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## **Guaraní Production**

The Guaraní reap a good living from the forest. The first conquistadors in the region were impressed by the bountiful harvests and the fat game of the Guaraní. "They want for nothing, they have abundant fruit in their gardens and their traps seem to attract game that keep them well fed. They never lack for honey, corn or meat." (Cabeza de Vaca 1555/1891) We could say the same of the Guaraní today. Although Guaraní gardens may look unkempt to the newcomer, they produce an abundance of corn, beans, squash and an array of other edibles. Guaraní bring game from the forest and fish from the streams. After four centuries, the trees of this verdant paradise are still weighed down by fruit and honey. Contemporary Guaraní production differs from that observed by the first conquistadors, in that Guaraní now produce for commercial markets as well. Today, in addition to corn and meat, the Guaraní have access to salt, soap, cloth and tools that the forest cannot produce.

## **TROPICAL ECOSYSTEMS**

Lowland South American forests are among the most diverse on earth. These lush, green ecosystems may have as many as 75 percent of all known plant species. Walking into the forest, a newcomer's eye is often struck by the chaos of plant growth. Unlike temperate forests, where one or two species dominate,

tropical flora is extremely diverse. Plants grow in a profusion of layers: the undergrowth, a lower canopy, the vines that climb and hang from branches, a second canopy, and the epiphytes that take root on the tallest branches. The variety often confuses even the trained eye of the botanist. Surveys show that while there are hundreds of species per hectare, there are usually only a few individuals of each.

The verdant growth hides the fact that the resource base on which tropical systems depend is among the most inhospitable on earth. Forest soils are under constant attack from the elements. The direct sunlight quickly breaks down nutrients in the soil and the harsh rains wash them away in torrents of muddy water that leave rivers clogged with particulate matter. The clay soils that remain lack fertility and, when exposed to the sun, quickly harden into an impenetrable layer. Forest soils anchor the forest, but do not provide water or nutrients. Thus, plants look to one another for nutrients.

Lowland forest plant species have solved their resource problems by being interdependent. Species' needs are woven together in a tightly integrated ecosystem. As plants grow and die, nutrients pass among the various layers as parasitic species feast on their rotting neighbors. Water moves between layers as well, evaporating off lower leaves, condensing in the canopy, and dripping below again. The canopy also protects the soils the forest needs to grow. Dense covers shelter the ground from harsh sunlight and deflect the strength of the torrential rains.

These tropical ecosystems are among the most fragile on earth. If one element of the system is lost, it disturbs the flow of nutrients for all other plants. Removing a single species inhibits the growth of all those plants that depend on it. Removing a major component, such as the upper canopy, destroys the entire forest.

## INDIGENOUS KNOWLEDGE

Indigenous peoples in lowland South America have developed highly organized systems to exploit the forest resources, without undermining the integrity of the tropical

ecosystem. These activities are as integrated as the forests' own growth. When Avarijú leaves his house in the morning, his activities at first seem poorly organized. He may set out to work in his field, only to be distracted by an armadillo that crosses his path. Abandoning his garden work, Avarijú may spend the morning digging the animal out of its burrow. Or he may work intensely to plant his crop, then devote himself to fishing and not return to his garden for several weeks. However, these activities are not haphazard. They fit into a carefully organized system that assures that his family will always be able to satisfy its needs.

Over the thousands of years that the Guaraní have inhabited the forests, they have experimented with a variety of ways to earn a living from it. With their intimate knowledge of the diversity of plants, and their close attention to the soils and the water systems, indigenous people have adapted their production patterns to fit the highly evolved ecosystem of the lowland forests. Far from being primitive or uncivilized, indigenous peoples have a highly developed production system.

## GUARANI AGROFORESTRY

Indigenous agroforestry does not replace the existing ecosystem, but builds on it, mimicking both the structure and the process of the tropical forest. First, indigenous production systems are diverse, like the organization of forest. This diversity allows forest residents to exploit a variety of ecological niches. Secondly, indigenous production systems depend on the resources of plants and animals, rather than on the scarce nutrients of tropical soils. Fertility is cycled from nature to human use and returned to the larger ecosystem, bringing agroforestry into dynamic equilibrium with nature. Throughout Latin America, farmers have learned that by diversifying their production activities, they avoid overexploiting any specific resource. Like the forest system itself, indigenous people spread out their dependence on a series of resources. By moderate use of the soils, the water, the canopy, and the fauna, forest residents assure that the entire ecosystem will continue to function.

