

**Nuosu Biodiversity and Ethnobotany: A Case Study in Yangjuan Area, Yan Yuan  
County, Liangshan Autonomous Region.**

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## **Abstract**

The study we performed was a focused survey on the flora of Sichuan in a specific area within the Liangshan autonomous region, at remote Yi minority villages called Yangjuan, Zhuchang, Pianshui and Gangou. Our goals were to complete a collection study of the endemic species in that area by creating a plant database that could eventually be used as a teaching tool. Plans included visiting Yangjuan and surrounding villages periodically over the course of a year in order to assess the vegetation that grows during each season. Plant samples from various locations within and near the villages were collected in triplicate and then brought back to Chengdu where they were pressed, dried, and identified to species using [The Flora of China](#) keys published online in PDF format by Harvard University. The identified species were mounted on archival paper and brought back to the village to serve as teaching materials. An ethnobotany portion of our survey was also conducted for the purpose of assessing how the Yi people in of this region made use of the plants surrounding their villages. Group and individual interviews were held, revealing a wide range of plant uses. The species we collected had various uses, including edible, animal fodder and medicinal. Use intensity was found to be low for native edible and medicinal plants, while shrubs collected for animal fodder and fuelwood had high use intensity. Using this data, a rough estimate of the biodiversity and intensity of native plant resource use will be made. In the future, a teaching curriculum will be created to include traditional knowledge of plants in a pre-dominantly culturally Han Chinese teaching curriculum. We hope that future generations of Nuosu will be encouraged to appreciate their cultural knowledge.

## **Introduction**

In order to understand the ecological relationship between flora and their environmental surroundings, the first step is determining the array of species that occupies a certain area. Only then can one begin to observe the complex interactions between plants on an individual, communal, and environmental scale. Through this, one can begin to distinguish the key players that shape a community. In order to do this, it is important to document the various plant species growing in that region, and create a database of the observed biodiversity. However, plant community interactions are not only limited to the plants, but extends to the natural world around them, as well as human influences. A joint study of both biodiversity and ethnobotany can be performed by investigating plant use by locals through collecting samples and carrying out interviews. Sichuan province is renowned for its immense plant biodiversity, and the area it spans encompasses much of China's endemic species. The Liangshan autonomous region within this province offered valuable resources to allow a primary survey to be performed at remote Yi minority villages called Yangjuan, Zhuchang, Pianshui and Gangou.

Between June 2002 and June 2003, 5 plant collection/interview trips were made to Yangjuan by professors and exchange students from the University of Washington. During these trips, plants were pressed and made into herbarium specimens that would not only serve as documentation and reference for future researchers, but would also be used as a botany teaching tool for the local elementary school. Plant usage, such as human consumption, animal feed, fuelwood and medicinal were obtained through interviews with the locals. Recommendations can be offered for what the people in Yangjuan and surrounding villages can do to both preserve and promote the biodiversity within their area.

## Plant Diversity in Sichuan Province

Sichuan is one of China's largest provinces, and its climate is often described as wet subtropic, though its ecological conditions vary from alpine-arctic to subtropical. Its diverse landscape has proved to be favorable for rich evolutionary speciation. Tropic-subtropic and temperate species dominate its vegetation, while Arctic and tropic plants contribute to only a minor part of Sichuan's flora. The province is second behind Yunnan in biodiversity of angiosperms and ferns, but is the richest province of China in gymnosperms. The high mountain areas in Sichuan's west and southwest also provide important centers of diversity for temperate genera such as *Rhododendron* (*Ericaceae*), *Primula* (*Primulaceae*), *Gentiana* (*Gentianaceae*) and *Saussurea* (*Asteraceae*) ("Plants Resources of Sichuan").

Cataloging the variety of species that grow in southwest Sichuan is an ongoing process. The area of Sichuan that we collected in is called the Liangshan autonomous region, and is considered part of the western highlands. Its climate is affected by both the southeastern and southwestern monsoons, causing the composition and vertical distribution of its vegetation to take on features characteristic of both alpine mountains and valleys. These monsoons also produce distinct yearly drought and rain periods, so winters are quite dry while summers can be very damp. Many drought-resistant species within *Fagaceae* can be found here, as well as subtropical coniferous forests comprised of *Pinus yunnanensis*, *Keteleeria evelyniana*, and *Cupressus duclouxiana*. *Pinaceae* and *Cupressaceae* are the most abundant gymnosperm families in Sichuan province ([Plant Resources of Sichuan](#)).

In comparison, the gymnosperms we collected include a small number of shrub oaks from genus *Quercus* (*Fagaceae*), identified as *Q. pseudosemecarpifolia* A. Camus, *Q. monomotricha*, *Q. aquifolioides*, and *Q. senescens*. The substrate they grow upon varies between each sample, including limestone, sandstone, and grassy meadows. While our collection does not include *K. evelyniana* from genus *Keteleeria* (*Pinaceae*), we located and collected one sample of *K. davidiana*. From *Cupressaceae*, we collected *Juniperus formosana*.

According to "Plant Resources of Sichuan", approximately 2,500 different medicinal plants might be found in this area. Of the expected examples listed in their article, we collected and identified species within the following families: *Ranunculaceae*, *Phytolaccaceae*, *Berberidaceae*, *Rosaceae*, *Fabaceae*, *Araliaceae*, *Apiaceae*, *Ericaceae*, *Gentianaceae*, *Scrophulariaceae*, *Dipsacaceae*, *Campanulaceae*, *Asteraceae*, *Poaceae*, *Araceae*, *Liliaceae*, *Dioscoreaceae* and *Iridaceae*.

The most variety of species collected and identified in our sample of these families falls within *Asteraceae*, *Ericaceae*, *Lamiaceae*, *Ranunculaceae*, and *Rosaceae*. While at first glance our data may cause these families to seem exceptionally prevalent throughout the surveyed areas, this is not necessarily true. These families are large and complex, and known to contain a wider variety of species than many other plant families, abundant even in the Pacific Northwest. The perceived biodiversity from the samples collected in these families may be simply due to their immense number of genera and species rather than being particularly diverse in this region. The large number of species found in the *Lamiaceae* family is characteristic of southwestern Sichuan, and is to be expected. This also holds true for numerous species within the *Rhododendron* genus in *Ericaceae*.

## **Methods and Materials**

During the week-long research trips to Yangjuan, Pianshui, Zhuchang and Gangou we were guided by someone native to the area. At every site, for each new plant species not previously collected, we collected enough for three herbarium samples. We went by the rule that only one plant will be collected for every ten plants we saw of a species. Therefore, if there were fewer than ten plants, we did not collect that rare species. Also we tried to collect plants that had flowers, fruit and roots. In addition to collecting plants, a geographical information system (GIS) reading was taken. This allowed us to know exactly where and at what elevations plants were found.

After collecting plants, we returned to the school in Yangjuan. While the plants were dried we took detailed notes on each plant's characteristics that may be lost due to drying, such as the color of flowers and stems. Next, local people of knowledge were asked to give Nuosu plant names and uses. Ashy, one of the village elders, has an extraordinarily broad knowledge of plants and was the main interviewee for our project. Nuosu names were recorded. The uses of the plants are often for human consumption, animal feed and medicinal use. After being described, the plants were dried using plant presses and brought back to Sichuan University for identification.

Household interviews allow more questions about which plants are collected throughout the year, what they are used for, when they are collected, when they bloom and much more to be asked. Interviews were conducted with 22 people in Yangjuan of varying age, gender and place of residence. The information was compiled and analyzed for any trends. See section on plant resource use and plant knowledge variation.

At Sichuan University, plants were identified using The Flora of China keys published online in PDF format by Harvard University in English, 3-D microscope, plant dissecting tools and hand-held magnifying lenses. After each plant species was identified to species, they were formatted onto paper and given tags for herbarium samples—a collection label and a formal label. The collection label had a line for the date collected, collectors, where collected, type of plant, description of fruit, description of flower, description of roots and more. The formal label had fewer lines for the Nuosu name, Chinese name, scientific Latin name, common name, date collected, collectors and habitat. Mounted specimens were then returned to the Yangjuan elementary to be used as an ethnobotanical reference collection.

