buying the black plastic seedling bags or of getting non-local seeds. In the year 2000-2001, FHI worked with Apharumiri to build new brick houses for 25 families, to build another river wall, and to make a tree nursery, for distributing trees to other communities. The villagers were happy to work in the nursery as long as FHI provided bags and seeds, and paid people to gather mulch from the (thin, remnant) forest. The locals even planted several hundred of the trees as erosion control in the river bed, where the river was starting to wash out the artificial **pampa**. But the people cannot be bothered to maintain the nurseries without outside help. They are not lazy. The same people get up at 3 AM to shovel a cubic meter of hard packed rock and gravel from the river bed to dig the foundation for a new wall, with no pay, whether an institution gives them cement or not.

One reason people do not experiment more with nurseries is that they will not buy the black plastic bags. Víctor Chinchilla described how, after the foresters left Apharumiri, he tried planting his own seedbed, in a broken, ceramic pot. Many eucalyptus seedlings sprouted, but when he transplanted them to the pampa, they died. He then bought seedlings, in black plastic bags, from someone else.

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<sup>4</sup> Mana sach'awanqa, mana kawsay kanchu. Imawan wayk'usayku?

### **The new forest in Ankhara**

In the 1980s, the foresters induced the people of Apharumiri to plant a small forest (perhaps 2 hectares) of eucalyptus and pine. The foresters and the people chose the spot of Ankhara, below a distant ridge, because it is so steep that even goats have difficulty walking there. Women and men worked hard, hauling seedlings to Ankara on the backs of donkeys. The trees are now large enough that some could be harvested for timber, if a timber crew could reach the site. Ankara is about a 2-hour walk from the road, a vertical climb of almost 1,000 meters. A person must be in reasonably good physical condition just to walk there, and the site itself is almost vertical. Ankara is now like some sort of practical joke: a beautiful forest of exotic trees, too remote and too steep to harvest, of no use for a people who have an eminently pragmatic view of the forest. Ankara may serve as an object lesson for other projects. New outsiders can be taken to Ankara to see how serious the community is about trees. However, most villagers have little interest in it. Some people in Apharumiri haven't seen the grove in years, and don't care.



FIGURE 0-7 THE FOREST PLANTATION OF ANKHARA (PATCH OF TREES IN THE CENTRE, ON THE HORIZON)

### **Introducing new tree species**

The 2 men who had worked most closely with the foresters were happy to show us the trees in Apharumiri. For each tree, the men knew the name, uses, harmfulness, diseases, and much other information. Their excitement died when we got to the little grove of trees in the village proper that had been introduced by the Forestry School. Only one of the men could remember their names.

Neither one could remember anything about any of the trees<sup>5</sup>. They stood before each tree for a moment, looking bored, and then passing on.

### The village agro-forest

One Bolivian forester told us “campesinos do not make forest initiatives on their own. They think of forests as things to cut down for firewood and to have land to plant something to eat.” The 3 earlier sections lend some support to that notion. But our second day in the field we noticed that each village, not just Apharumiri, was set in a small forest. For example, we stopped at the nearby village of Laqhiraya and asked a woman to name the trees in the village. She quickly listed 20 species of perennial plants<sup>6</sup>.

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<sup>5</sup> In 2001, one local man planted *retama* in his garden, and the community as a whole planted *retama* and some other new species (e.g. *Atriplex*) in collaboration with FHI. Two or 3 other local people tried to plant the native molle near their homes, with uneven success. So there has been some innovation, including the increased planting of eucalyptus, but forestry innovation in Apharumiri has been modest, at best.

<sup>6</sup> Willow (*Salix humboldtiana*), pacay (*Inga sp.*), peach (*Prunus persica* (L.) Batsch), fig (*Ficus carica*), prickly pear (*Opuntia ficus-indica* Mill.), molle (*Schinus molle*), **jarka** (*Acacia visco*), **thaqu** (*Prosopis alba*), **khiñi** (*Colletia spinosissima* J.F. Gmel.), **ch'akatiya** (switch sorrel: *Dodonaea viscosa* Jacq.), eucalyptus (*E. globulus*), **ch'illka** (*Baccharis salicifolia* Pers.), **t'iu**, apple (*Malus domestica* Borckh), lemon & orange (*Citrus spp.*), **t'isikiri** (a cactus), **phasakana** (a cactus, *Trichocereus sp.*) ulala (a cactus, *Eriocereus tephraanthus* Riccob.), **tisikira** (*Schinopsis haenkeana*).



FIGURE 0-8 THE 3 NAMED LAND USE TYPES. THE PAMPA IN THE FOREGROUND, THE AGRO-FORESTED LLAJTA (VILLAGE PROPER) IN THE BACKGROUND, WITH REMNANT FOREST OF THE MONTE ABOVE IT.

In Apharumiri, the slopes above the village are merely dotted with trees, but the village proper, the **llajta**, has so many trees that it hides many of the houses. People explained that in the village, they keep the goats in corrals, and do not let them eat tree seedlings. People plant a few fruit trees, especially peach, and at least one fellow is experimenting with lemon trees. Most native trees that sprout, especially molle, **thaqu**, and **jarka** are recognised and protected, especially if people think they may be able to shape one into a haystack tree or **kalcha**. One of the few native perennial plants that people usually destroy in the village proper is the **alqu thaqu**, because its long, needle-sharp thorns can hurt children. The trees in the village are valued for their products, and also for shade. Yet these people who like trees so much, who have received so much outside help and gone to so much trouble themselves to plant trees have still not developed an effective system for encouraging the growth of native trees in the *monte*, the remnant forest away from the village.

## 1.4 Factors for Effective Knowledge Generation

### 1.4.1 Why Local People Did Not Develop Formal Research in Forestry

#### **Hypothesis 1. There was no felt need for more knowledge**

This is only true to a point. While there is still enough vegetation left in the *monte* to keep the agricultural system from immediate failure, the locals do want more native trees on the arid hillsides (but do not know how to plant them). Local people desperately want solutions to certain pests and diseases (especially the blue gum borer in eucalyptus, and fungal diseases of peach and other fruit trees).

#### **Hypothesis 2. The main limiting factor is not knowledge, but leadership, capital, legislation etc.**

This study lends partial support to this hypothesis. A major limitation in Apharumiri was money to buy cement to make river walls to make more farmland. The positive experience with the German Forestry Mission in the 1980s led the way to a major social innovation, in that local people realised that outside donors had no intention of taking the land away. Villagers continue to work with other donors on river walls, tree nurseries and new housing.

#### **Hypothesis 3. The disciplinary gap: foresters offered a narrow range of technical options**

The foresters concentrated on plantation forestry, with little emphasis on pests and diseases, fruit trees or native trees. Some of the new techniques were not useful to local people. Foresters built a cottage for the resident forester and planted 1-2 individuals of some 8 species of new trees around it. These were of little interest to villagers, mostly because they were slow growing. The plantation forest at Ankharu was too remote to be harvested. Villagers continued to plant and tend tree nurseries, but only if outside institutions brought the seed, black plastic bags and then bought the seedlings.

### 1.4.2 Effective and Autonomous Knowledge Generation

#### **Local knowledge is based on observation**

Farmers insisted that they would tolerate few trees near crops, because the trees “suck the soil” (jallp’ata ch’unqan); i.e. remove the earth's nutrients (*la mejora*). Farmers said that molle and thaqu do not suck the soil, and their canopies are thinner, so they cast less shade, which also make them more crop-friendly. Molle and thaqu are the only trees farmers tolerate in a wheat field. When we asked farmers how they knew which trees improved the soil, they described observing how the fallen leaves of molle rotted when it rained, and how the crops were better if grown in tree mulch (sach’a wanu). Local knowledge is built up by individual experience and observation. But people also talk to kin and neighbours, so insights gained by experience are cross-referenced with the knowledge of elders and others.

#### **Important and easy to observe**

Traditional ethnobiological knowledge is deeper for phenomenon that are important (to the local people), and easy to observe, or at least possible to observe (Bentley and Rodríguez 2001). People in Apharumiri can name each tree, shrub, herb and grass that goats will eat, and can describe the plants

that kill goats and under what conditions. This is because of the importance of goats in the local economy, and the difficulty of finding fodder, hence people have scrutinised and discussed the interaction of goats with plants. For the more easily observed tree diseases, farmers offered explanations that are consistent with modern science; e.g., poplars can rot on the inside, and topple over, if too much moisture enters the trunk.

### **Not culturally important, but conspicuous**

Farmers told us of an insect, with no local name which cuts off branches of jarka (*Acacia visco*) as neatly as a saw. One man imitated the insect's signature sound "qhef, qhef, qhef." This beetle (a cerambycid) is not common enough to cause major damage of the jarkas, but villagers have noticed it because its natural history is "crying out" to be noticed (to misquote Berlin, 1992).

In contrast, molles in Cochabamba are infested with a psyllid, a small, scale-like insect living under a round, brown shield. The psyllids are noticeable, but do not look like insects. When Eric Boa and the senior author first noticed them, we wondered if they were a disease or even part of the tree. Most farmers in Apharumiri dismissed psyllids as "some disease, it just appears" (uj unquy, rikhurinlla). Yet one young man said that during the dry season, small, yellow creatures (khurus) emerged from the spots on molle and on thaqu. This is a perceptive observation, near the limit of what one can see with the naked eye. Unlike more important, more easily observed information, this item remained part of one person's knowledge, and did not pass into the community domain.

### **Farmer experiment**

The same young man mentioned that his mother taught him that goats would not eat young trees if they were smeared with cow dung. When he planted a few lemon seedlings in 2000-2001, the fellow modified his mother's recommendation, "painting" the trees with a one litre slurry of water and cow dung. He took the added precaution of building little fences of thorny alqu thaqu (*Acacia macracantha*) branches around the young trees. The goats avoided lemon and fig trees that were painted with cow manure,<sup>7</sup> but had snapped off the untreated ones.