As discussed in the first chapter, agroforestry integrates tree crops with agriculture, domestic animal raising, and other activities. Some agroforestry systems are closely managed by the farmer. In Costa Rica, for example, banana trees are planted over coffee trees, and cattle graze on pasture underneath the canopy (Clay 1989). In contrast, the agroforestry of most indigenous groups are much less structured. In systems such as Guaraní agroforestry, the forest canopy is often left intact and existing area plants managed and harvested for human use.

Guaraní agroforestry is composed of three general types of activities: horticulture, hunting and fishing, and gathering. These three activities integrate to assure that Guaraní have sufficient food throughout the year. Diversity reduces the economic disruption created by seasonal changes in garden production, declining hunting populations, crop pests, or the market. Although Avarijú's daily tasks may seem poorly organized to the newcomer, he is shifting between different productive sectors to use his time and resources efficiently.

The different sectors of the Guaraní economy demand two primary resources: human labor and physical resources. Integrating various production activities demands that these resources be carefully allocated. The Guaraní do not allow their use of one physical resource to conflict with the protection of another. For example, they do not cut down the high canopy that protects the thin, tropical soils. Labor resources need to be protected as well. Since each family must provide labor for all the various production spheres, Guaraní carefully arrange their work to assure that workers are free when needed in each activity.

## Gardening

If one were to ask Avarijú what his primary work was, he would say gardening. With a little prodding, he would take you on a tour of his garden. He would lead you down the small path that enters the forest behind his house, over the small stream, and up the opposite bank to an opening in the forest. With his machete, he would point with pride to the size of the half acre clearing, about as big as a city house lot,

and call your attention to the towering corn stalks and bursting bean pod.

Corn, beans and manioc are most important in the Guaraní garden, supplemented by peanut, banana, sweet potato, and sugar cane. Although most crops are seasonal, planted once or at most twice a year, Guaraní plant manioc sufficient to provide a constant supply of the tuber throughout the year. Manioc provides a basic starch for Guaraní families, but it is low in nutrition and needs to be supplemented by other foods.

Rather than isolating crops into different plots, Guaraní farmers plant the full diversity of their crops in a single plot. It is not uncommon for a gardener to have ten or twelve different crops interplanted in one garden. Moreover, Guaraní plant several varieties of each crop. Thus, there may be six or seven types of corn and the same number of kinds of sweet potato, manioc, beans and bananas.

The new visitor would probably be struck by the chaotic profusion of the garden's growth. Bean vines climb corn stalks, sweet potato winds its way around the stems of the manioc, and banana plants erupt unexpectedly throughout the plot. The growth is not confused. Avarijú carefully arranges his field to maximize production. Each crop is interplanted with another that helps it grow. He plants corn and beans in the same hole so that the fast-growing corn stalks can provide poles for the climbing bean vines. Manioc leaves provide the shade needed by the more delicate sweet potato plants. This diversity creates a microcosm of the larger forest. In structure, the canopy of banana and manioc shelters the soils, and a profusion of sweet potato and squash vines climb through the growth. In process, plants are grown in the debris of the forest, and the refuse from one harvest becomes fertilizer for the next crop.

Guaraní gardening is often called *horticulture* or *shifting agriculture*. It differs from more conventional agriculture in that crops are rarely planted in the same soil for more than three years, as new plots are periodically cut into the forest. Gardening follows the wet and dry seasons, with the annual cycle generally opposite that of the northern hemisphere. Avarijú usually begins to clear his garden in July. With machete

in hand, he scans the forest and soils for a suitable spot. The topsoils under high forests usually have the greatest fertility. The experienced farmer will usually choose an area where the deeper soil is reddish, signaling a good mixture of sand and clay. Guarani gardeners avoid higher sandy areas, where soils are hot and dry, in favor of the gradual slopes along small streams. This assures that roots will have water, yet protects them from the saturation of floodplain soils.