## **Description of Bioregion and climate**

Yang Juan is located at approximately 27.4°N, 101.2°E at an elevation of 2500m. Although exact climatic data is not available for Yangjuan and surrounding villages, data of Lijiang (26.9°N, 100.2°E and elevation of 2393m), whose climate is very similar to Yangjuan's, is available from the Carbon Dioxide Information Analysis Center (CDIAC). Some of the principal investigators at the CDIAC include Shiyao Tao, Congbin Fu, Zhaomei Zeng, Qingyun Zhang and members of the Chinese Academy of Sciences.

The majority of rainfall occurs during the monsoon season, between June and September. During this period, there is a combined precipitation of over 800mm, where as the rest of the year, particularly between November and April, is considerably dry with little rainfall (Figure 1).

Throughout the year, due to its higher elevation, Yangjuan has a relatively cool climate. Average summer highs are around 19-24° C and lows around 14-18°C, while winter nights are

almost uniformly below freezing, and even in clear, high-elevation conditions, daytime temperatures rarely rise over 10°C (Harrel, 4).

In the region, there have been 3 major forest cuttings over the past 40 years, and tree branches are still being cut and collected for human use. The cool climate, with a sharp contrast between dry and heavy rainfall season create a rather challenging condition for plant regeneration after such disturbances. The forest stands of the area (from approximately 2500 ~ 3000m elevation) consist primarily of young *Pinus yunnanensis*, which is a pioneer species capable of withstanding moderately harsh conditions. Other species in the overstory include those in the *Quercus*, *Alnus*, *Viburnum*, and *Rhododendron* genera. *Viburnum* and *Lyonia* compose the greatest portion of the understory. Most of the pine forests cover the lower mountain region (2600 ~ 2900m), and the middle mountain story (2800 ~ 3100m) forest consist mainly of *Oak* and *Rhododendron* with some fir, larch and spruce as well. Even higher in elevation are the grassy meadows with occasional patches of oak trees. The grassy meadows are rich in herbaceous species, including some orchids (Harrell, CNH draft, p6). A little lower in elevation from the mountainous region (2600 ~ 2750m) is a vast story of sandstone substrate, and even farther down (2500 ~ 2650m) are the limestone benchlands sparsely covered with *Berberis* and *Quercus* shrubs. The benchlands have numerous Karst sinkholes, which have formed through many years of water eroding the limestone substrate. The depths of these sinkholes provide more moisture, creating a microclimate quite different and rich with lots of herbaceous species.

Figure 1. Precipitation at Lijiang

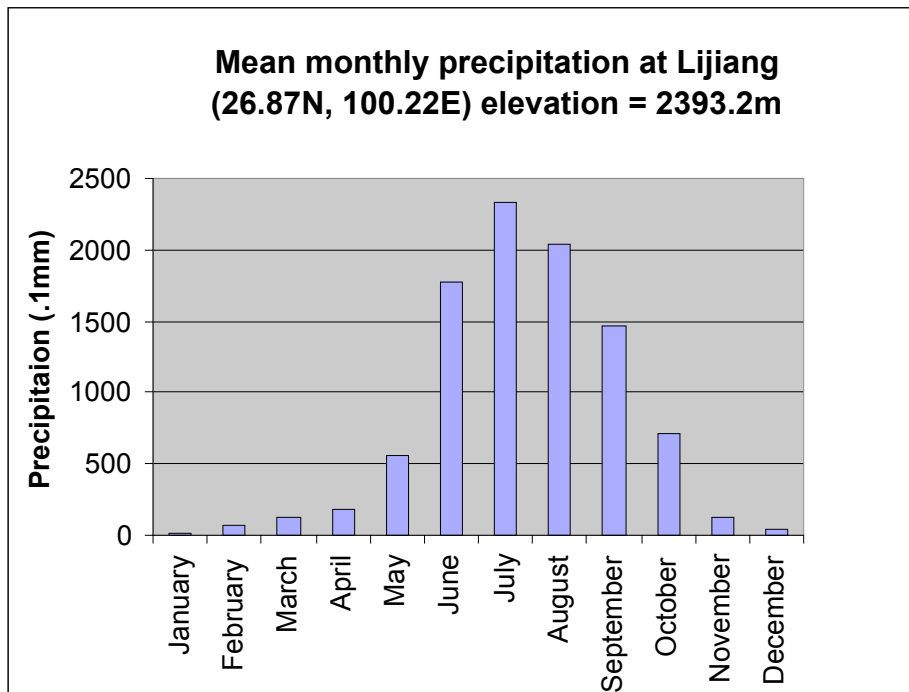
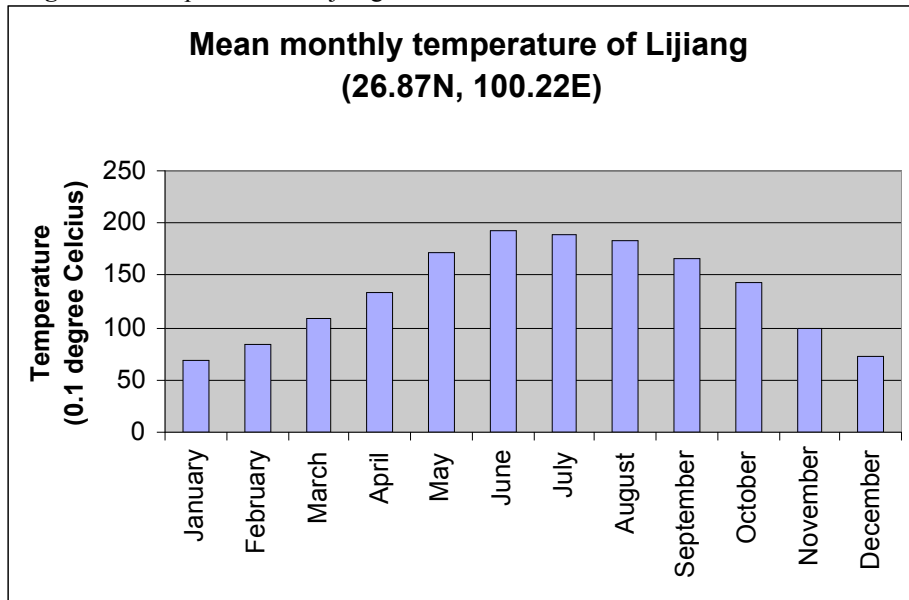


Figure 2. Temperature of Lijiang



### Yi Minority

Within the provinces Yunnan, Guizhou, Guangxi and Sichuan there are about seven million Yi. The Yi minority is one out of fifty-six ethnic groups in which the People's Republic of China has divided its' population. Han Chinese make up about 91% of China's population. Thus, every other ethnic group is considered a minority group. Yunnan is home to four and a half million Yi, half a million live in Guizhou and only a few thousand reside in Guangxi (Harrell 2001). In Sichuan there are about two million Yi, 1.8 million live in the Liangshan Autonomous Prefecture. These 1.8 million Yi are also known as Nuosu. The University of Washington has chosen to study an area encompassing four small villages--Yangjuan, Pianshui, Gangou and Zhuchang. The villages are in Yanyuan county which is a part of the Liangshan Yi Autonomous Prefecture. There are about 800 Nuosu within 202 households living in the four villages.

The land the Nuosu live in is known to them as Nuosu Muddi or Nimu, which translates into the land of the Nuosu. Others call it Liangshan, which means cool mountain, because its' winters carry frost, cold winds and sometimes snow.

Nuosu Muddi lies between plains, hills and medium-elevation plateaus of Southwest Sichuan. Because the lie of the land is covered with hills and plateaus, many Nuosu homes are isolated from others or small villages are formed with a few houses grouped together. It is rare to see large Nuosu villages. If a large village is formed it is likely because the land the village lies on is flat and near a stream or river. Their walls are built of wood boards (planks), piled stones or packed mud. Roofs are made of straw thatch, wood shingles held down by rocks or overlapping stone slabs. Inside the house, the simple furniture sits on floors of packed earth (Harrell 2000).

Families often gather

for meals or conversations around their circular hearth, which is in the center of the main room.

Through farming and herding, the Nuosu have learned to live off the land. Since it is too high above sea level and too cold, they are unable to grow rice. Instead they harvest other grains and vegetables that grow at higher elevations. That is, corn and wheat grow in middle-elevations and oats grow at high elevations. Potatoes and buckwheat grow nearly everywhere.