### **Learning by working on a community initiative: new lands on the pampa**

For 100 years the people of Apharumiri have added new river-bottom lands onto the pampa. The people have learned to use cement, and to harness outside institutions to buy it. This is not an isolated case. Many communities are building river beaches, with and without institutional support, along the Tapacari River, the Arque River and the Río Chico, all tributaries of the Río Grande. Since 1952, Apharumiri added 3 new strips of rich soil to the east edge of the pampa. Suddenly dozens of old willow trees were no longer on the river wall, but were in the middle of productive farm land. The *sindicato* gave control of these trees to the nearest landowner. By 1985 most of these landlocked old willows were still standing, but were shading crops. In 1985 the villagers asked the foresters to cut most of the willows with chainsaws. Then the locals cut the trees into lumber with large handsaws (*corvinas*). One reason the villagers left the old trees standing is that the trees were quite thick, and difficult to work with hand tools. The villagers also liked the trees. Grown men remembered that the trees were once on the river bank, where they used to swim as boys. Even in

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<sup>7</sup> It is well known among pasture management specialists that ruminants avoid forage contaminated with animal faeces (Paul Van Mele, personal communication).

the year 2001, a few of the old trees were still left, in the middle of the pampa. Several lessons are clear:

1. Local people can manage a sustained, long-term project (e.g. land reclamation).
2. The main goal of the initiative was to acquire more farmland.
3. Trees can be incorporated into production agriculture.
4. The community decided to change the tenure of trees from community to individual, as the situation changed.
5. Even pragmatic people may have sentimental feelings about a few old trees.

### **Autonomous learning following a formal project**

One of the original intentions for this study was to see how local people had adapted new trees and new information since the exit of the Forestry School in 1997. We expected local people to have continued learning on their own, by observing the trees and modifying the new technologies. Results have been somewhat disappointing. As mentioned in Chapter 2, the people of Apharumiri have made some modest modifications with trees, e.g. planting eucalyptus on a 10-meter wide strip behind the old willows on the river bank, and planting mixed species in the river bed where part of the new strip of land washed out in 2000-2001. The only other observation we documented was this: one local man said that pine trees (introduced by the foresters) improve the soil below them, because the soil becomes darker and more humid. As a result of their involvement with the Forestry School, Apharumiri seems to have acquired a reputation as a “forestry community” and institutions come there and plant tree nurseries, to take seedlings to other communities.

### **A hypothesis is rejected**

We hypothesised that when a community receives new information and has new experiences, and has years to experiment with them, there will be some autonomous discovery of knowledge. With some exceptions, this was not the case. We suggest that the new ideas failed to thrive for the following reasons:

1. The economy of Apharumiri is based on agriculture, livestock and migratory wage labour. Not on forestry.
2. There was limited land for planting new plantation trees offered by foresters (still, villagers made some efforts to plant them.)
3. Foresters failed to see that the village proper is a heavily wooded agro-forest. Outsiders made little attempt to introduce fruit or other trees (other than eucalyptus) that offer harvestable products or services, or offer practices that villagers might have wanted to adopt near their homes<sup>8</sup>.
4. Villagers value the economically-useful native trees on the dry canyon wall, although the foresters were more interested in planting exotic trees.

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<sup>8</sup> The foresters helped some people plant molles in the village proper, with irrigation, but these trees died, for reasons no one understands. In 2001 some villagers planted a few molle again, some on the canal bank. These lived.

### 1.4.3 Institutional Mechanisms

#### Folk knowledge is experiential, not experimental

Ethnobiology is built up by life experience, learning *ad hoc*, during work and play. Local people rarely manipulate the environment to learn about it. For example, they do not touch the urticating hairs of caterpillars to see if the hairs are irritating. Instead, people said that one day they grasped a molle tree without looking and accidentally touched a mass of gregarious caterpillars, and their hand swelled and blistered. People talk about this information, but all of it is not shared. For example, one woman told us that the **tikira** tree was useful for improving soil, just like molle and **thaqu**. Other community members scoffed at the idea, saying “only a donkey (i.e. a foolish person) would say that.”

#### The *sindicato* is a remarkable institution

In Bolivia, the revolutionaries of 1952 freed the hacienda workers and organised them as *sindicatos*. Each household sends a member to a monthly meeting, where land, water, development etc. are decided. The *sindicato* elects officers once a year, who represent the community in higher levels of organisation. At the national level, the *sindicato* movement is powerful enough to make demands on the central government, block highways and march in the city streets if their demands are not heard. They are, in development-speak, “empowered.” If the *sindicato* catches an outsider herding goats in Apharumiri’s *monte*, the goats are killed. The elected leaders of a *sindicato* are merely spokesmen. In Apharumiri, we saw the *sindicato* leader (*dirigente*) climb onto the backdirt where the men were digging the foundations for a new river-wall. He implored each of them to give him a peso so he could go to town for a meeting about this year’s cement. One man threw a shovel full of dirt on the leader’s legs<sup>9</sup> (though later, they gave him some money). The *sindicato* is self-perpetuating, democratic (though male-dominated) and able to make and enforce community decisions. The *sindicato* can and does decide to change the tenure of certain parcels of wooded land from communal to private<sup>10</sup>; it decides to plant nurseries and to dedicate certain lands, like Ankhará, to planting pine and eucalyptus with the foresters.

### 1.4.4 Contributing to Other Preconditions for Local Accountability

Building the barrier walls in the riverbed has strengthened the *sindicato* in Apharumiri. When we asked for permission to work in Apharumiri, the *sindicato* sounded a horn throughout the village, announcing an extraordinary meeting. The leader took roll and fined the households that did not attend. Not all *sindicatos* in Bolivia are organised to this extent. To its credit, the Forestry School recognised this, and helped the villagers establish a forestry committee within the *sindicato*. The forestry committee is no longer active, but the *sindicato* is well-enough organised to collaborate on a forestry project with FHI, planting and caring for a nursery (with support from the local mayor’s office).

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<sup>9</sup> The shovel full of dirt was a rough, practical joke, acted out as though it were an accident. The point is that all members of a *sindicato* are formally equal to the leader, who must never forget that he is the spokesman and facilitator for a group of equals, not the boss.

<sup>10</sup> We did not record a case where land tenure had gone in the other direction, from private to communal. Except for the small strip of forest land behind the defensive river walls, the community does not mandate what crops may be sown where, nevertheless most people do tend to sow the same crops in similar environments.

## 1.5 Limitations, Constraints and Required Environment

### 1.5.1 Limitations, Constraints and Required Environment

We have contrasted 3 experiences or domains of knowledge generation:

1. Traditional ethnobiology, or folk knowledge of trees.
2. A community initiative to reclaim new farmland and stabilise it with trees, with help from donor institutions.
3. An initiative by foresters, to plant new trees, later turned over to the community, i.e. one purely local initiative, another local effort that incorporated outsiders and a third initiative where outsiders incorporated local people.

#### **Folk knowledge is constrained by the interests and powers of observation of local people**

Folk knowledge will inform a community about creating a dense agro-forest around the homesteads. Local people know which trees can be cut for fuel, or fed to goats or carved into ploughs, all key knowledge for surviving on the land, and all observable with the naked eye. Local knowledge has not solved problems of long-term deforestation. Local people know that the native trees germinate on their own, and that thorny bushes act as nurse plants until the trees are old enough to survive the goats. The people want more native trees, but cannot afford to stop grazing, browsing and harvesting the *monte*, in order to let the shattered forest recover. The villagers (and apparently the foresters as well) did not know how to induce reforestation of native species, in the *monte*, without irrigation and without demanding much labour from the community. Little or no initiative was undertaken to nurse endemic tree species for reforestation. Regarding pests and diseases, local knowledge has only been able to identify the most important insect pests and label certain symptoms of fruit tree diseases. This is because much of the life cycle of the insects occurs in ways that people cannot observe it, and because of the microscopic natural history of the diseases.

#### **One new idea about eucalyptus**

The community initiative to reclaim new land has been quite successful in its stated aims. The outsiders (foresters) were less successful at turning it into a forestry experiment. To their credit, the foresters did not try to co-opt the land reclamation project, but merely encouraged villagers to plant some eucalyptus between the individual parcels of land on the new strip of land. The foresters taught the people of Apharumiri how to plant eucalyptus, not just harvest seedlings that have sprouted under large trees, and the people are planting hedgerows, river barriers and even some small plots of eucalyptus. All of this is happening in the rich farmland of the **pampa**, where villagers can keep the goats away and can eventually harvest the timbers to use or sell. As the trees mature, they may substitute for some of the firewood and lumber that is now being cut from what is left of the native forest. While the foresters did not introduce many successful innovations, one of them (planting eucalyptus from seed) was adopted and is spreading through the community. This one innovation seems to be having a large impact, as people are now growing eucalyptus as a crop on the **pampa**, and are becoming self-sufficient in timber.

### **The failed disciplinarian approach**

Other than the success with eucalyptus plantations on newly reclaimed land in Apharumiri, there has been little impact of formal forestry in Apharumiri. This is remarkable, considering that Apharumiri had a resident forester for 12 years, from 1985 to 1997. Four young men served full-time in Apharumiri for several years each. Judging by the last one, they were personable, well-intentioned fellows with university training (under Bolivian and German instructors). They spoke fluent Quechua and Spanish, and lived in the village for 3 weeks every month. The foresters played football with the youth, laboured on river walls with the men and learned even the children's names. In 1995 a student at the Forestry School wrote the results of a participatory needs assessment of Apharumiri, correctly identifying: low agricultural yields; lack of forage for goats and other livestock; and soil "degradation" (erosion, declining fertility, high levels of salt in irrigated land) as the villagers' concerns (Choque 1995).

In response, the foresters offered more ways of planting trees, mostly exotics: tree windbreaks, forage trees, 3 rows of trees to stabilise the river bank etc. In other words, the problems were livestock-and-agricultural, and the solutions were plantation forestry. The Forestry School did not consider fruit trees or pest management, not even of the blue gum borer which attacked the eucalyptus that the foresters introduced. The School was unable to design a technique for increasing populations of native trees on dry slopes. More creative solutions were not considered either: like bottled gas for cooking, to relieve the pressure on fuel woods, or compost and dry latrines to improve soil fertility. As mentioned already, the foresters had some success introducing exotic trees in nurseries and small plantations. Lessons to be learned:

1. The disciplinary approach led to plantation trees as the solution to all problems.
2. The foresters did not have a holistic understanding of the village's human ecology.
3. The best intentions of some really good people were not enough, given the above limitations.

### **1.5.2 Other Preconditions for Local Accountability**

#### **Perceived benefits**

When local people perceived benefits from new forest techniques (e.g. planting eucalyptus on the pampa), they were willing to learn about them and adopt them.

#### **Money**

Cash is the most interesting perceived benefit, although people respond to non-monetary economic uses. For example, most native woods in highland Bolivia are hard, with twisted branches and trunks. Eucalyptus grows much straighter, so the people of Apharumiri like it because it is easier to use for house beams and plough tongues.