When a suitable location has been chosen, Guarani men clear the forest with machetes and axes. The small trees are chopped down, bringing much of the canopy and vines (*jitina*) crashing to earth in a tangled mass. Larger trees are left standing, but the bark near the base is stripped off, killing the tree. Without foliage, the dry trunks do not hinder the garden and are blown over after several years. The work is hot and heavy. It is common for fathers, sons, brothers and cousins to join forces, clearing each person's plot in turn. This not only speeds the work, but provides companionship in the lonely forest.

Farmers clear land in the dry season, from July through September, before the start of the October rains. At this time of year it only takes a couple of weeks for the sun to dry the forest detritus. Procrastinators pay a high price. Once spring showers begin, the forest reclaims its land even before the confusion of brush, vines and tree trunks turns brown.

When the forest debris is as dry as tinder, the Guarani build small fires in the underbrush and it erupts in an inferno. The cool, damp forest stops the raging fire at the edge of the plot. If one burning does not complete the task, and it rarely does, the family returns the next day to pile the remaining branches and relight the fire.

This slash and burn technique is an extremely efficient use of the overstory. The fire releases nutrient compounds that are otherwise bound in wood and foliage and leaves a coat of fertile ash over the soil. By using nutrients from the forest cover to fertilize their crops, the Guarani mimic the forest's own process of recycling nutrients among plant populations in a closed system. In this case, nutrients are shifted from forest plants to cultivated crops.

When the spring rains arrive, entire families go to the fields to plant crops. A hole is poked in the soft earth with a simple, sharpened pole. A couple of seeds, or a bud from a manioc stalk is dropped into each. Finally, the planters kick dirt into the hole and tamp the spot with their heel. Guarani place plants approximately a meter apart, but may plant three or four different crops over the same ground. Consequently, there are often four or five different plants in each square meter.

After the garden is planted, field work is finished for several weeks. Abundant spring rains water the crops during the critical growing season. Tender shoots erupt from the fresh soils. As crops mature, there are few pests or competitors to hinder their growth. Grasses and plants of the forest cannot withstand the direct sun and rain of the garden, allowing crops to grow without competition. The insects of the dark, damp forest, also find the dry air of the garden intolerable and ignore the growing crops. Consequently, families often travel after planting their crops, returning weeks later to find the crops ready to harvest.

The arrival of the first crops is cause for celebration in Itanarami. The ripening of the first corn in February signals the end of the annual food shortages and ushers in a period of abundance. Families who have been without corn and beans for months, have more than they can eat. The end of the *karuvai*, the hunger season, is the time for religious gatherings and initiation rites. Besides initiating new members, the *mongarai* ceremoniously welcomes the garden crops. Corn is of central significance to Guarani society, a fact that is clear in these ceremonies. Corn stalks are gathered and laid against the wooden vat of fermented corn and, as the religious leader divines the names of the new children, he recognizes the corn and initiates it into the community.

It is men's task to clear the plot, but harvesting is women's work. Women leave the house each morning with children in tow to dig manioc, pick beans and harvest corn. By February, corn and beans are ready to be collected. As the season progresses, the peanuts, rice, and squash mature. Like men, women join forces to work in their gardens. The otherwise tedious task is relieved with joking and singing. By mid-morn-

ing, they have returned with bags of corn or manioc balanced on their heads, ready to cook for the midday meal.

The annual garden cycle ends in August as garden plots are depleted. This begins the start of karuvaí. Even when harvests are abundant, it is difficult to store foods for the coming cold months. Birds, peccary and deer eat whatever remains in the field, and insects attack the stores in houses. Thus, by September, most gardens are reduced to manioc and sweet potato and families are forced to look elsewhere for food.

The annual cycle of gardening builds into a longer cycle of garden shifting. Despite the gardens' ability to mimic the forest, clearing exposes the soils to the rigors of the intense sun, rains and competition from insect and plant pests. Warmth from the sun breaks up compounds and harsh rains wash them out of the soils. Corn and beans demand considerable nitrogen from the thin soils. Fertility soon declines. Moreover, as time passes, pests and weeds find their way into the plot. Grasshoppers and grubs discover the clearing and reproduce quickly on the vulnerable crops. Grasses, when they finally are introduced, quickly colonize and cover the exposed soils. When gardeners replant beans in the same area for a second or third year, they find that vines are stunted and seeds are littered with weevils.