Agriculture in this area is not very productive. At the end of a day, a usual meal consists of a pile of potatoes roasted and peeled by hand (Harrell 2000).

Any land that is not suitable for agriculture is pastureland for horses, cattle, sheep, goats and pigs. Nuosu use horses for transport, work and pleasure. That is, horses are raced occasionally. Cattle are used for food and work. Sheep provide wool and meat for them. Goats provide milk and meat. Pigs are only a meat resource. Chickens usually kept in the courtyard of the house, provide meat and eggs. Because meat is often hard to come by, it is usually saved for special occasions, like weddings, funerals, holidays or the arrival of guests from far away. When a special occasion occurs, the minimum gift is a pair of chickens, then a pig, then a sheep or a goat. Killing an ox for the feast is the greatest gift anyone could give (Harrell 2000). Animals are extremely valuable to Nuosu people.

The Nuosu living in the Liangshan Autonomous Prefecture live a simple life. They live a life that seems untouched by the large Chinese cities around them. Unlike the cities around them, most houses do not have electricity. Instead they depend on candles and fires at night. Although children wear jeans and sweaters, some adult men and women still wear traditional Yi clothing. Their culture has changed a little, but for the most part the outside world has failed to make Nuosu people assimilate with the Han Chinese culture (Harrell 2001).

### **Plant collection data**

215 botanical collections were made for a reference collection to remain in the village elementary school, as well as for the Sichuan University and University of Washington herbaria. 78 of the collected plants either had no Nuosu name, the person asked didn't know the name, or we were unable to find someone to ask before the plants needed to be pressed. Conversely 109 Nuosu plant names were recorded for plants we had no opportunity to collect. This brings us to a grand total of 324 plants we have either collected or whose existence we are aware of. Out of 228 plant names in our sample, there are 215 different and distinct plant names.

### **Ethnic plant identification and classification methods**

For the majority of our Nuosu ethnobotany study, we have had one informant. Mgebbu Ashy is the head of the primary branch of the Mgebbu clan in the village of Yangjuan. He is 71 years old, and has witnessed a time of great change and upheaval in his people and community's way of life. Born into an upper class family in Pajyyidde, about 2 kilometers west of Yangjuan, Ashy would have become head of his village had Chairman Mao's policies not intervened. Previously scattered families moved to create the village of Yangjuan, and were subsequently forced into collectivized agriculture and herding. Since the economic reforms of the Open Door Policy, some land has returned to private ownership, while some remains collectively owned. The people of the area have remained in the villages.

Mgebbu Ashy has an almost encyclopedic knowledge of plants and plant names. He was assisted in identifying plants by several of his children, daughters Mgebbu Jygy, 36 and Mgebbu Ajia, 34 and his son, Mgebbu Lunzy, 46 all of whom speak either Mandarin or the Sichuan dialect. We have been limited to Ashy's family partly out of convenience and partly due to the nature of collecting botanical specimens. While collecting in the field, we generally encountered few people who could identify plants on the spot. We were hampered by language barriers, as we speak limited Mandarin and do not speak Nuosu. Many of the villagers speak a limited amount of the Sichuan dialect. Furthermore, we were under pressure to press and dry the



collected specimens before they wilted. It was more convenient to bring our specimens to Ashy directly after collecting and ask him to identify them the same day.

At this point in the study there has been no structured analysis of ethnic plant classification methods. Hypotheses to date are based on observing Ashy as he picks up plants and examines them. Ashy uses several techniques to identify plant specimens.

When asked to identify plants, Ashy first examines the leaves. Plants with very similar leaves may be given the same name. For instance, two *Lamiaceae* spp. are both called **mupssenapbbo**. **Colt's ears!** The flowers differ in size and color (lavender and dark purple). However the leaves on each plant are large (approx. 9cm in length), deltate to ovate and abaxially pubescent.

Plants with similar leaves may also be lumped into a generic<sup>1</sup> plant category. Plants with narrow, linear leaves (resembling blades of grass) and no outstanding morphological features, such as showy flowers or rhizomatous roots, may be called **zhet**. Another generic term for herbaceous plants, in this case with wide leaves, is **bbut**. It is not clear whether there is a gray area between these categories, such as a plant with narrow, linear leaves, that does not resemble grass (*Poaceae* family spp.).

After examining the leaves, Ashy will look at flowers and roots. Some medicinal plants can be immediately identified based on the size, shape and number of fleshy rhizomes. Roots are commonly the useful part of a medicinal plant.

If looking at leaves, roots and flowers is not sufficient to identify the plant, Ashy may smell the plant or crush the leaves and smell them. He may also ask for a description of the location and habitat of the collected plant.

To our knowledge, formal training in Nuosu plant identification is limited to Bimo education. Bimos are religious leaders and doctors, who use plants both medicinally and for ceremonial purposes. Although Ashy has not had formal training, he clearly uses a logical dichotomous system to identify plants. However, his identification methods may or may not be identical to other people's techniques.

In future research it will be necessary to interview more local experts, such as other village elders and Bimos.

### **Plant naming**

It is generally accepted that not all plants will have ethnic names (Berlin 1992). However, the fact that many plants do have ethnic names, regardless of whether they are culturally useful, shows evidence of basic human curiosity. Further analysis of names given to plants also shows a propensity to compare and contrast different plants, different living organisms, and different living spaces or habitats.

In the first section we will introduce the idea of plant recognition or salience. In the second section we will discuss the perceptual and cultural salience of named and un-named plants. In the third section we will use examples of Nuosu plant names to introduce the ways ethnic plant names reflect systematic classification.

### **Perceptual and cultural salience**

Whether a plant is significant enough to receive a name depends on multiple factors. These are divided into two categories, cultural salience and perceptual salience (Hunn 1999). Cultural salience is the likelihood a plant will be recognized due to its cultural significance. The cultural

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<sup>1</sup> "Generic" in this case refers to a folk generic category (Berlin 1992).

significance of a plant can also be further broken down by individual people's interest level in the plant. People performing different activities, such as fishing vs. farming, will use and recognize a different set of plants.

Perceptual salience is the likelihood plant characteristics will even be recognized or taken note of. It depends on the available reference plants, or similarity to other known plants, and is not culturally dependent.

Within the perceptual salience category there is arguably a subcategory ecological salience (Hunn 1999). This reflects the biogeography and the interaction of people with the plant. A plant with a wide distribution or high abundance is more likely to be recognized than a plant with a small distribution and low abundance. A plant encountered in the course of normal daily activity is also more likely to receive recognition than a plant growing outside of commonly frequented areas.

Another factor is size. The smaller the plant, the less likely it will be noticed and named.

Of the 72 unnamed plants in the sample, eleven were found around the rim of or inside Karst sinkholes. These areas are not frequented as commonly as the surrounding grasslands. In a normal daily activity, such as grazing sheep, Ashy would not be as likely to sit and observe plants in a sinkhole as he would elsewhere, because of the extreme slope and lack of adequate graze in a sinkhole. Seven unnamed plants were found in Apilapda, a river valley used extensively for grazing. During the period of our fieldwork, Ashy was not observed grazing sheep or doing any other activities in this area. Two other unnamed plants were collected along the road to Baiwu.

#### **Plants with no name and no use:**

We start off with this category in order to establish reasons why a plant may not have any particular salience. Of our collected specimens, 16 had no name, and our informant Ashy assured us they were not culturally useful in any way. A further 56 specimens were unnamed, and no use was given. In some of these cases we may have failed to ask explicitly whether or not the plant was useful. The 16 species with no name and no use have a few similar characteristics. However, no one characteristic stands out as contributing to the insignificance of these plants.

Out of 16 species, two have very small leaves, four have basal leaves and two have linear leaves resembling blades of grass. Three out of 16 plants also have dark purple or very dark leaves. Seven out of 16 have white flowers; three have yellow, and three have purple; the flowers are also generally small. However, a *Spirea* species is also included in this category, and it is a large woody shrub with showy sprays of purple flowers.

If the hypothesis that Nuosu identify plants by their leaves is correct, small indistinct leaves could lead to a plant going overlooked and unnamed. In the case of plants with basal leaves, these may be overlooked because the leaves can easily be hidden beneath a layer of grass and other herbaceous plants. Especially if the flowering season is short and the flowers are small, these plants are also likely to go unnoticed and unnamed.