#### **Profitability**

Local people may continue low profit activities, like community nurseries, if they become part of a package deal (FHI funded nurseries in Apharumiri, along with new brick houses and cement for a new river barrier), and if the outsiders donate non-local materials e.g. black plastic bags.

## Organisation

Communities with strong organisations, like the *sindicato*, may be easier to work with. The foresters established a forest committee, within the *sindicato*.

## Access to forest land

The people of Apharumiri defend their legal rights to land. The *monte* (remnant native forests) and a small fruit orchard (mostly fig and *Inga* sp., once part of the hacienda's private garden) are open to all community members. The *sindicato* conserves the trees planted along river defence-walls. Farmland, village homesteads with agro-forests and some new eucalyptus plantations are assigned to individuals<sup>11</sup>. In other words, the land tenure is a flexible blend of individual and communal lands, controlled by the community. The community already had very strong control over their forest and farmland, before the forestry initiative started. Still "access" takes on new meaning with the pine and eucalyptus forest which the foresters planted on the cliff-side at Ankhara. The local people own these trees, but they are so distant, and would be so difficult to log that community members can merely sigh and wish that the trees were in an accessible location.

## Knowledge

The people of Apharumiri have outside and local knowledge about trees. They are proud and secure in what they already knew (e.g. they are not ashamed of the folk names of trees and associated organisms). They have also learned enough about planting trees that they say "now we are foresters, too." Yet, something is missing.

## Bare eyes

Unlike development experts, the smallholder farmers of Apharumiri are not specialists, but generalists. While walking across the pampa, a farmer stopped to see a spot of feathers on the ground. "*Q'ara ñani*" he said, meaning "bare eyes," a local name for a type of bird. The local man could name the species just by its feathers, although we had no idea which bird it was. It was a reminder that the rural folk know about not just trees, but birds, and shrubs, weeds, crop varieties, hand tools, soil types, weather, pests and diseases. We development experts are like the hedgehog who knows one big thing, but the peasant farmer is like the fox, who knows many things. Formal development needs to be capable of looking beyond our disciplines. We must be able to learn from the community about their countryside, jointly find their main limiting factors and strengths, and then seek the information that the rural people need, and making them a larger, more useful offering of ideas.

## Positive lessons

The villagers of Apharumiri named the 2 newest strips of land "Forestales" in honour of the foresters. Ten years after the German forester Albert Hosius left Bolivia, the campesinos in

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<sup>11</sup> Land is assigned as follows: The original hacienda's irrigated and dry fields were divided in 1953, formalised in more-or-less equal shares in the land reform of the 1970s. Since then, distribution has been through inheritance. Originally only sons inherited land, but now daughters are starting to inherit as well. When new lands were created from the river bed, and when the strip of trees behind the wall was passed to individual usufruct, the *sindicato* divided the land into plots of equal size, gave each one a number, written on a slip of paper, which the men drew from a hat.

Apharumiri still remember his first and last names. The foresters were willing to bend their mandate (not just work with trees) and help local people build new farmland, which is what they wanted the most. The people were able to express this demand clearly (in part because they are tightly organised).

## 1.6 Conclusions

### 1.6.1 Natural limits of folk knowledge

Local learning is broader, and in many cases, deeper than what foresters offer, e.g. few foresters can carve a plough from an acacia or list all the bushes that goats eat. Yet local knowledge has a limited ability to learn about the very small (e.g. disease organisms), the cryptic (**sika** reproduction) or how to reforest the *monte* (perhaps because it is beyond the yardstick of human life-time). Local people rarely orchestrate experiences specifically to learn. Indigenous technical knowledge is vast, uneven and *ad hoc*.

As we have said elsewhere, necessity may be the mother of invention, but the father of invention is a fresh idea (Bentley 2000). A felt need without new information may just lead to frustration: for example in this case locals want to control peach diseases, but do not understand the nature of disease (e.g. the natural history of fungi or even of aphids). Unless this knowledge gap is filled, there is little they can do to experiment with disease management. When a new idea is not married to a felt need, the result is irrelevant information. For example, the new tree species growing as oddities around the old "Forestry Centre" (forester's cottage) at Apharumiri.

Necessity wed to information yields trial and adoption, as in the case of the eucalyptus, now being planted almost as a crop, on the field edges on the best farmland of Apharumiri. In other cases, invention requires not only a mother and a father, but a midwife: someone to encourage experimentation (Bentley 2000). An example from Apharumiri: although the foresters taught the villagers to make tree nurseries, the local people only make them when stimulated by outsiders. FHI has given Apharumiri supplies and the people have planted seedlings and sold them to FHI. Some of these seedlings were donated to other communities (by FHI), but others were given to the people of Apharumiri. The villagers could have discarded the seedlings, but instead they planted them on the alluvial fan of the ephemeral Pucara River. They planted others in the Tapacarí River bed, where the river is eroding the pampa. In other words, the people are aware of erosion and want to control it. They know that trees can prevent erosion and have learned to make nurseries. Yet the experiment to control erosion with trees was only conducted with the encouragement of an institution, that supplied the outside materials.

These trees were planted in 2001, so they are still quite small, although nearly all of them have survived the first few critical months. This underscores another problem with studying popular experiments with trees: the long time needed to judge the experiment. For example, it took several years for the results of the Ankhara experiment to become clear: the trees grow well, pest-free, but are too distant to be of much use. Likewise, the experiment with the new trees in and near the riverbeds has a clear intent (to control erosion), yet the results will take years to test.

Table 5.1 summarises traditional ethnobiology, the building of river walls, and all the more specific, recent experiments and experiences with trees. It shows that few, if any, of the experiences were organised to learn. Some with more input from foresters were designed as demonstrations: to show things to campesinos. The experiences conducted by local people were intended to produce a commodity or to reach some other goal of production agriculture. Learning was a by-product.

### 1.6.2 Supply and demand of information

Foresters could not see the people for the trees, did not see the dense agro-forest around each village, and missed an opportunity to work in the village agro-forest, or to reforest the degraded *monte*. Foresters in Apharumiri made an honest effort to understand local people, but did not analyse the human ecology well enough to **identify local demands**. Foresters offered narrow knowledge on timber trees, with little emphasis on other perennial species, fruit trees, native trees (a failure of the **supply of outside knowledge**) (see Figure 0-9).

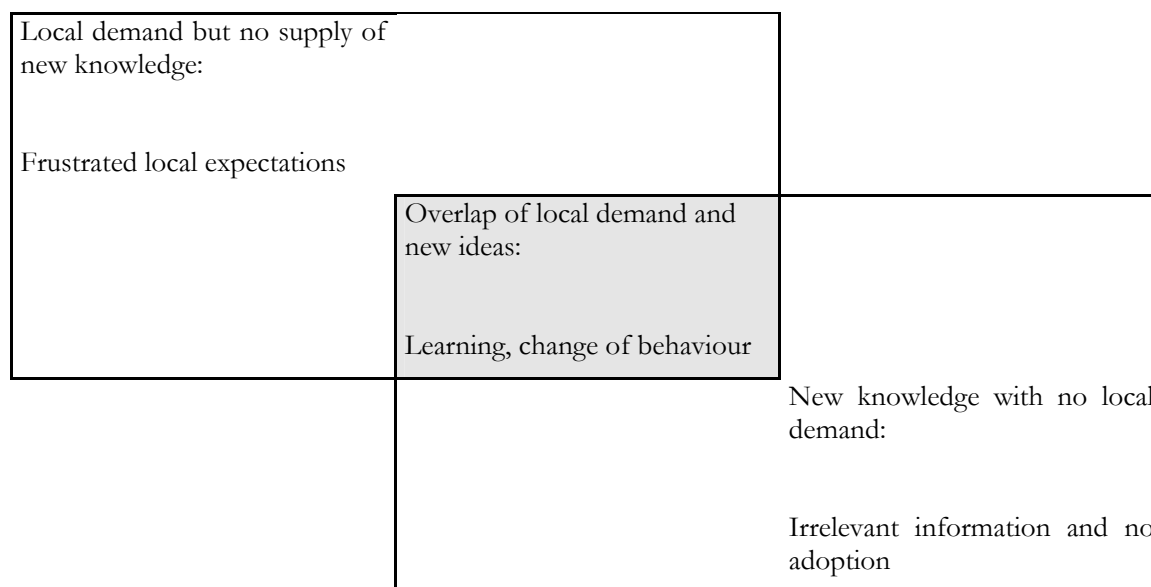


FIGURE 0-9 SUCCESSFUL JOINT LEARNING REQUIRES A SUPPLY OF OUTSIDE INFORMATION AND LOCAL DEMAND

## 1.7 Acknowledgements

Thanks to Paul Van Mele for suggesting this study, and for a most helpful reading of the first draft. Thanks to an anonymous reviewer at the FAO for a careful reading and, constructive criticism of an earlier draft of this report. We are grateful to Fimo Alemán for identifying plant species and for organising the stay in Apharumiri. Thanks to Sergio Ballón for helping to install the computer graphics. We especially appreciate the people of Apharumiri for allowing us to work in their community and for sharing their knowledge with us.