Rather than simply abandoning gardens after a single productive season, Guaraní plant them with crops that can thrive on poorer soils. Manioc and sweet potato demand little of the soils and are resistant to the weeds and insects that invade corn and beans. As women uproot manioc and sweet potato each morning, they replant buds in the holes. The buds grow through the tangled chaos of old fields with almost no maintenance. Although tubers take nine months to mature, these crops produce continuously for up to four years. This assures a constant supply of basic food with very little work.

After the fourth and fifth years, when even manioc fails to prosper, the Guaraní plant banana and other tree crops. These are not hindered by the weeds and brush that overtake the plot. In fact, the plot produces many edible plants after the forest canopy reclaims the sky over the garden.

Guaraní gardeners exploit several areas at the same time. Farmers continue to work old plots even as new plots are cut. The annual cycle of clearing, planting and abandonment builds into a multiyear cycle, where farmers exploit parcels of a variety of ages, using each for a different type of production. These plots often abut. Where one end of a gardener's plot may be freshly cut, the other side may be an aging banana plot that is being reclaimed by the forest.

When gardens are no longer cultivated, the forest quickly takes over the plot. The forest colonizes the plot from the edge toward the center. Vines send tendrils into the sunlight and roots of the trees at the plot's edge burst through the soil with saplings. Bats and birds feeding on the insects in the garden drop seeds into the weeds, as do foraging deer, peccary and armadillos. Within a decade of clearing it is difficult to identify a plot; within twenty years the high canopy has been replaced and the forest ecosystem has restructured itself. Weeds and insects that prosper in the broken earth and the intense sunlight are driven off. Species that flourish in the moist shade of the forest replace them.

The shifting of gardens and houses builds into larger community movements. As gardeners seek out fertile soils for farming, they eventually destroy the high forest near their houses. As Avarijú destroys the high forest near his house, he and his family are forced to walk farther and farther to bring in crops. Guaraní houses are rudimentary wooden frames with simple roofs that can easily be built with a few days' labor. After a point, it is easier to move their house than trek over muddy paths with heavy loads. Families will then dissemble their houses and haul the beams and thatch to the edge of their new garden.

Every several decades, Guaraní move their communities to new areas of the forest. The death of a religious leader often spurs this shift. His body is placed on a bier inside the house and the houses of his followers are abandoned. The community builds new houses at another site in the high forest. It is useful to note that the pattern of the religious exodus coincides with the ecological cycle. After several decades of population increase and garden clearing, it is not uncommon for a community to be surrounded by infertile, dry fallow. Re-

cating at the death of a religious leader, which happens every two or three decades, moves Guaraní families when they are also being forced to walk several kilometers to find fertile garden land.

### Hunting, Fishing, and Gathering

In addition to gardening, Guaraní harvest materials from the standing forest to satisfy their subsistence needs. When Avarijú abandons his garden to chase an armadillo or spend a day fishing, he forages, rather than produces his family needs. The Guaraní depend on the forest for food during the months when the garden is bare. Fishing, trapping, and gathering provide critical protein when corn and beans are gone. As the harvest dries on and manioc and sweet potato become scarcer, wild tubers and forest honey provide important carbohydrates to supplement their diet.

Hunting is a primary means for the Guaraní to get protein in the forest. Although the stereotype is of an indigenous hunter with bow or lance, Guaraní prefer to trap animals. Walking down a community path, it is not uncommon to see a deadfall balanced over a game trail or a snare for deer or peccary at the edge of a garden. Gardens are favorite places to trap animals. Deer and paca are attracted to the tender crops, armadillo and peccary dig manioc and sweet potatoes. In fact, Guaraní make little effort to restrict forest animals from their gardens, preferring to set traps around the perimeter and harvest game as it tries to enter.

Traps are built with local materials. Hunters often simply suspend large palm trunks over corn or fruit bait and fix a trigger underneath. These deadfalls are especially useful for small animals, such as paca, armadillo, monkeys, and birds. This basic idea is sometimes elaborated into complex contraptions that defy the eye's ability to untangle the interconnections. In monkey traps the falling log closes the door to a small woven chamber, securing the animal without hurting it. To catch birds in gardens, the trigger drops a woven basket over the corn bait.