Two of the specimens with no name and no use were also quite dry when shown to informants. Dry specimens are much more difficult to identify.

There seem to be no patterns to determine why these plants have no names. We can only speculate according to the discussion above, that most of these plants are small and grow in out of the way locations. In addition, there may be other informants who know a name for some of these un-named plants.

### **Useful plants with no name or unknown names:**

Out of the 4 plants in this category, 3 are medicinal and 1 is animal fodder. One of the medicinal plants is *Panax notoginseng*, a very commonly used plant in Traditional Chinese Medicine (TCM) and well known in the US. The Mandarin Chinese name is **sanqi**. Chinese names for several other medicinal plants (**huangqin**, **mudanpi**) have been borrowed and are used by Nuosu at least in the Yangjuan area. In this case, no informant gave us a borrowed name. One other medicinal plant (*Orchidaceae*, genus *Spiranthes*) has roots that are used medicinally but no Chinese name was mentioned. The third medicinal plant is a *Geranium* species. Two other *Geraniums* are called by the borrowed name **daokouyao**, which in Mandarin literally means "knifewound medicine." The chances that this *Geranium* has a different name are very small, as it strongly resembles the other two. It is likely that we never got around to asking someone the name for this plant.

The animal feed plant has a blue and white flower. No other description or the animal that eats this plant is given.

Overall, useful un-named plants in our sample generally do have names, but knowledge varies between informants, or we may have omitted the plant in our plant interviews.

### **Named plants that are not useful:**

This is perhaps the most interesting category, as it more readily shows a common curiosity in the natural world (as opposed to the cultural world).

To start off, there are 5 plants with names, but uses are unknown. In this case, we know there is some use, but we were either unclear what it was (issues in translation), or our informants told use the plant was useful, but didn't know anymore what it was used for. 40 plants out of the collection have names but no use. Many of these have either brightly colored flowers, or they bear resemblance to crop plants. Exceptions include ferns, and an *Acer* species as well as many plants with small flowers. Bright colors make these flowers more noticeable and more likely to be named. Resemblance to crop plants creates familiarity by association. Easily recognizable plants are more likely to have names than plants with indistinct characteristics.

### **Trends in plant names:**

Commonly shared morphemes in plant names include **syp** (nut or fruit), **bbut** or **bbut cy** (**bbut cy** = medicine), **zze** (**zze lu** = food), **zza** (**zza lyp** = grain), **lyp** (**lyp** = seed), **vie** (flower), and **bbo** (tree). Each of these syllables is related to plant classification or indicates an edible plant. However, edible plants don't necessarily include **zze** or **zza**. Three plants species have names ending with **bbut cy**. All three are medicinal. One has roots that are crushed and applied to bug bites, one is used for fatigue, and one is cut into pieces and put on wounds as an antiseptic.

Other common names include references to animals. Names with **va bu** (rooster) occur three times in our sample, and **le mop** (heifer) occurs twice.

### **Distribution and variability in plant knowledge**

Although Mgebbu has been our major informant for Nuosu plant identification, some useful information from our study of plant resource use can be applied to understanding distribution of Nuosu plant knowledge.

Our plant resource use sample included 12 women and 10 men, aged 8 to 84. Informants were chosen from all four villages of Yangjuan, Pianshui, Zhuchang and Gangou.

Knowledge of culturally useful plants showed evidence of variation due to gender, age and based on area of residence. Variation in knowledge can be divided into variation in plants known and in relevance of this knowledge to individuals of particular age classes or gender (see **Tables 1 and 2**). An example of this would be the high average knowledge of edible plants in age class 1 for women. This age class includes one informant, an 8-year-old girl. In her list of edible plants she included multiple small berries (less than .5cm in diameter) that would certainly be relevant to small children who get hungry while herding sheep. Of the adults in our sample, only one included small berries in his response.

Overall, our data shows women to have a slightly higher level of plant knowledge than men in the categories of edible plants, animal fodder and fuelwood. However in the category of medicinal plants, men knew a higher average number of plants. A higher knowledge of edible, fodder and fuelwood plants in women than men could be expected, given the division of labor. Women collect mushrooms as well as edible greens. They collect most of the animal feed, often with the help of young children. Women also collect all of the fuelwood, except in the event of having large pine poles available.

Because our sample included two men with formal training in medicinal plant use and recognition, the results for male plant recognition may be higher than average in age class 4. Recalculating the mean for class 4 without including our local expert puts the mean at 1.3 medicinal plants known as compared to 5.5. This of course, is not representative either, as our local expert is a member of the community and his knowledge should be included in the union set of total plant knowledge of the community. Our assessment is that men are more likely to receive formal training in medicinal plant use, leading to a higher average knowledge of medicinal plants in men than in women.

As seen in **Tables 1. and 2.** there is no category of plant knowledge that is entirely gender-specific.

Knowledge variation based on age shows people in age class 2 (age18-30) to have somewhat lower levels of knowledge than those in age classes 3 and 4. Our 8 year old informant (age class 1) also showed a higher level of knowledge in three areas than age class 2. It seems unlikely however, that the young adult generation truly knows very little about plants. Our informants in this age group tended to be shy and acted self-conscious about giving names of the plants they know.

Analyzing the number of plant responses based on residence of the informant aims to find potential clusterings of knowledge. We ranked level of plant knowledge from 1 to 4, where a rank of 1 represents the highest mean number of plants known in each category. The rankings were added, yielding lower scores for greater average plant knowledge and higher scores for fewer plants known (**Table 3.**). Clustering of a higher level of culturally significant plants in Yangjuan are likely due to higher income level and social position of many of the residents, which leads to a higher level of education in medicinal plant knowledge. Also greater wealth indicates greater herds of animals, which may allow for greater exposure to different pasture areas across the vertical geographical gradient. A higher level of recognized culturally useful plants in Gangou is likely due to proximity to more diverse forested areas and associated plant resources, such as mushrooms, and variety of shrubs for fuelwood.

**Table 1.**

Average number of edible and animal fodder plants recognized by men and women in differing age classes.

Age Class	Age Distribution	Mean # of edible plants known		Mean # of animal fodder plants known	
		Women	Men	Women	Men
1	6-17	6	NA	6	NA
2	18-30	2	1.7	2	2.7
3	31-43	2.3	1.5	4.4	3.5
4	44-56	3	3	7	3
5	57-69	2	NA	5	NA
6	70-84	NA	NA	NA	NA

**Table 2.**

Average number of medicinal and fuelwood plants recognized by men and women in differing age classes.

Age Class	Age Distribution	Mean # of known medicinal plants known		Mean # of fuelwood plants known	
		Women	Men	Women	Men
1	6-17	0	NA	4	NA
2	18-30	0.67	1.7	3	3.7
3	31-43	2.8	0	5	2.0
4	44-56	0	5.5	4	4
5	57-69	0	NA	NA	NA
6	70-84	NA	NA	NA	NA

**Table 3.**

Clustering of plant resource knowledge by residence of informants. Scores are based on addition of rankings from 1-4. Low score indicates greater number of plants known and recognized.

Score	Location
6	Yangjuan
8	Gangou
12	Zhuchang
13	Pianshui

### Teaching and knowledge preservation

Our surveys also included questions regarding the methods of teaching and sharing plant and environmental knowledge based on utilitarian or cultural importance of these plants. The total sample consisted of 11 interviews in which this question was answered. When an interview included multiple informants, each person's answer was counted. The results show most of the plant knowledge is passed down from grandparents and parents to their children.

Many informants considered actively teaching plant knowledge to be unnecessary. Especially in the case of animal feed and edible plants, 45% of our interview participants and

27% respectively responded there is no need to teach knowledge of these plants. Interestingly however, despite the feeling there was no need to teach this knowledge, 73% of our sample said they learned about animal feed and edible plants from their parents or grandparents. A possible conclusion is people learning from elders don't consider themselves being "taught." Perhaps the word "teaching" has strong associations with the idea of formal schooling in a classroom.

In the case of medicinal plant knowledge, again the majority (69%) responded that the knowledge was passed down by family members. However, a much larger percentage (54%) of our sample considered themselves to be teachers of this knowledge, than of animal fodder plants and wild edibles (27%) or materials (18%). Only 9% of our sample felt it unnecessary to teach about medicinal plants (**Table 5**).