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TABLE 5.1 SUMMARY TABLE OF KNOWLEDGE GENERATION ABOUT TREES IN APHARUMIRI

Experiment or experience	Intention	Institutional context	Method & time frame	Value & security added	Results & effectiveness	Conclusions
<b>Traditional ethno-biology</b>	To extract forest products.	Spontaneous, without institutional support.	Occurs "naturally" as people work and play. Has been part of human behaviour for millennia.	Adds economic value to many forest products, but does not always lead to conservation of the forest as a whole.	Effective at revealing uses for (and damage by) most easily observed species in the local environment.	The most important way local people have of learning about the forest.
<b>River defensive walls</b>	To create & conserve new farmland in the riverbed.	Conducted by <i>sindicato</i> , which since 1987 has obtained outside help in buying cement	Locals build stone and cement walls in the river to trap sediment. Since ca. 1900.	Adds high value, individually owned land. Held in place with trees.	Very effective. One wall per year added. About 40 ha of land and many trees maintained.	Local initiative. Successfully incorporated outside institutions.
<b>Eucalyptus around farm plots</b>	To grow eucalyptus.	First adopted as a compromise to please the German Forestry Mission, which wanted the plots planted in eucalyptus.	Planted by local people with seedlings from a nursery, made with help from the Mission and the Forestry School in 1987.	May add some value to the plots. The community already has secure title to the land.	The trees are now large and villagers want to plant more. Some problems with blue gum borer.	Successful & participatory, although more of an experience than an experiment.
<b>10-meter wide strips of eucalyptus</b>	To provide small plots of land for families to grow trees, and to conserve farmland.	The <i>sindicato</i> awarded management of part of the edge of the pampa to individuals.	Of 25 families, 3 planted eucalyptus about 1996. 9 more planted trees in 2000-01.	Adds value to small plots of land. The old trees (willows etc.) are still preserved.	Effective transfer of land tenure with conservation of land and trees still practised.	More of an experiment in land tenure than in forestry.
<b>2 plots of eucalyptus</b>	To grow eucalyptus.	2 individual initiatives.	2 men each planted eucalyptus on their new plots (ca. 600 m <sup>2</sup> ) on the pampa.	May add value. Saves labour. Land tenure is already secure.	Most of the trees are growing well, though some are stunted, possibly due to lack of fertilisation.	So far no neighbours have replicated the experience.
<b>3 rows of trees</b>	Soil conservation--to hold the edge of the pampa.	Designed by the Forestry School. Carried out with local consent and labour.	A complex of 3 rows of poplar, willow & <i>retama</i> planted ca. 1995.	Little or none.	Most of the trees washed out in the annual floods of 2000-01.	A not very successful experience with local people and institutions.
<b>New tree species</b>	To introduce new tree spp. to the community.	Brought by the Forestry School, planted in the village centre.	Foresters planted a few individuals of ca. 7 new spp.	Little or none.	The trees survived but local people show little interest in them.	These trees, may grow too slowly to arouse local interest.
<b>Hillside plantation at Ankhará</b>	To grow pine & eucalyptus.	The Forestry School, with the community.	Foresters led local people in planting trees on a distant peak.	Little or none.	The trees thrived, but are too inaccessible for local people to use.	A frustrating experience for local people.
<b>Making nurseries</b>	To rear trees from seedlings.	Induced first by the Mission and the Forestry School. Later supported by	Started about 1985. Still maintained in 2001. Managed by local people.	Some value may be added through new trees reared in nursery.	The seedlings were the source of trees for most of the other experiences on this chart.	Local people know how to run the nursery but will not do so without outside

Experiment or experience	Intention	Institutional context	Method & time frame	Value & security added	Results & effectiveness	Conclusions
<b>Planting trees in river bed</b>	To conserve farmland.	FHI and mayor's office. Conducted by <i>sindicato</i> , with seedlings from nursery supported by FHI	<i>Spartium, Erythrina, Abnus, Salix, Schinus, Eucalyptus, &amp; Atriplex</i> planted near farmland, in 2 riverbeds, in 2001.	High potential.	The trees have survived the first few months. Too soon to tell if they will conserve soil as planned.	support (e.g. for materials). An interesting start, too soon to evaluate. Enjoys a mix of local & outside interest & support.
<b>Planting molle</b>	To grow amenity trees near home.	3-4 individuals	<i>Schinus</i> seedlings germinated spontaneously in the nursery. A few people planted a few at home, e.g. on canal banks in 2001.	Modest potential.	The trees have survived a few months and are still alive.	Too soon to judge.
<b>Playing forester</b>	A boy playing	One boy. (The adults were planting thousands of seedlings on a hillside).	He imitated his father, planting 10 eucalyptus seedlings at home ca. 1985.	Adds to value of homesite. Land tenure already secure.	The trees lived because the homesite is humid. The trees the adults planted died.	Part of a larger experience; local people learned not to plant eucalyptus on dry slopes.
<b>A broken pot used as nursery</b>	To grow eucalyptus seedlings	One man.	Many seedlings germinated in the pot, planted ca. 1995	No value added.	The trees died after being transplanted. The man bought more seedlings	Reinforced the idea that only seeds planted in black plastic bags survive.

## Appendix 5A Catalogue of Indigenous Knowledge of Perennial Plants in Apharumiri, Tapacarí, Cochabamba, Bolivia

We asked local people to show us and tell us about trees (**sach'as**). As they showed us trees, bushes, cactuses and even large grasses, we reconfirmed our idea that **sach'a** does not mean "tree" *per se*, but includes all (or at least most) woody and perennial plants. We have also included plant epiphytes in this annex, although they are not **sach'as**.

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Sauce ( <i>Salix humboldtiana</i> ).....	40
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Chhina Kalistu ( <i>Eucalyptus camaldulenses</i> ).....	42
Jarka ( <i>Acacia visco</i> ).....	43
Lluq'i ( <i>Kageneckia lanceolata</i> ) .....	45
Duraznero, Durazno ( <i>Prunus persica</i> ) .....	45
Higuera, Higo ( <i>Ficus carica</i> ) .....	47
Tuna ( <i>Opuntia ficus-indica</i> ) .....	48
Alqu Tuna, Alqu Tunilla ( <i>Opuntia cochabambensis</i> ).....	50
Tikira ( <i>Schinopsis baenkeana</i> ).....	51
Ch'akatiya ( <i>Dodonaea viscosa</i> ).....	52
Ch'illka ( <i>Baccharis salicifolia</i> ).....	53
Khiñi ( <i>Colletia spinosissima</i> ).....	55
Waych'a ( <i>Senecio clivicolus</i> ).....	55
T'ula ( <i>Baccharis</i> sp.) .....	57
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Ulala ( <i>Eriocereus tephacanthus</i> ).....	60
Phasakana ( <i>Trichocereus</i> sp.) .....	61
Alamo ( <i>Populus deltoides</i> ).....	63
Japa Japa (unidentified species) .....	64
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Chuchuruma ( <i>Eryngium paniculatum</i> ) .....	67

## Mulli (*Schinus molle*)

Meaning of folk name	Unanalysable
English common name	Molle, also California pepper tree, Brazilian pepper tree
Uses	<p><i>Wood</i> - The wood is strong, relatively lightweight, and easily moulded into shapes: ideal for making tools, especially ploughs, yokes and pitchforks. Shade: An important shade tree, especially in wheat fields, for resting oxen. Farming: The fallen leaves improves the soil beneath the tree; this is considered a major benefit. Only molle and thaqu are thought to improve the soil beneath them. Crops will grow in the light shade of molle, unlike the dense shade of some trees. Ideal for shaping into kalchas (haystack trees). Firewood: also makes good charcoal. Timber: Boards and light construction. Medicine: Molle leaves can be boiled and used to bathe a person who is suffering from susto (literally "fright.") Susto is a common folk illness in Latin America. The gum that weeps from wounds in the bark is placed on paper and used as a patch on sore body parts.</p> <p><i>Sacred</i> - Molle is one of the few trees with ritual uses. Leaves and branches are used as ramadas for wedding parties, because the tree never loses its leaves. It symbolises the hope that the couple will never leave each other. When a person is invited to accept the sponsorship of a ceremonial fiesta, he is offered a drink of chicha with molle leaves wrapped around the neck of a ceramic vessel. Molle leaves are included in an offering to the Pacha Mama; the leaves are wrapped in a handkerchief with coca and cigarettes and left on the threshing floor under a stone when people bag the winnowed wheat. The offering is topped with a small cross, and the farmer pours and drinks a libation (ch'alla) of distilled alcohol. This ensures a harvest in following years.</p>
Habitat & manage-ment	Found in the village and in the <i>monte</i> , much less so in the pampa, where the trees will die if the soil becomes waterlogged. Molle can live on canal banks. People protect molle seedlings, especially ones that sprout in the village. Under the influence of foresters, a few local people are starting to experiment with planting molle seedlings near their homes. Locals say there were more molles in the mid-twentieth century.
Health problems	The molle is host to a psyllid, which most local people do not think of as an insect; they call it "just a disease" (unquylla). Older molle trees host a parasitic plant, mulli jamillu ( <i>Phragmites cunaecifolius</i> ), which local people do not consider a serious problem. Other epiphytes (chuchuruma) are also common, but not considered serious problems. According to local people, the most serious problem with molle is the sika, (a lepidoptera larvae, probably of the Saturniidae family, see Appendix B). The caterpillar is gregarious and eats molle leaves, but spends much time on the bark of the trunk and branches. People who have accidentally brushed against its hairs have felt intense pain, with itching and blisters.
Indigenous knowledge	<p>Locals recognise two kinds of molle based on wood colour: a harder, red wood, and a softer, white wood. Some people call the red wood molle "male molle" (urqu mulli) and the white wood molle "female molle" (chhina mulli), although this classification has nothing to do with biological sex. Both kinds of molle have the same type of flowers and fruit. Some people claim that the red molle has a more twisted trunk and rougher bark on the smallest branches, although the 2 types of molle are difficult for local people to distinguish and are best thought of as different varieties of carpenter's wood.</p> <p>Molle has a dense root system, "like hair." The roots go a long ways under ground, and suck the soil and can be harmful. People realise that the molle seeds are found in the leaf litter under the trees.</p> <p>A molle branch may be cut where it branches, and shaped into a pitchfork. People singe it to soften it, bend it to the required shape and then leave it pressed under rocks or wedged between trees for 2-4 weeks until the wood hardens (see Figure 0-12).</p>
Figure	5-10, 5-11, 5-12 and 5-13

## Cruz Mulli (*Schinus* sp.)

Meaning of folk name	Cross molle (people perceive the leaves as cross shaped)
English common name	Not available
Uses	<b>Medicine:</b> Said to be useful for curing <b>wayra</b> (a folk disease, meaning "wind," associated with the aches and pains of hard, physical labour). The leaves of <b>cruz mulli</b> , with altamisa and rue leaves are tied to the sore part.
Habitat & manage-ment	There is only one <i>cruz mulli</i> tree in Apharumiri, in the low <i>monte</i> near the village. Villagers think the seed blew in by wind, about 1960. They are conserving the tree.
Health problems	None recorded
Indigenous knowledge	None recorded
Figure	5-14 and 5-15



FIGURE 0-10 MOLLE TREE



FIGURE 0-11 SMALL DRINKING TROUGH (BATEA) FOR ANIMALS, CARVED FROM A BRANCH OF MOLLE



FIGURE 0-12 A PITCHFORK CARVED FROM THE BRANCH OF A MOLLE TREE, PRESSED UNDER ROCKS IN A DRY RIVER BED SO IT WILL HARDEN INTO THE RIGHT SHAPE