The Guaraní also are skilled snare builders. They spin the fiber of the Caraguatá plant into strong twine, which camou-

flages easily on the forest floor. Hunters suspend a twine noose from a bent sapling, which tightens when the animal disturbs it. Guaraní snares lift the head or a leg of the animal. By taking the creature's weight off the ground it makes it difficult for it to struggle loose. Snares are used to kill heavy game. A simple noose on a trail can hold a deer or peccary. When positioned over a covered pit it can hold a tapir (*Tapirus terrestris*). Some Guaraní have even use baited snares to catch large cats, such as the jaguar (*Panthera onca*).

Although they prefer to trap game, Guaraní sometimes hunt with arms. Bows were often used in the past, but today only old or poor men cut bows and fashion arrows. In most communities, at least one family has purchased an old shotgun, and most men can borrow one for a night's hunting. In exchange, hunters are usually generous in sharing their meat with the gun's owner.

Rather than stroll through the forest in the day, the preferred method of sport hunters, Guaraní hunt from trees at night. They often build a stand over a game trail or in their garden, then wait motionlessly for their quarry. This is extremely effective, but excruciatingly boring and terribly uncomfortable. Only the most committed hunter can withstand hours of incessant assault by the mosquitoes that fill the night air.

Fishing is another source of dependable protein that can be harvested in the forest. Rivers flood their low banks during the rainy season, inundating a broad plain on both sides. Oxbow lakes left behind by a meandering river are filled by the flooding. Fish are trapped in the lagoons as the rivers subside at the end of the wet season.

Poisons are a favorite way for Guaraní to kill many fish quickly. The bark of the timbo plant is crushed and washed through the water, leaving a thin seal over the surface of the lagoon. Once the water is poisoned, the fishermen sit around, sometimes for hours, waiting for the poison to take effect. They relax at the lagoon's edge, gossiping or sleeping until the water is depleted of oxygen. The stunned fish rise to the surface and can be collected by hand. While poison is extremely effective, it ruins the lagoon for future fishing, and usually provides more fish than families can eat. Therefore,

Guarani use poison on smaller or more distant lagoons, using lines or nets in larger lagoons near communities.

Many men prefer to fish with hook and nylon line. This method is quicker than poison and allows fishermen to target a specific variety of fish they prefer. Guarani fish lagoons at night, because the fish are most active after dark. Fishermen leave their houses in the late afternoon. For bait, they collect wasp larva and use them to catch minnows. Arriving at the lagoon at dusk, they build a roaring fire against the night and settle down to fish. Nylon line is tied to a sapling and a minnow is baited on the hook. Fishermen then toss the bait into the murky water and slap the surface of the lagoon with the end of the pole to attract the fish's attention.

Guarani are reluctant to spend the night in the forest; there are too many dangers - animals, humans, and especially the supernatural. So men fish with relatives and friends whose gossip and stories make the long hours pass more quickly. A favorite pastime of the men of Itanarami was to convince a reluctant anthropologist to join them in the mosquito filled night. He provided hours of mirth as he swatted bugs and vainly tried to catch something to eat. When fishing is good, the night is punctuated by yells and laughter as fish are pulled unceremoniously onto the bank. Guarani prefer small catfish (e.g. *Pimelodus charras*) for their size and taste, although they will eat almost any fish they catch, including mud eels (*Symbranchus marmoratus*).

The fishing season starts in December, as the lowlands dry enough to allow travel on the floodplains. It ends as the lagoons are fished out in late February. Consequently, fishing returns are the greatest in these months between planting and harvest, when Guarani are most in need of food. It is harder to catch the large river fish, but the *surubi* (*Pimelodus tigrinus*) and *dorado* (*Salmonidae*) grow to twenty kilograms. These are divided up by the community or sold for cash to mestizos. Catching a luncker catfish is a windfall for the community, but not a predictable source of food for a family.

Guarani collect a variety of other subsistence goods from the forest. During the dry season in April, May and June, families make excursions to orange groves in the forests or berry patches in the marshy grasslands. Honey is also a favorite

reason for a day trip. There are nine varieties of forest bees, and several produce succulent honey. People watch these bees carefully, tracing their flight to the nest, and harvesting the honey.

A family traveling through the forest can usually find a meal easily. The hearts can be cut out of palm trees as a nutritious salad; fruit collected from a myriad of trees; or filling roots dug from forest plants. Hungry travelers can even get a good meal from insects. The larva of bamboo moths and the abdomen of leaf cutter ants are not only tasty, but extremely high in fat.