**Table 4.**  
Learning plant knowledge.

Who taught you?	Animal plants	Food plants	Med Plants	Materials
Experimented on my own	3	0	2	0
Knowledge is passed down	8	8	7	8
Chinese Doctors	0	0	2	0
No one; everyone knows	1	1		1

Overall, the results show that the most common vehicle for learning plant knowledge is through parental or grand-parental teaching. In addition, the word "teaching" may be more closely associated with a formalized method of teaching and memorizing than with an informal method of demonstration and imitation. This is shown by the association of complex medicinal plant knowledge (which includes collection locations, preparation methods, dosage, and diagnostic symptoms for disease) with the idea of teaching.

**Table 5.**  
Teaching plant knowledge.

Do you teach?	Animal plants	Food plants	Med Plants	Materials
No need	5	5	1	3
Children	3	3	6	2
By demonstration	0	0	2	0
Whoever doesn't know	0	0	1	0

### **Plant knowledge in the future**

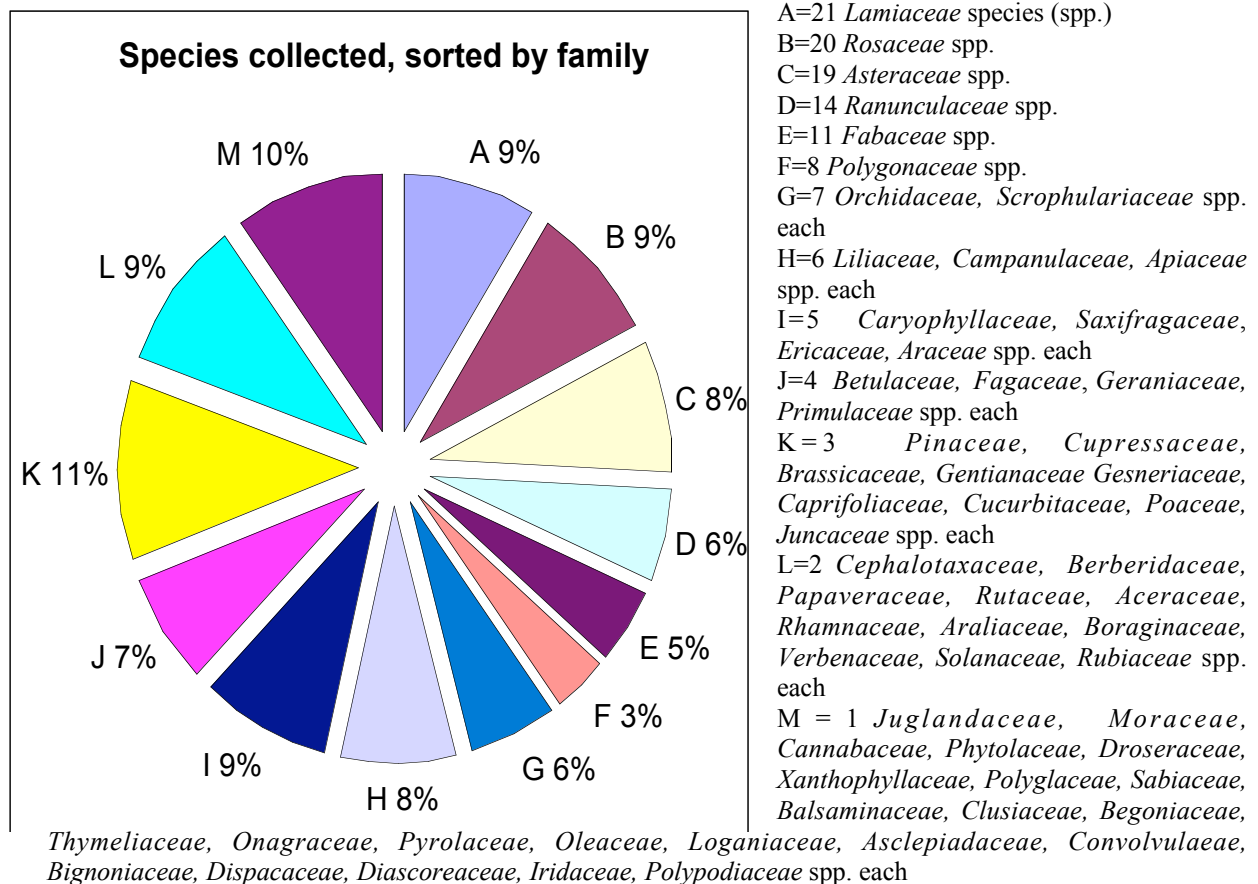
The initial goal of our research was to provide materials for and create a teaching curriculum for native plants in the Yangjuan elementary school. Although there is no obvious loss of plant knowledge, combining a curriculum on uniquely Nuosu knowledge taught in the Nuosu language could head off the perception that either "only worthless Han Chinese knowledge is taught in

school," or that "Han knowledge is important because it is taught in school, and Nuosu knowledge is less valuable" (Harrell, personal communication).

### Plant Trends

A summary of the different families of plants that were collected can be found below in **Figure 3**. Notably, a large proportion of those collected were plants of the family *Lamiaceae*, *Rosaceae*, *Asteraceae*, *Ranunculaceae*, *Fabaceae*, and *Polygonaceae*, with 40% of the species belonging to those six families, out of a total of 62 observed. One of the floral diversity characteristics of South-western Sichuan is their high number of *Lamiaceae* species, which is clearly supported in our findings. In addition, South-western Sichuan is known for their numerous species of those belonging to the *Rhododendron* genera, which is again corroborated by our data (look into the data section). *Rosaceae*, *Asteraceae*, *Ranunculaceae* and *Fabaceae* are all large families with abundances in species number, even here in the Pacific North-west. From a biodiversity point of view, most of the findings at Yangjuan were what had been expected, confirming our general understanding of South-western Sichuan.

**Figure 3.** A pie chart of proportions of species collected in their respective families. A, B, C, D, E, and F are all of single families, and all others are multiple families grouped together in accordance to their abundance.



### Plant resource uses

In our sample of plant diversity in the Yangjuan area, we recorded 228 plants with Nuosu names and 78 plants without Nuosu names. 72 are medicinal, 55 have edible parts, 40 can be used for animal fodder, 11 are used for fuelwood, and 12 have other uses, such as poles for construction, oilseeds, fibrous material, poison for fishing, beekeeping, smoking and washing the body. 61 plants have no use and 74 plants remain undetermined.

To determine which plants are identified as resources and are actively collected, group interviews were conducted. The results of the interviews determine collection frequency of wild plants, perceptions on resource harvesting restrictions, and methods of teaching knowledge of useful plants. Our sample consisted of 22 people. Out of 16 group interviews, 4 were households, 6 were groups of people working together in the fields who most likely are relatives, and 4 people were interviewed individually. Although in group interviews individuals may influence each others responses, our priority was to observe group discussion and to collect as many different ideas as possible.

We chose four villages from which to select informants, Yangjuan, Pianshui, Zhuchang and Gangou. The majority of the interviews took place in homes around a firepit, or in the potato fields while people were working. 13 of our informants live in the Yangjuan/Pianshui area along the river floodplain, 6 live on the limestone benchlands in Zhuchang, and 3 live in Gangou, several kilometers up the river valley from Yangjuan.

We attempted to interview people of all ages, with a 50/50 ratio of men to women. 10 men and 12 women between the ages of 8 and 84 were interviewed. Income level was not taken into account. Demographics are given in the table below. See the following section on Nuosu plant classification for a discussion of variability in plant knowledge based on population demographics (**Table 6 and 7**).

**Table 6.**  
Ages of sample population.

AGE	MEN	WOMEN
6-17	0	1
18-30	4	3
31-43	2	5
44-56	3	1
57-69	0	1
70-84	1	1

**Table 7.**  
Residence of sample population.

Place of residence	Women	Men
Yangjuan	5	2
Pianshui	2	4
Zhuchang	3	3
Gangou	2	1

### Edible plants

Nuosu in the Yangjuan area have a low dependence on wild food sources. The majority of food is cultivated (buckwheat, potatoes, corn), and vegetable proteins are the major source of protein, supplemented by meat (pigs, chickens, goats). A slight trend in collecting wild foods is correlated with either distance from the township and the river floodplain dominated by agriculture or amount of time spent at higher elevations. People who routinely climb the mountains west of the area in order to herd yaks or sheep depend more heavily on wild plants. These people listed a leafy green plant **latjy** and tubers **yuangen** that can be made into pickles and preserved.