FIGURE 0-13 DIONISIO ROCABADO IN A KALCHA MADE FROM A MOLLE TREE. JORGE VALENCIA WATCHES FROM THE GROUND



FIGURE 0-14 CRUZ MULLI TREE



FIGURE 0-15 CROSS-SHAPED LEAVES OF CRUZ MULLI

## Thaqu (*Prosopis alba*)

Meaning of folk name	Unanalysable
English common name	Not available
Uses	<b>Farming:</b> Improves the soil beneath the tree, even more so than molle. It is the best tree to shape into <b>kalchas</b> (haystack trees). <b>Fodder:</b> Goats and hogs eat the seed pods. <b>Human food:</b> people, especially children, also eat the sweet tissue surrounding the seeds. <b>Firewood:</b> Excellent. <b>Wood:</b> For making ploughs and other tools. Dry branches are used as corral gates, and are used in building rock-&-brush barriers ( <i>chamisos</i> ) on the river. <b>Shade:</b> In wheat fields and near houses.
Habitat & manage-ment	Is the most common tree in the <b>monte</b> and in the village. People protect so many seedlings in household gardens that the homes are surrounded by groves of <b>thaqu</b> . The tree was more common before mid-twentieth century. Pollarded branches grow back.
Health problems	There is a <b>sika</b> (caterpillar) that lives on the tree. The hairs of this gregarious caterpillar (probably Lepidoptera: Saturniidae) are painful to touch, although not as much as the <b>sika</b> on molle. There is also a <b>jamillu</b> or parasitic plant in <b>thaqu</b> , although it is not considered a serious problem. <b>Chuchuruma</b> (non-parasitic epiphytes) can be quite common in <b>thaqu</b> , more so than in other trees. They are not harmful unless they are quite dense. The same cerambycid (no local name) that cuts <b>jarka</b> branches also infests <b>thaqu</b> .
Indigenous knowledge	The tree has thorns, which can cause infections if they puncture people's skin. The <b>thaqu</b> has galls, which people say are full of small flies ( <i>mosquitos</i> ); not considered a health problem. <b>Thaqu</b> has a large root system, which can lower crop yields. The leaves turn yellow and fall during cold weather.
Figure	5-16 and 5-17

## Alqu Thaqu (*Acacia macracantha*)

Meaning of folk name	Dog thaqu
English common name	Not available
Uses	<b>Wood:</b> The branches are cut and used as corral doors, as barriers around tree seedlings, as fencing to keep goats out of fields and gardens. <b>Fodder:</b> Goats eat the tender leaves.
Habitat & management	Grows wild in the <i>monte</i> . People destroy most of the plants that sprout near the village, so children will not hurt themselves with the long, thin, sharp needles. It is encouraged on field edges, as natural fencing.
Health problems	None reported.
Indigenous knowledge	Women pointed out that while goats will eat the leaves of this plant, the needles are difficult for the animals to negotiate. The goats frequently puncture their mouths on the needles, and the wounds can become sore. People become infected when pricked by <b>alqu thaqu</b> needles.
Figure	5-18 and 5-19

## Sauce (*Salix humboldtiana*)

Meaning of folk name	Willow (from standard Spanish)
English common name	Willow
Uses	<b>Soil conservation:</b> The most important use is as a barrier against the river. The roots are thick, and when planted behind the stoneworks on the river bank, the tree helps protect the man-made pampa from erosion. <b>Firewood:</b> Can also be made into charcoal. <b>Wood:</b> Useful for timber, boards, ploughs and other tools, especially for looms, even basketry. <b>Fodder:</b> Goats eat the leaves, a bit.
Habitat & manage-ment	<b>Pampa</b> only. People plant them in August, with cuttings, placing one end of a pollarded branch in the soil. Some willows grow to be quite old and large. Some veteran trees that were once on the edge of the pampa are now in the middle, because people have added new strips of land. These trees were shading valuable cropland, so people cut most of them.
Health problems	The old willow trees develop cavities in the centre of the trunk and can become quite hollow, although not necessarily falling over. Large vespid wasps ( <b>wayrunq'us</b> ) live in some of the cavities. People in Apharumiri described an arthropod called <b>qhapa</b> living on the leaves of willow, which appears around All Saints' Day. The central meaning of <b>qhapa</b> is probably mite, although this creature may be a Homoptera. It is said to be large and red and it exudes a sweet liquid. Sheep and guinea pigs like to eat the fallen leaves covered with the honeydew. One man said <b>qhapa</b> was harmful, but other community members said that it was not.
Indigenous knowledge	Crops will not grow beneath willow.
Figure	5-20 and 5-21



FIGURE 0-16 JULIETA BASWALDO STANDS UNDER A KALCHA (A LIVING HAYSTACK TREE) OF THAQU, LOADED WITH MAIZE STALKS.



FIGURE 0-17 SEED PODS OF THAQU, DRYING ON A ROOF TO STORE AS LIVESTOCK FEED. (THE PILE FURTHEST FROM THE CAMERA IS OCA (UQA, *OXALIS TUBEROSA*, SUNNING MAKES IT SWEETER, FOR HUMAN FOOD).



FIGURE 0-18 ALQU THAQU



FIGURE 0-19 A SMALL LEMON TREE, SURROUNDED BY AN ANTI GOAT FENCE OF DRY ALQU THAQU BRANCHES.



FIGURE 0-20 WILLOWS PROTECTING THE RIVER BANK, SET BEHIND A ROCK-&-BRUSH WALL (*CHAMISO*) IN THE COMMUNITY OF LAQHIRAYA, UPSTREAM FROM APHARUMIRI.



FIGURE 0-21 FRANCISCA GARCÍA AND HER DAUGHTER, ELI CHINCHILLA, WEAVING HOMESPUN WOOL ON LOOMS OF WILLOW WOOD.

## Urqu Kalistu (*Eucalyptus globulus*)

Meaning of folk name	Male eucalyptus
English common name	Tasmanian blue gum
Uses	<b>Timber.</b> Especially useful because the boles are straighter and longer than those of native trees. Used for household construction: roof beams, posts, boards, lintels etc. Is the preferred wood for plough tongues, because it is so long and straight. <b>Firewood.</b> And was also once used to make charcoal. <b>Soil conservation.</b> Now being planted behind the willows on the river wall, to hold the <b>pampa</b> against annual river floods, because the roots hold onto the stones.
Habitat & manage-ment	One of the dominant trees in well-watered areas: planted on canal and river banks. The people of Apharumiri used to scavenge seedlings that sprouted spontaneously below mature trees. Foresters have taught them to make seedbeds. The tree grows back if pollarded. People like the tree very much and are planting more of it.
Health problems	The blue gum borer ( <i>Phoracantha semipunctata</i> ), a cerambycid beetle, called <i>taladro</i> (drill) locally. Locals consider it a serious pest. There is some problem with leaf yellowing and stunted growth in new plantations (see photo below), although local people have not been able to diagnose the problem. Seedlings must be protected from goats, which will destroy them.
Indigenous knowledge	Eucalyptus has abundant roots "like hair." It sucks the soil and no crop can grow beneath it. Eucalyptus does not grow well in the shade. Eucalyptus is so important in the economy of Cochabamba, that local people have little or no idea that the tree is exotic. The name for it in Quechua, <b>kalistu</b> , is obviously borrowed from the Spanish <i>eucalipto</i> , but with so much phonetic deformation that the word was obviously borrowed many years ago, when many people were still monolingual in Quechua.
Figure	5-22 and 5-23

## Chhina Kalistu (*Eucalyptus camaldulenses*)

Meaning of folk name	Female eucalyptus
English common name	River red gum
Uses	Most of the same uses as <i>Eucalyptus globulus</i>
Habitat & management	Similar to <b><i>urqu kalistu</i></b> ( <i>Eucalyptus globulus</i> ), although <b><i>chhina kalistu</i></b> is grown much less.
Health problems	Not reported.
Indigenous knowledge	Local people say that <b><i>chhina kalistu</i></b> is not as straight as <b><i>urqu kalistu</i></b> , so it is not quite as useful.
Figure	5-24

## Jarka (*Acacia visco*)

Meaning of folk name	Unanalysable
English common name	Not available
Uses	<b>Wood:</b> Tools, especially plough bodies. <b>Kalchas</b> (haystack trees). <b>Firewood:</b> excellent and can also be made into charcoal. <b>Fodder:</b> Cattle eat the leaves. Goats eat the leaves and seed pods. <b>Textiles:</b> Used to dye wool orange brown.
Habitat & manage-ment	Grows wild in the village and <b>monte</b> . People protect the seedlings.
Health problems	A cerambycid beetle (no local name) cuts branches off, with neat, circular cuts, as though made by a saw. People recognise it as a worm ( <i>gusano</i> ). The insect is conspicuous, though not very common.
Indigenous knowledge	None recorded
Figure	5-25 and 5-26



FIGURE 0-22 VÍCTOR CHINCHILLA (RIGHT) SHOWS JORGE VALENCIA (FORESTRY TECHNICIAN, LEFT) A NEW, SMALL PLANTATION OF EUCALYPTUS.



FIGURE 0-23 OLD WILLOW TREE WITH WOODEN HAND TOOLS LEANING AGAINST IT. OX PLOUGH, WITH EUCALYPTUS TONGUE, LOWER RIGHT HAND CORNER.



FIGURE 0-24 LUCHO CHINCHILLA WITH A DEMONSTRATION PLOT OF MIXED SPECIES OF EUCALYPTUS, PLANTED WITH FORESTERS



FIGURE 0-25 JARKA TREE, ON THE OUTSKIRTS OF THE CITY OF COCHABAMBA



FIGURE 0-26 TWO UNFINISHED PLOUGH BODIES, BEING CARVED FROM FORKS IN JARKA TREES



FIGURE 0-27 A LLUQ'I TREE

## Lluq'i (*Kageneckia lanceolata*)

Meaning of folk name	Left hand
English common name	Not available
Uses	<b>Wood:</b> Especially good for pitchforks, ploughs, shovel handles and other tools, even looms and basketry, because it can be molded when cut green, and is a tough wood. <b>Firewood:</b> Excellent. <b>Fodder:</b> Goat browse (if green or dry, but not if wilted).
Habitat & manage-ment	<b>Monte.</b> People often harvest <b>lluq'i</b> one branch at a time, to avoid killing the whole tree.
Health problems	None reported
Indigenous knowledge	The leaves are extremely poisonous if wilted. If a person cuts a branch and takes it home to make tools, and the goats eat the leaves 1-2 days after the branch has been cut, the goats scream and die within half an hour. Their stomach lining peels and the meat stinks.
Figure	5-27

## Duraznero, Durazno (*Prunus persica*)

Meaning of folk name	The standard Spanish word for peach tree is <i>duraznero</i> , and <i>durazno</i> is the peach fruit. Quechua-speaking people often refer to the tree as <i>durazno</i> .
English common name	Peach
Uses	Fruit
Habitat & management	Planted in the village and on the irrigated <b>pampa</b> . The current generation learned from their parents to break open the hard seed coat ( <b>luru</b> ) and plant the inner seed in seedbeds, before transplanting the seedlings.
Health problems	People in Apharumiri reported serious problems with diseases they call <i>polvillo</i> and, to a lesser extent, <b>qaracha</b> (see Appendix B). Also with leaf cutter ants ( <b>chhaka</b> ). Some people have noticed a "black fly" ( <b>yana ch'uspi</b> , i.e. aphids) associated with ants ( <b>sik'imira</b> ) which cause leaf curl. People described said frost ( <b>qhasa</b> ) causes leaf fall. Unlike other Bolivian communities we have visited (Boa and Bentley 2001), local people here deny having problems with peach leaf curl: they do not recognise the symptoms when described to them and know the word <b>musuru</b> only in its original meaning as maize smut ( <i>Ustilago maydis</i> ). The same <b>jamillu</b> that occurs in molle infests peach, and can cause damage. The <b>chuchuruma</b> epiphyte is also a problem.
Indigenous knowledge	One woman in Apharumiri said that the wilted leaves of peach trees are poisonous to livestock, almost like <b>lluq'i</b> .
Figure	5-28

## Higuera, Higo (*Ficus carica*)

Meaning of folk name	The standard Spanish word for fig tree is <i>higuera</i> , and <i>higo</i> is the fig fruit. Quechua-speaking people often refer to the tree as <i>higo</i> .
English common name	Fig
Uses	<b>Fruit:</b> Mainly eaten at home. Figs ripen during the rainy season, when the road to Apharumiri is closed by the swollen river, so figs cannot be sold to Cochabamba. People haul some to Tapacari for the Sunday market and sell them or trade them.
Habitat & management	A few are planted during August in household gardens in the village.
Health problems	When hailed on, fig trees get <i>sarna</i> . Is damaged by frost ( <b>qhasa</b> ). <i>Polvillo</i> or <b>qaracha</b> cause the fruits to turn hard. Sometimes wind knocks the branches off. Goats can damage seedlings. Leaf cutter ants ( <b>chhaka</b> ) eat the fruits.
Indigenous knowledge	Crops will not grow beneath a fig tree.
Figure	5-29

## Tuna (*Opuntia ficus-indica*)

Meaning of folk name	Standard Spanish, a loan word from Taino, a native language of the Caribbean (Academia Real Española 1984)
English common name	Prickly pear cactus
Uses	<b>Fruit:</b> People eat it and sell some. <b>Fodder:</b> Cattle eat the leaves, especially if people burn off the thorns. <b>Construction:</b> The juice of the leaves can be mixed with lime, to harden it like cement.
Habitat & management	Planted in the village
Health problems	Farmers reported a disease which they could not diagnose (see photo below). They called it <i>sarna</i> (mange), a general term describing scab-like symptoms
Indigenous knowledge	None recorded
Figure	5-30 and 5-31

## Alqu Tuna, Alqu Tunilla (*Opuntia cochabambensis*)

Meaning of folk name	Dog prickly pear
English common name	Not available
Uses	<b>Fodder.</b> Goats and cattle eat the leaves, if the thorns are burned off for them. <b>Food</b> People avoid eating the red fruits, because eating them causes <b>sirk'itas</b> (little warts).
Habitat & manage-ment	Grows wild in the <i>monte</i> .
Health problems	None reported.
Indigenous knowledge	This is one of several plants that are named in the folk taxonomy, not so much because of the plant's importance, but to distinguish it from other, more important ones.
Figure	5-32



FIGURE 0-28 PEACH TREE ON THE PAMPA DURING THE DRY SEASON



FIGURE 0-29 MARTÍN CHINCHILLA WITH A FIG TREE HIS FATHER PLANTED



FIGURE 0-30 PRICKLY PEAR (LOWER LEFT HAND CORNER) IN THE VILLAGE PROPER OF APHARUMIRI. BACKGROUND: CONFLUENCE OF THE RIVER PUCARA (LEFT) AND THE RIVER TAPACARÍ



FIGURE 0-31 AN UNDIAGNOSED DISEASE OF PRICKLY PEAR



FIGURE 0-32 ALQU TUNA

## Tikira (*Schinopsis haenkeana*)

Meaning of folk name	Unanalysable
English common name	(also known as <i>soto</i> in Spanish)
Uses	<b>Fodder:</b> Cattle but especially goats eat the leaves and seeds. <b>Wood:</b> Tool handles and ploughs. With much straightening, it can be used as a plough tongue. Timber for household construction. <b>Firewood:</b> Before the 1952 Revolution, the tree was more common and the hacienda owners made charcoal from it. <b>Kalchas</b> (haystack trees).
Habitat & manage-ment	Grows wild in the <b>monte</b> . Is no longer very common. Can grow on steep rocky places ( <b>qaqas</b> ) where the soil is thin, especially at lower altitudes (i.e. below about 3,000 meters). Is said to attract lightning, so people discourage it from growing very near their homes.
Health problems	None reported.
Indigenous knowledge	The seed is carried in goat droppings. The leaves grow in August, but the tree produces few leaves.
Figure	5-33 and 5-34

## Ch'akatiya (*Dodonaea viscosa*)

Meaning of folk name	Unanalysable (may be a loan word from another, native American language)
English common name	Switch sorrel
Uses	<b>Medicine:</b> The leaves may be warmed and wrapped around the injured hooves of sheep and goats, to heal them. <b>Fodder:</b> goats. <b>Firewood.</b>
Habitat & management	Grows wild and abundantly in the <i>monte</i> , especially in fallow wheat fields and other places where the soil is a bit soft.
Health problems	None reported. An unidentified leaf-and-stem rolling caterpillar called <b>wawa k'iru</b> lives in the sorrel, without causing much damage.
Indigenous knowledge	Cattle and donkeys that eat it become agitated, run about wildly, lick anything white as though it were salt, until their gums bleed. Livestock can lose weight and die from eating it. The cure is to throw clayey soil in their eyes.
Figure	5-35 and 5-36

## Ch'illka (*Baccharis salicifolia*)

Meaning of folk name	Unanalysable
English common name	Not available
Uses	<b>Basketry. Construction:</b> Can be used to roof houses, if there is no <i>caña hueca</i> . <b>Soil conservation:</b> The roots are very "hard," so it is a good plant to grow along the river walls, to protect the <b>pampa</b> from erosion. <b>Fodder:</b> some say goats eat it, but others deny this. <b>Firewood.</b>
Habitat & manage-ment	Grows wild and thrives along the edge of the river.
Health problems	None reported.
Indigenous knowledge	The seed is carried in river mud.
Figure	5-37



FIGURE 0-33 TIKIRA (*soto*), CLOSE-UP OF LEAVES. CHUCHURUMA EPIPHYTES IN BRANCHES



FIGURE 0-34 LARGE TIKIRA GROWING ON THE EDGE OF THE MONTE, IN THE VILLAGE PROPER OF APHARUMIRI



FIGURE 0-35 CLOSE UP OF SWITCH SORREL



FIGURE 0-36 SORREL ON THE ANKHARA RIDGE. SNOW CAPS OF MOUNT TUNARI IN THE BACKGROUND.



FIGURE 0-37 MARTÍN CHINCHILLA IDENTIFIES CH'ILLKA



FIGURE 0-38 KHIÑI

## Khiñi (*Colletia spinosissima*)

Meaning of folk name	Unanalysable
English common name	Not available
Uses	<b>Fodder:</b> Excellent for goats. <b>Firewood:</b> Mediocre. <b>Farming:</b> When ploughing a fallowed field, farmers cut and burn the <b>khiñi</b> , which improves the soil.
Habitat & manage-ment	Grows wild in the <i>monte</i> .
Health problems	None reported.
Indigenous knowledge	None recorded
Figure	5-38

## Waych'a (*Senecio clivicolus*)

Meaning of folk name	Dishevelled, unkempt (e.g. said of hair)
English common name	Not available
Uses	<b><i>Medicine:</i></b> leaves rubbed on twisted arms to relieve pain.
Habitat & management	Grows wild on the <b>pampa</b> .
Health problems	None reported.
Indigenous knowledge	The seed is carried by wind. Animals will not eat it.
Figure	5-39

## T'ula (*Baccharis* sp.)

Meaning of folk name	Unanalysable
English common name	Not available
Uses	<b>Wood:</b> Light, household construction. Can be used to make corral gates, if there is no <b>thaqu</b> , because the branches do not lose their structure when they dries. <b>Brooms:</b> It is the only plant used for making brooms for sweeping wheat or barley off the threshing floor, because it has small leaves which do not fall off into the grain. <b>Firewood.</b>
Habitat & management	Grows wild and fairly abundantly in the <i>monte</i> .
Health problems	Small groups of 20-30 plants may dry up and die, for no apparent reason. Surrounding plants stay healthy.
Indigenous knowledge	Large wasps ( <b>lachiwanas</b> , possibly tarantula wasps) are attracted to its flowers, and carry off its pollen.
Figure	5-40

## Chhina T'ula (*Baccharis* sp.)

Meaning of folk name	Female <b>t'ula</b>
English common name	Not available
Uses	<b>Fodder.</b> Goats, sheep and cattle
Habitat & management	Grows wild in the <b>monte</b> . Not extremely common.
Health problems	None reported.
Indigenous knowledge	The leaves are sticky. Does not grow beyond the size of a bush.
Figure	5-41

## Luyu Luyu (*Schinus polygamus*)

Meaning of folk name	Unanalysable
English common name	Not available
Uses	<b>Fruit:</b> People eat the fruit, and so do most livestock. <b>Farming:</b> The fallen leaves improve the soil (as with molle and <b>thaqu</b> ). The branches can be used to make fences. <b>Fodder:</b> Goats eat the leaves. <b>Medicine:</b> Scrapings from the plant are heated and placed on paper, applied to the body for muscle aches.
Habitat & manage-ment	Some trees grow in the little strip of wood behind the defensive river wall. A few more grow near the banks of the Pucara River (an ephemeral stream).
Health problems	None recorded
Indigenous knowledge	If the thorns prick people, the sore can become infected. Local people believe that few trees produce leaves that improve the soil: only <b>thaqu</b> , molle, <b>khiñi</b> and <b>luyu luyu</b> .
Figure	5-42