The most commonly collected edible plants are **nyit vop**, **ha bit**, **mge hlop** (buckwheat leaves - considered to be wild although cultivated for grain), **nyip ho vox**, **ax jji bbur zza**, **got**

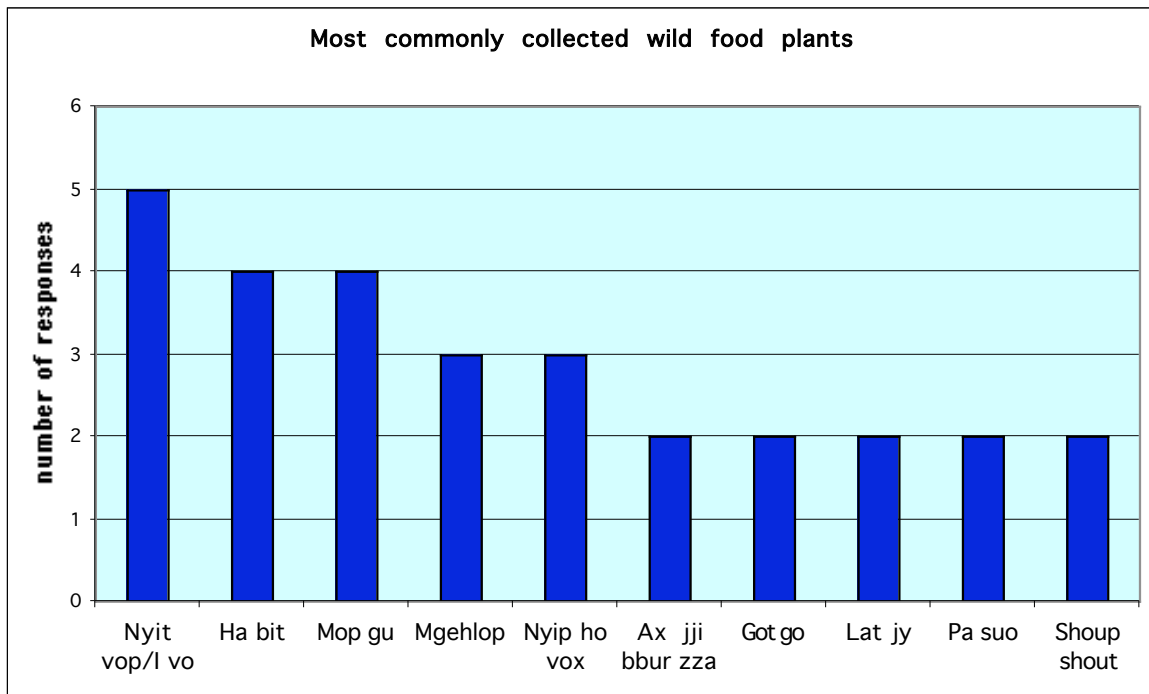


**go, lat jy, pa suo, and shuop shuot.** All of the above are leafy greens except for **shuop shuot**, which refers to strawberries (*Fragaria spp.*) and two different *Rubis spp.*

None of the edible species have been identified, as the plant-use interviews were conducted at the beginning of potato harvest, when everyone was too busy to go on plant collecting walks with us.

Mushrooms were included in the survey although they are not plants, because they are also a commonly collected wild food. The edible mushroom species were not determined. Yangjuan native and Liangshan Institute for Ethnic Studies professor Mgebbu Lunzy, informed us that the prized Matsutake mushroom grows in the area. Other mountain villages in Yunnan province have found Matsutake a lucrative cash crop. As yet, no research on Yangjuan's Matsutake resource base and market potential has been conducted.

Of the most commonly collected edible plants, 12 grow in the fields (presumably as weeds), and 2 grow "everywhere." Only 5 grow in the **ladda** (uncultivated river bottom) and 2 grow on the limestone benchlands or hillsides. Most of the "wild" edible plants are therefore being collected close to home, and not in uncultivated forest or pasture land.



**Figure 4.**

Wild food plants most likely to be collected. Degree of "commonness" inferred from interview responses giving the name of the plant.

### Animal Feed

Generally, Nuosu graze their animals on open pasture. These include goats, sheep, horses, cows and pigs. Yaks are also grazed at higher elevation (3500-3900m) on the Zala mountains. However, households with pigs will also collect animal fodder. Green fodder is collected up to twice a day and boiled for slop.

The most commonly collected wild plants for animal feed are **mu hxit**, **pat qi**, **ha bit**, **hxix ke**, **nyie zha**, **yap you bbox bbo** (potato leaves - actually a cultivated plant), **wa hni**, **mge hlop** (buckwheat leaves - also a cultivated plant), **bbu shy ddut zza**, **gge nie**, and **zhet** ("grass"). All of these are some sort of leafy green edible for pigs. Notable is the **bbu shy ddut zza**, *Ariseama bathycoleum*, and *A. erubescens* which is also a medicinal plant. We were unable to collect these at the time of our interviews.

A key element here is the idea of "wild" plants. Nearly all of our sample participants listed buckwheat and potato leaves in response to "wild plants collected for animals." When asked if these plants were "wild", informants said no, but they are important. Although Nuosu do not consider these two sources of green fodder to be wild, they are clearly a very important seasonal source of animal feed, so we have included them in our selection of animal fodder plants.

When asked where the wild plants can be collected, the consensus was "everywhere." Pressed for specific place names, people gave the name of the entire valley, Apiladda. As with edible plants, forested areas are not significant sites for collecting animal fodder.

### Medicinal plants

Traditionally, a whole host of native plants have been used for medicinal purposes. 72 medicinal plants were identified through our interviews and through specimen collection. Of these 72 medicinal plants, analysis of our interviews identified 6 commonly recognized and collected plants. Though these 6 plants are recognized by their leaves, only the roots are used for medicinal purposes.