## Ulala (*Eriocereus tephracanthus*)

Meaning of folk name	Unanalysable
English common name	Not available
Uses	<b>Fodder.</b> Goats and cattle. People burn the thorns so cattle can eat the plant. People eat the <b>fruit</b> .
Habitat & management	Grows wild in the <b>monte</b> .
Health problems	People reported a small worm that appears in the fruit and stems. Causes fruit to fall. Can be serious.
Indigenous knowledge	None recorded
Figure	5-43

## Phasakana (*Trichocereus* sp.)

Meaning of folk name	Unanalysable
English common name	Not available
Uses	<b>Fodder.</b> Cattle and goats eat it, if people remove the thorns. People eat the <b>fruits</b> .
Habitat & management	Grows wild in the <b>monte</b> .
Health problems	None reported.
Indigenous knowledge	The fruits are mostly eaten by birds.
Figure	5-44



FIGURE 0-39 WAYCH'A



FIGURE 0-40 T'ULA



FIGURE 0-41 CHHINA T'ULA



FIGURE 0-42 LUYU LUYU



FIGURE 0-43 ULALA



FIGURE 0-44 PHASAKANA

## **Alamo (*Populus deltoides*)**

Meaning of folk name	Standard Spanish for poplar
English common name	Poplar
Uses	<b>Wood:</b> Easy to saw and to work. Used for light construction, for making the goalposts of the community football field. <b>Firewood. Industry:</b> Before the 1952 Revolution, the hacienda owner sold a few trees for matchsticks.
Habitat & manage-ment	People cut branches of poplar, soak them in water, and them along canal banks and other humid areas in the pampa. It is not a very common tree.
Health problems	If humidity enters the trunk, it can rot and break (see photo below).
Indigenous knowledge	None recorded
Figure	5-45 and 5-46

## Japa Japa (unidentified species)

Meaning of folk name	Unanalysable
English common name	Not available
Uses	<i>Fodder.</i> Goats eat the leaves. Can be used as <i>firewood</i> .
Habitat & management	Grows wild in the <i>monte</i> .
Health problems	None reported
Indigenous knowledge	People said that if men sucked the flowers, it gave them an insatiable sexual appetite. Their breasts itch with desire and in extreme cases they can go blind or mad. We did not speak with anyone who had tried it personally. People have observed cattle driven mad by eating <b>japa japa</b> . The plant has abundant blue flowers, "like alfalfa." Animals that eat the flowers run about, and can go blind unless people apply fine, powdery clay to their eyes. When it rains, if goats walk under the wet branches, and rub against the leaves, the goats lose their hair. Women said that <b>japa japa</b> could blind <u>black</u> goats and cows, but made light coloured ones lose their hair; we are unsure what this means, but mention it in the interest of future research.
Figure	5-47

## Mulli Jamillu (*Phrigilantus cunaecifolius*)

Meaning of folk name	Molle jamillo
English common name	Not available
Uses	<b>Paraphernalia:</b> People remove the <b>jamillu</b> by hand, dry it, and burn it to ash and mixed it with boiled potatoes to make <b>llijt'a</b> , which is chewed with coca leaves to help release the alkaloids in coca.
Habitat & management	Grows wild on molle trees.
Health problems	None reported.
Indigenous knowledge	Birds eat the seeds and defecate them onto trees, where they grow and graft themselves into the tree. Local people understand that the <b>jamillu</b> in <b>thaqu</b> is a different species, with larger leaves and with yellow flowers instead of red ones. If a bird defecates a seed from <b>mulli jamillu</b> in <b>thaqu</b> (or visa versa) it does not attach itself. The <b>mulli jamillu</b> will take root on peach trees.
Figure	5-48



FIGURE 0-45 POPLARS AND EUCALYPTUS GROWING ALONG A CANAL BANK IN THE VILLAGE PROPER OF APHARUMIRI



FIGURE 0-46 A POPLAR THAT ROTTED UNTIL THE TRUNK SNAPPED



FIGURE 0-47 JAPA JAPA



FIGURE 0-48 BRIGHT RED FLOWERS OF JAMILLU IN A MOLLE TREE IN THE MONTE OF APHARUMIRI.



FIGURE 0-49 A THAQU IN THE MONTE, LADEN WITH CHUCHURUMA.



FIGURE 0-50 A THAQU, WITH A MODERATE INFESTATION OF CHUCHURUMA, GROWING IN A HOUSEHOLD GARDEN. SOME OF THE TREE'S BRANCHES HAVE BEEN HARVESTED. A WHISK BROOM IS STORED IN THE BRANCHES.

## Chuchuruma (*Eryngium paniculatum*)

Meaning of folk name	Unanalysable
English common name	Not available
Uses	<b>Fodder.</b> Goats.
Habitat & manage-ment	Grows wild on many trees, including molle and <b>thaqu</b> .
Health problems	None reported.
Indigenous knowledge	The same kind of <b>chuchuruma</b> grows on molle and <b>thaqu</b> . It does not hurt most trees, but can "suck the food" from peach trees. It occurs mostly on older trees.
Figure	5-49 and 5-50

## Appendix 5B Pests, Diseases and Other Organisms associated with Perennial Plants in Apharumiri, Tapacarí, Cochabamba, Bolivia

Although this was not a full-time study of pests and diseases, we documented over 20 distinct names for organisms associated with trees. No doubt there are many more, and more that could be said about some of the ones we did collect.

We have made no attempt to organise these categories into folk taxonomies, but many of them would fall under that categories: **khuru**, which refers to arthropods and other small creatures, and **unquy**, which labels diseases and other plant health problems (including those caused by insects).

The following descriptions indicate that local people have a weak knowledge of insect reproduction. But they know very well the host specificity of many organisms (e.g. **jamillu**, **sikas**).

Some of the following labels represent discrete categories of arthropods or diseases, but many are general symptom types, which is probably why some diseases are associated with so many different hosts.

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## Bolita

<b>Meaning of name:</b>	Little ball
<b>Definition:</b>	Large galls on smaller branches
<b>Host:</b>	Thaqu ( <i>Prosopis alba</i> )
<b>Importance:</b>	Not considered very serious. Farmers claimed that small flies (mosquitos) emerged from the galls, and birds ate the flies.

## Chhaka

<b>Meaning of name:</b>	Unanalysable.
<b>Definition:</b>	Leaf-cutter ants, (Hymenoptera: Formicidae: Attini).
<b>Host:</b>	Peach, fig and other trees.
<b>Importance:</b>	Described as a serious pest of fruit trees. Local people recognise 2 kinds of leaf-cutter ant. A red one (puka chhaka), which attacks grain crops, and a black leaf-cutter ant (yana chhaka) which attacks fruit trees. It removes the leaves of peaches and the fruit of figs.

## Chuchuruma

<b>Meaning of name:</b>	Unanalysable.
<b>Definition:</b>	See Appendix B.
<b>Host:</b>	Thaqu, molle and many other trees. Peaches.
<b>Importance:</b>	Not considered a serious pest unless there is a lot of it, although it is considered a pest in peach. Local people say it sucks the food from peach trees.

## Jamillu

(see mulli jamillu, thaqu jamillu)

## K'aspara, K'asparilla

<b>Meaning of name:</b>	Singeing, little singeing.
<b>Definition:</b>	Yellowing or blackening of leaves.
<b>Host:</b>	Thaqu, molle, other trees. Potatoes, broad beans and other crops.
<b>Importance:</b>	This category is a general symptom, more than a disease label. People attribute some k'aspara to cold weather.

## Mulli Jamillu

<b>Meaning of name:</b>	Molle jamillo.
<b>Definition:</b>	A parasitic plant ( <i>Phrigilantus cunaecifolius</i> ) with bright red flowers.
<b>Host:</b>	Molle ( <i>Schinus molle</i> ) and peach.
<b>Importance:</b>	Removed by hand if it infests peach. See Appendix B.

## Musuru

<b>Meaning of name:</b>	Unanalysable.
<b>Definition:</b>	The fungal disease, maize smut ( <i>Ustilago maydis</i> ).
<b>Host:</b>	Maize.
<b>Importance:</b>	Is not considered a pest. It can be fried in oil and eaten. NB: In other parts of Bolivia, musuru is used as the label for other diseases, e.g. peach leaf curl ( <i>Taphrina deformans</i> ) (Boa and Bentley 2001). In Apharumiri, people denied that peach leaves turn red (which is characteristic of peach leaf curl). Maize smut seems to be the original, central meaning of musuru (see Lara 1991).

## Polvillo

<b>Meaning of name:</b>	Little dust.
<b>Definition:</b>	Various kinds of problems, most of which are probably fungus (probably mildew) and aphids, which cover leaves and stems profusely. When people wipe the plant with their fingers they pick up a smear of the bodies of the small organisms.
<b>Host:</b>	Peach, apple, grapes, figs, various row crops (wheat, barley, quinoa, broad beans).
<b>Importance:</b>	Perhaps the most serious tree health problem. Causes heavy fruit loss. Fruit wrinkles (k'usuyapun), dries completely (muquchinchí) and falls. Fig fruits turn hard and black. The leaves turn yellow (but not red), wilt and fall. The powder may be white. One person mentioned ants (sik'imiras) and red insects (bichos rojos) associated with polvillo. Local people associate polvillo with rain and humidity. Damages the roots of plants. The disease was present before the Revolution of 1952. People have no control for polvillo, but want one.

## Psyllids

<b>Meaning of name:</b>	No local name. Called unquylla (just a disease).
<b>Definition:</b>	Psyllid insects (Homoptera: Psyllidae).
<b>Host:</b>	Molle, thaqu.
<b>Importance:</b>	Not considered important.

## Qara, Sach'a Qara, Qaralla

<b>Meaning of name:</b>	Skin (i.e. bark), tree bark, just bark.
<b>Definition:</b>	Lichen.
<b>Host:</b>	Most trees. Rocks (lichen on rocks is called rumi qara: rock skin).
<b>Importance:</b>	Not considered important.

## Qaracha, Sarna

<b>Meaning of name:</b>	Mange. The Quechua term, qaracha, is derived from qara, meaning skin, hide, bark, leather.
<b>Definition:</b>	Probably a general symptom label for any condition with dry or leathery scales or scabs on plants, including fruit.
<b>Host:</b>	Peaches, figs, others.
<b>Importance:</b>	Is considered a pest. Turns fig fruit light brown (uqi) and makes ones mouth hurt if people eat it. Associated with hail in peaches. Ruins peach fruit.

## Qhapa

<b>Meaning of name:</b>	Mites. The original, central meaning was probably mites that infest hens.
<b>Definition:</b>	Probably includes various small arthropods, not only mites but Homoptera too.
<b>Host:</b>	Willow.
<b>Importance:</b>	Most people do not consider it a pest in willow. There is a qhapa in alfalfa which is described as having a web, so it probably is a mite. The qhapa in willow is almost certainly a Homoptera, because people say it exudes a honeydew (misk'i), which covers the leaves. Goats and guinea pigs like to eat the sweet, fallen leaves. Local people are unconcerned about the damage to the willow trees, but do observe the effects on livestock of eating leaves with honeydew. One man said that animals could get diarrhoea if they ate the fallen leaves.

## Qhasa

<b>Meaning of name:</b>	Frost.
<b>Definition:</b>	Frost and cold.
<b>Host:</b>	Many trees, including peach, fig.
<b>Importance:</b>	Moderate. People notice that cold weather causes some trees to yellow and lose their leaves.

## Sarna

(see qaracha)

## Sarna en Tuna

<b>Meaning of name:</b>	Prickly pear mange.
<b>Definition:</b>	Unidentified disease.
<b>Host:</b>	<i>Opuntia ficus-indica</i> .
<b>Importance:</b>	People in Apharumiri showed us one severely affected plant (see "tuna" in Appendix B), but they did not know the cause of the disease.

## Sika, Sika Thapa, Sika Sika, Mulli Sika, Thaqu Sika etc.

<b>Meaning of name:</b>	Sika means caterpillar, especially hairy, gregarious ones. Sika thapa means "caterpillar nest" and refers to some of the egg clutch coverings, pupa cases and other structures that some of these species make. Sika sika means group of or many caterpillars. Mulli sika means molle caterpillar. Thaqu sika means thaqu caterpillar.
<b>Definition:</b>	Larvae of various species of gregarious lepidoptera, possibly <i>Hylesia</i> spp. (Saturniidae).
<b>Host:</b>	Molle, thaqu and others, including alfalfa and some kinds bushes.
<b>Importance:</b>	Considered very important as a nuisance to humans. If people accidentally brush against the urticating hairs of these insects, the pain is agonising, causes fever (q'ajachin) and large welts form. People distinctly recognise that the hairs of the insects are the source of pain. Livestock can die if they eat sikas. The sika of molle hurts worse than the one on thaqu. People can describe in detail how the mats of these hairy creatures cover tree bark, and how the caterpillars move in long lines, single file, as though glued together, from one tree to the next. Local people do not recognise the relationship between larval and adult lepidoptera (they deny that moths lay the eggs of caterpillars). When the sika pupate, local people think they have died. However, people definitely recognise that different host plants have different kinds of sikas, and that the mulli sika cannot eat <i>Prosopis</i> leaves, and the thaqu sika cannot eat molle leaves. Sikas appear late in the dry season, which led one man to guess that cicadas (t'isikiras) either lay sika eggs, or that the sikas come from the urine of cicadas: because the sikas appear just as the cicadas vanish.

## Sik'imira & Yana Ch'uspi

<b>Meaning of name:</b>	Ant and black fly
<b>Definition:</b>	Sik'imira includes ants that are not leaf-cutter ants (Hymenoptera: Formicidae, but not Attini). The "black fly" is probably aphids, which are often associated with ants.
<b>Host:</b>	Peach and other trees.
<b>Importance:</b>	Fairly important, some people probably confuse polvillo with aphids.

## Taladro

<b>Meaning of name:</b>	Drill.
<b>Definition:</b>	Probably the blue gum borer ( <i>Phoracantha semipunctata</i> (Fabricius), Coleoptera; Cerambycidae) (CABI 1999).
<b>Host:</b>	Eucalyptus.
<b>Importance:</b>	Very important. Local people desperately want a control for this insect, which they say is drying and destroying the eucalyptus which they have recently planted in larger numbers. Villagers are unsure of the life history of the borer, but think it may spend part of its life in the earth. They describe the insect as a grub (laqatu) and have little or no idea of what the adult is like.

## Thaqu Jamillu

<b>Meaning of name:</b>	<i>Prosopis jamillo</i> .
<b>Definition:</b>	A parasitic plant ( <i>Tristerix penduliflorus</i> ) with yellow flowers.
<b>Host:</b>	Thaqu ( <i>Prosopis alba</i> ).
<b>Importance:</b>	Not extremely common, but people said it can dry up a thaqu tree. Local people realise that the plant is spread by birds, which eat the fruit and defecate the seeds on the branches of other trees, where the seeds germinate and graft themselves into the trees. People also recognise that the jamillo of molle cannot live in thaqu, and visa versa, although the birds may deposit the seeds in any tree. People remove jamillo from thaqu, and feed it to sheep and goats.

## **Wawa K'iru**

<b>Meaning of name:</b>	Baby swaddling.
<b>Definition:</b>	Unidentified lepidoptera larvae that cover themselves with a case of silk, with bits of leaves and twigs incorporated into it.
<b>Host:</b>	Sorrel and other plants.
<b>Importance:</b>	Not considered a pest.

## **Wayrunk'u**

<b>Meaning of name:</b>	Unanalysable.
<b>Definition:</b>	Large, unidentified cavity-dwelling social wasps (Hymenoptera: Vespidae)
<b>Host:</b>	Nest in hollow willow trees.
<b>Importance:</b>	Not considered a pest.

## Appendix 5C Geographical and Historical Background for Case Study in Apharumiri, Tapacarí, Cochabamba, Bolivia

### The Land

The Tapacarí canyon is a deep cut in the Palaeozoic sandstone and shale of the East slope of the Bolivian Andes. At 2,800 meters above sea level, the canyon bottom is warm. Frost is rare: mild, dry winters (June through August) and warm rainy summers. The forest type is low subtropical dry montane forest (Barrenechea 1989), although that distinction is largely academic, since so little of the original forest is left. The canyon sides are dotted with remnants of Molle, *Prosopis*, *Kageneckia*, *Schinopsis*, and various shrubs. Sorrel is the most important shrub, because it rapidly colonises disturbed soil (e.g. abandoned wheat fields). Cutting firewood, clearing cropland and browsing by goats and sheep have all diminished the original forest.

### The River

The bed of the Tapacarí River in the bottom of the canyon is several hundred meters wide. It is mostly white sand, but it is laced with red sands and sedimentary and metamorphic boulders. In the dry season the river is a ribbon of clear, salty water, twisting through its oversized bed. In the rainy season it runs muddy from bank to bank.

### The Agro-Forest

From the lunar surface of the riverbed to the goat-stripped sides of the canyon walls, there seems to be no forest worth writing about. But just above the riverbed, the farm villages are built into thriving anthropogenic agro-forests of native and introduced trees: cultivated for timber, fruit, for making handtools, medicines, for browsing animals, firewood, to conserve the soil, and to make barriers against goats. There are even trees carefully shaped into what look like large nests, for storing animal fodder.

### History

In the centuries before the Spanish Conquest, the Quechua-speaking people of the Inca Empire conquered what is now Cochabamba, in Central Bolivia. They farmed the immensely fertile Cochabamba Valley for maize, which they hauled to Cusco on herds of llamas. The road went up the Tapacarí canyon, through its headwaters to the Altiplano, and around the shores of Lake Titicaca (Deheza *et al.* 1986). After the Conquest, many Indians abandoned the Tapacarí area to escape colonial taxes and to work in the rapidly emerging commercial agricultural sector of the Valley of Cochabamba (see Larsen 1998). Many others died. Their numbers were partially replaced by newcomers from Spain and Africa. Goats, sheep, donkeys, cattle, horses were introduced as well as a few crops, especially wheat, barley and peaches. Diseases and the holocaust of colonial silver mining continued to reduce the local population until about the late 19<sup>th</sup> century. Much of the native forest may have been lost about this time, which must have contributed to the massive floods on the river. From 1911 to 1918 the 400-year-old colonial town of Tapacarí was completely buried in alluvium. The survivors rebuilt it at the confluence of the 4 rivers that form the Tapacarí River.

## Haciendas

In 1866 the republican government of Bolivia passed a law requiring a small land tax. Landowners who did not pay the tax had their land taken away and given to those who paid the tax for them. A few Quechua-speaking farmers paid their tax, but most could not or did not know about it. Spanish-speaking elites quickly confiscated the best Indian lands and with government help, forced the native people to work as serfs (Mesa *et al.* 1997). The Indians worked for at least 3 days a week without pay on the hacienda. They were given the use of small plots of land on which to grow their own food. In many parts of Bolivia, the hacienda owners used Indian labour to build massive adobe houses. But in Tapacarí, the *hacendados* had a more productive use for this captive labour: building large stone walls into the riverbed, to capture silt at the start of the rainy season. Layer by layer, the neo-feudal lords acquired strips of deep, fertile irrigated land along the riverbed. The people planted rows of native willows along the edges of the new beaches to stabilise and conserve the soil. Hacienda owners oversaw the planting of orchards of mixed fruit, of peach, apple, fig and the occasional pacay (*Inga edulis*) near the manor house.

## The Revolution

In 1952, the miners and the farm workers overthrew the government, expelled the multinational mining companies and drove the hacienda owners into the cities. The senior military officers were replaced by younger men. The new government formalised the transfer of hacienda land to the former workers, and organised them into *sindicatos*, farm unions with elected officials. Each hacienda became a union, with each household having voting and land rights. They owned the land collectively, but farmed it individually. These rights were formalised by the agrarian reform of the mid 1970s.

## Trees

Since the 1952 the Quechua-speaking farmers of Apharumiri (a village 5 kilometres downstream from Tapacarí) have continued to thin the remnant forest on the canyon walls. But they have built on the land use styles of the hacienda period (1866-1952), planted more trees and have shaped the agro-forest described in this report. They have 3 broad categories for land use types:

**Pampa.** The irrigated flatland built up from the river bed. Ringed by a defending wall of willows, eucalyptus, **ch'illkas** and other trees, but with few trees in the centre.

**Llajta.** The village proper, with its dense agro-forest of *Prosopis*, molle, fruit and other trees.

**Monte.** The degraded native forest of the semi-arid canyon walls.