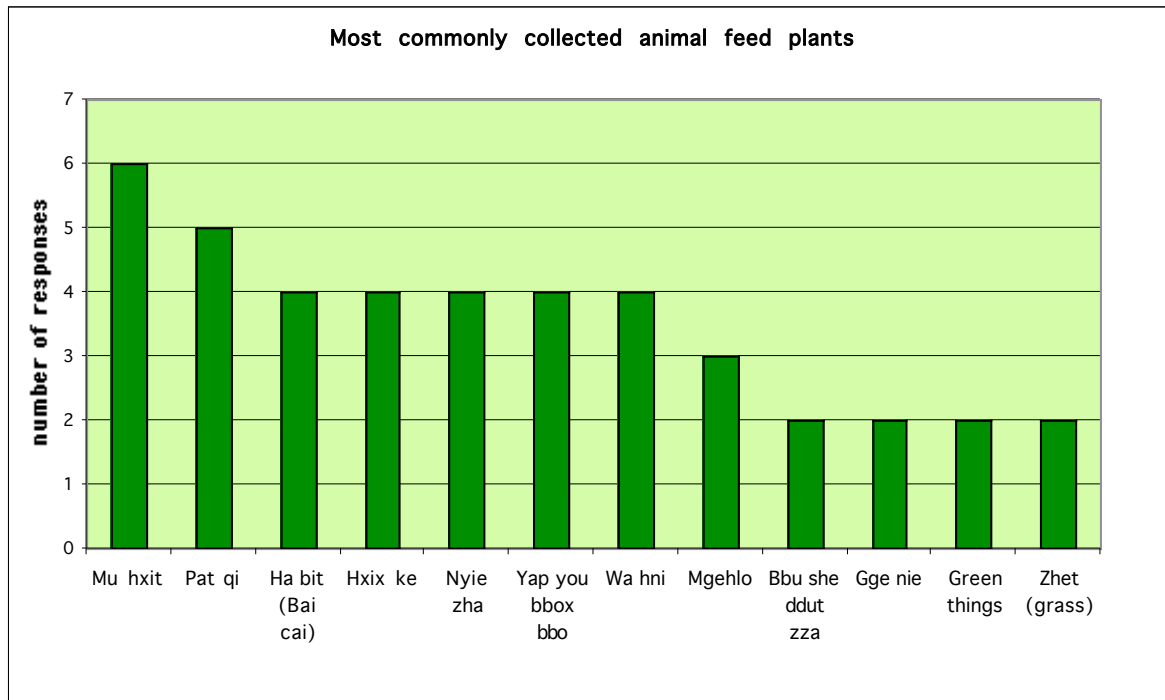


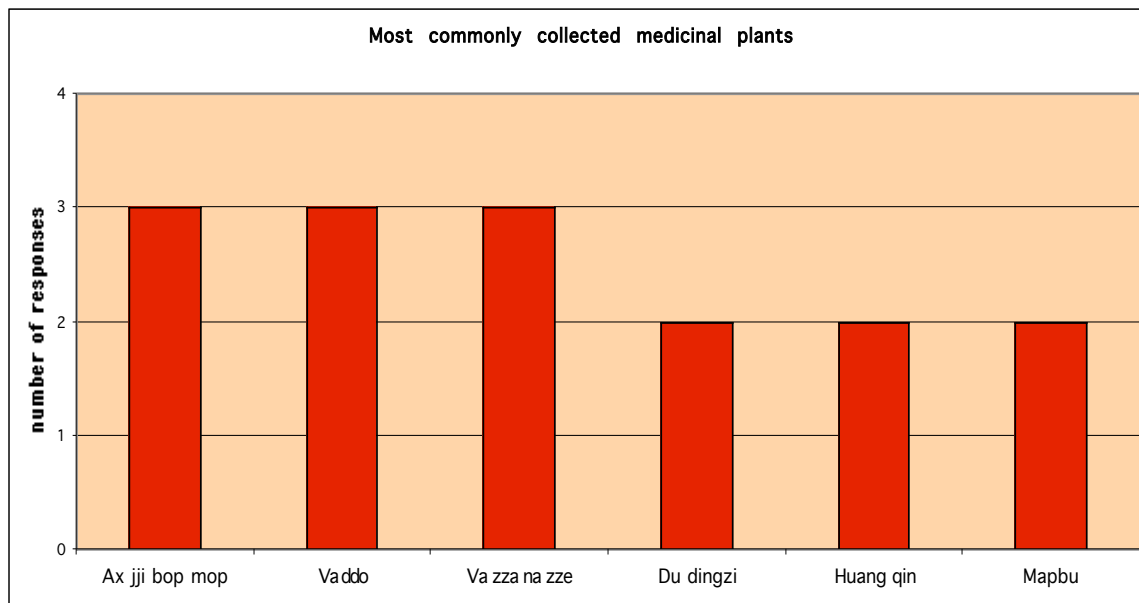
Figure 5.

Animal feed plants most likely to be collected. Degree of "commonness" inferred from interview responses with the name of the plant.

**Ax jjix bop mop** (*Dipsacus asper*) is used as a palliative. **Va ddo** (*Berberis wilsonae*) can be mixed with **va zza nap zzy** (*Potentilla fulgens*), **va ma se hni** (Unknown spp.) and **chutu**

**shuop shuot** (Unknown spp.) for diarrhea and stomachache and coughs. **Va zza na zze** (*Potentilla fulgens* or *Agrimonia pilosa*) is mixed with **di shy** (Unknown spp.), or mixed with **va ddo** (*Berberis wilsonae*), **va ma se hni** (Unknown spp.) and **chu tu shuop shuot** (Unknown spp.) for diarrhea, stomach illnesses and stomachaches. **Du dingzi** is used for stomachache. **Huangqin** (*Scutellaria hypericifolia*) is used for stomachache, diarrhea and removing excess heat from the body (Chinese= 黄芩 ). **Map bu** (*Paris polyphylla*) is used for pain relief and for infectious diseases. **Map bu** contains a poison and must be used topically. **Ax jjix bop mop** (*Dipsacus asper*) is added to meat dishes or made into an oil. The roots of the other plants listed above are boiled in water to make a soup or tonic.

It should be noted that two of these plants have names "borrowed" from Chinese, **huangqin** and **du dingzi**. Also in the case of **va ddo**, the borrowed name "**huanglian**" is used to refer to the medicinal root, while **va ddo** is generally used to refer to the entire shrub.



**Figure 6.** Most commonly known, or recognized medicinal plants.

In our interviewed sample, two men are local medicinal plant experts. Mgebbu Viezhur, now 84, has been studying medicinal plants since he was young. He learned first from local elders, who were not in his immediate family and who he paid to teach him. In the early 1970s, Han Chinese doctors came to the area and taught both Viezhur and Ali Yousse, the other plant expert in our sample. Viezhur explained that he has since slowly expanded his knowledge through experimentation and experience. He has been teaching his youngest son, who also collects plants for him now that his eyesight is failing. He also cultivates some medicinal plants in his garden, such as **munjip** (*Acorus calamus*).

Viezhur is also the only person we know of in the village who sells medicinals and keeps a stock of dried plants in storage. Our other local experts, Mgebbu Ashy and Ali Yousse don't keep stores of plants available; they collect medicinal plants as necessary when someone has an ailment. Other participants in our interviews who had some medicinal plant knowledge also only collect them as necessary.

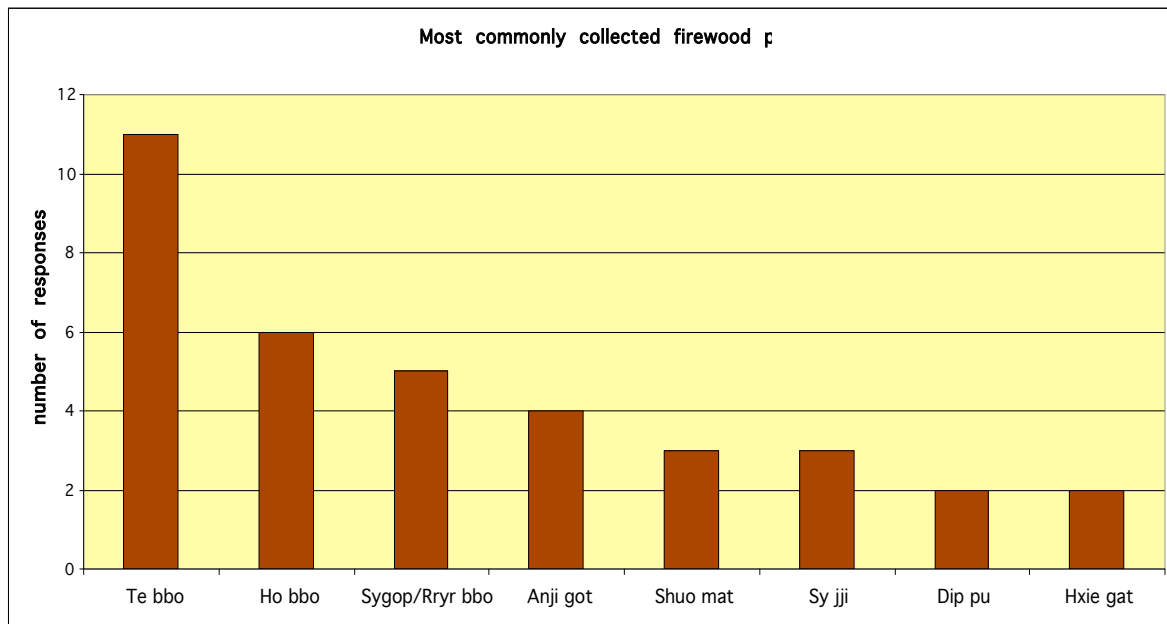
The proximity of a Han run clinic in Baiwu is a large factor in the use of native medicinal plants today. The majority of people in our sample said they go to Baiwu when they are sick.

Mgebbu Lunzy felt there has been a loss of medicinal plant knowledge in general, because people are now relying on modern medicines (Chinese or Western) from the clinic in Baiwu. However, he and his father Mgebbu Ashy agreed that for serious problems, such as bone fractures, people would use traditional medicines, because of the difficulty of transporting an injured or very sick person to Baiwu. For less serious problems, such as a cold, people would go to Baiwu for medicine.

### Firewood and building materials

The interview question regarding materials used was originally phrased as "What kind of materials do you collect?" However, due to the difficulty of translating the abstract concept of "materials" (we thought of materials as woods, fibers, containers, fencing, etc.), the question became "What kind of wood materials do you collect?" After the first interview, this question ended up changing into "What kind of firewood materials do you collect?" This was an easier question for Mgebbu Vuga, our friend, field assistant and patient translator to ask, and it also focuses on the most important material collected on a regular basis.

**Te bbo** (*Pinus yunnanensis*) is clearly the most commonly collected fuelwood. 69% of our sample (11/16 participants) collects *Pinus* for fuelwood. Other trees used for fuelwood include **ho bbo** (*Alnus spp.*) 38% and **rryr bbo** (*Quercus monomotricha*, *Q. senescens* & *Q. aquifolioides*) 31%. Shrubs include **ax njyx gox** (*Lyonia ovalifolia* and *Cotoneaster buxifolius*) 25%, **shuo hmat** (*Rhododendron hemitrichotum*, *R. racemosum*, *R. irroratum*) 19%, **sy jji** (Unknown spp.) 19%, **dip pu** (Unknown spp.) and **hxie gat** (Unknown spp.) both collected by 6% of our sample population.



**Figure 7.** Most commonly named fuelwood in survey.

The smaller shrubs are actually preferred over *P. yunnanensis* as fuelwood. The smaller branches and twigs provide better kindling.

Current fuelwood use estimates vary widely depending on methods used for measuring the bundle size collected. Estimates place the volume of wood in a bundle or stack anywhere between 12% and 50%, with the remaining volume taken up by air (Tsao, Chi, Schmitt). Use patterns also vary depending on the number of people in the household, income level, and number of pigs owned. Further statistics on rates of fuelwood use are currently being collected.

### **Construction**

*Pinus yunnanensis* poles are also used for building construction, mainly as framing for doorways and roofs, as well as for gates. The branches are used for firewood.

### **Fertilizer**

An important use for *Quercus* branches and leaves and *Pinus* branches and needles is to make fertilizer. Branches and dung are collected and mixed in a pit to make fertilizer, which is mainly applied to buckwheat fields. Some of this fertilizer is also applied to corn fields. However, beginning with the initial the adoption of hybrid corn in 1992, chemical fertilizer has been used. In 2000 hybrid corn was introduced on a larger scale, increasing the amount of chemical fertilizer applied to corn fields. Chemical fertilizer generates higher corn yields than the dung and branches fertilizer. No chemical fertilizer is used on buckwheat fields. Potatoes are rotated with corn to prevent the formation of a hardpan, which is believed to be caused by the chemical fertilizer.

### **Paths**

*Quercus* and *Pinus* boughs are also used to "pave" dirt paths, which become very slick and muddy during the rainy season. The branches provide a spongy walking surface.

### **Walls**

*Pinus* branches are also an important material for building walls. Most houses in Yangjuan and Pianshui are in a courtyard enclosed by packed earth walls. Lining the top of the walls with *Pinus* branches stabilizes them and prevents erosion by rain and wind.

### **Fencing**

Several thorny plant species are either stacked or planted as fences between fields. These include but are not limited to **ax njyx got** (*Lyonia ovalifolia* and *Cotoneaster buxifolius*), **chu nuo** (*Prinsepia utilis*) and a *Robidia* spp., which was referred to as **zhyr** (thorns). The *Robidia*, *Prinsepia* and *Lyonia* are often planted using cuttings.

### **Cultivated foods**

A study of cultivated food plants and different landraces of these plants is currently in progress.

### **Plant Use intensity**

Besides fuelwood collection, there is no evidence that collecting wild plants has much impact on the local ecosystem. 10 responses to a question on change in plant availability within the lifetimes of the interviewees yielded no negative results. Plants included in this question were edible, animal feed and medicinal plants. Two interviewees said there are more plants available than previously. The remaining 8 interviewees said there had been no change in plant availability during their lifetime. There is clearly no perception of plant resource loss in general.

However, Mgebbu Ashy, his son Lunzy and his daughter Jygy agreed that it is more difficult to find some species of medicinal plants, such as **bbuyox**, than it used to be. Further distances must be travelled to find them than before. The three agree it is because of population growth in the area. Although no further elaboration was given, it is likely that the result of population growth is not increased medicinal plant collection. Rather, it results in more land conversion to agriculture and a widening of the area used for grazing. Also, the medicinal plant mentioned (**bbuyox**) is a tree, which no doubt is more difficult to find because it is cut for fuelwood.

Because the majority of our sample was unfamiliar with medicinal plants, their perceptions may differ from Ashy's family. 56% of our sample was not familiar with any medicinal plants; 6% knew only one, and 12.5 % knew only 2. It may be that some previously locally common medicinal plant species are now locally uncommon, but there is low recognition for these plants as resources.

No further empirical evidence was found showing either high plant resource use or decreased resource availability for actively collected wild edible plants, animal fodder or medicinal plants. Nuosu in this area depend mainly on agriculture and their animals for food, and animal fodder is available both on the pasture and as green fodder collected specifically for pigs. A lower recognition and active collection frequency for medicinal plants also shows no evidence of decreasing resource availability.

However, increases in animal herds and grazing may be causing damage to overgrazed pasture. Traces of multiple crisscrossing goat tracks are clearly visible on hillsides. Further study is necessary to determine the impact of grazing in the area.

Regarding fuelwood consumption, two assessments remain to determine the impact on forest growth. One concerns the amount of shrub biomass harvested. The limestone benchlands are suffering from severe erosion. The largest *Quercus* shrubs are less than 1.5 meters in height. Pockets of diverse herbaceous plants can be found in proximity to patches of *Quercus* where moisture and soil are retained and shade is provided by the shrub. One factor contributing to the difficulty of finding medicinal plants as described by Mgebbu Ashy, Lunzy and Jygy is likely the removal of shrub growth.

The second assessment of impact of fuelwood collection on forest growth is in progress. A preliminary estimate of yearly biomass removal of *P. yunnanensis* across the total of all stands sampled is 3.4% of the standing biomass. This was estimated by counting stumps and calculating estimated biomass of the cut trees. However, this doesn't take into account branch removal from standing trees, and does not show variation between stands with more biomass and those with less biomass, and consequently less biomass removal. A calculation of the yearly growth increment of each stand is also in progress. Until the yearly growth increment can be compared with the estimated removal mass, no meaningful information on the impact of fuelwood collection on forest growth can be given.

### **Collection restrictions and regulations**

Collection restrictions and regulations could potentially impact the types of resources collected and their collection frequencies and volumes. We enquired as to the existence of traditional resource management systems. After several interviews it became clear that either no traditional collection restrictions are now recognized, or we were asking our questions incorrectly. We asked specifically about plant collection restrictions. Asking about areas people do not go, or are not allowed to go might have yielded results. Restrictions on resource use may not be explicit.

Restricting areas for spiritual reasons or because they are haunted by spirits will limit people's access to them. This can have the additional effect of conserving plant resources within that area.

Be this as it may, existing government forest policies restrict the allowable amount of live wood cut to 5 m<sup>3</sup> per year per family. An exception to the policy is an allowance for newlyweds building houses. A newly married couple may cut between 30 and 50 trees to build their house. There are no restrictions on collecting downed, dead stems or dead branches (Worker-Braddock). It is also forbidden to cut green branches. But because the whole population of the area is dependent on fuelwood, this regulation is not always observed. The winter in Yangjuan is quite cold. We visited during the end of March 2003, and found ample evidence of fresh stem and branch removal in our sample plots.

Additional management guidelines include boundary delineation between, village land use areas. For example interviewees in Zhuchang indicated a north/south boundary on a slope behind their house dividing Zhuchang forest from Mianba forest.

### **Future research**

In order to create a meaningful assessment of the effects of plant resource use in the Yangjuan area, several additional studies are necessary. These include:

- biomass sample of shrubs (*Quercus*, *Rhododendron*, *Ericaceous shrubs*, etc. );, both in plots where harvest is occurring and plots where harvest is not occurring estimate of shrub mass removal per year
- impact of grazing on plant cover, soil stability, soil loss; includes study of herd size, length pasture use before rotation, local estimates of viable time period for using a pasture site
- fungi study, especially edible mushrooms, Matsutake resource base estimate, market study
- soil erosion; impact of soil loss on production of forest plants and agricultural crops

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