In addition to food, the Guarani can satisfy almost all their other needs from the forest. Building materials, for example, are readily available. Tall marsh grasses are cut for thatch and the roof timbers are cut from the abundant hardwood. Guarani also make forest medicines. Tropical plants have high concentrations of powerful organic substances, called alkaloids. Guarani specialists concentrate these alkaloids to manufacture effective medicines for many sicknesses. Even salt can be collected from forest lowlands and purified into a satisfying condiment.

### Commercial Harvesting

Guarani collect a variety of forest goods to sell into regional markets. Yerba mate, animal skins, essential oils, and food are all harvested from the forest. These provide cash and manufactured commodities from national and international markets. In terms of production, commercial collecting differs little from indigenous subsistence activities. As in their gardening, Guarani are careful to harvest forest materials without degrading the ecological integrity of the larger system. First, commercial collecting uses the forest extensively, but not intensively. For example, collectors cut foliage from all yerba trees, but harvest only the mature leaves of each tree every third year. This protects the plants' survival.

Second, as subsistence production exploits a variety of ecological niches (e.g. soil, flora, and fauna) the Guarani harvest a variety of goods for sale. Consequently, families do not over-exploit a commodity in a desperate attempt to earn cash.

As families need more money, or as the market for a commodity declines, they harvest and market a different resource. By collecting different goods for sale, families generate income throughout the year. When the yerba harvest is finished in May, the Guaraní shift their energy to hunting skins for cash. When fur quality declines in September, they cut fence posts. Consequently, families follow an annual cycle, harvesting for a variety of commercial markets over the year.

The most important source of income for the Guaraní is the sale of yerba leaves into the national and international markets. *Ilex paraguayensis* is closely related to the holly tree and grows to about thirty-five feet. It prefers low soils and shade, thriving under the broken canopy along streams and the edges of marshes. The Guaraní call these areas *ka'aifí*, which derives from the Guaraní word *ka'á*, which means yerba. Although it is common throughout the region, yerba does not grow in dense stands and rarely comprises more than 10 percent of the forest cover.

Yerba is gathered at the end of the annual growing season, when the leaves are thick and full of alkaloids. Men, alone or in pairs, set up temporary camp in a dense growth of yerba. Yerba leaves grow on the thinnest twigs, which protrude from all areas of the thick trunk and branches like the suckers of an apple tree. Each half-meter branch has between eight and a dozen leaves. Working with sharp, short machetes, they climb into trees, clip twigs and drop the foliage to the ground.

Guaraní commercial cutting takes care not to damage yerba trees. Yerba gatherers, called *mineros* know not to harvest any branches thicker than their little thumb. This limits cutting to twigs that have foliage and protects the branches on which they grow. In addition, Guaraní harvesters harvest each tree every three years. This assures that plants are allowed to recover their size and health after each harvest. The collector who ignores these rules earns a bad name among his compatriots. These simple practices guarantee that the harvest will not reduce the productive capacity or the reproductive ability of the tree.

The first step in drying yerba is to scorch the leaves, a process called *ohapy*. Collectors wave small bundles of boughs through the flames of an intense fire. This converts water in the foliage to steam, bursting the thin membrane on the underside of each leaf with a sound like popping corn. This prevents the leaves from rotting quickly and lets them dry slowly.

After scorching, the minero ties the twigs into heavy bundles and carries them to his forest camp. There, he piles the leaves on a large drying rack called a *mbarbakuá*. Mbarbakuá are constructed from stakes and poles. Saplings are stuck in the ground about a half-meter apart to form an oval three meters long. The yerbatero then doubles the tops over and ties them to one another, forming a loose dome-shaped platform for the yerba. A second set of poles are then placed in the ground, but angled outward. Their tips are attached with a circle of thin branches to form a railing to keep the foliage on the platform. Finally, the yerbatero digs a fire pit beside the platform and hollows a cavity underneath the *mbarbakuá*, with an opening to allow smoke and heat to filter up through the leaves.

Drying racks can hold up to sixty kilos of fresh yerba leaf, about as much as a man can collect in a day's work. The scorched leaves are placed loosely on the frame and a fire is lit in the pit underneath. For twenty-four hours, yerbateros feed the fire and turn the leaf with long handled rakes, allowing it to dry evenly and slowly. Men prefer to work in teams. Not only do they share the labor of collecting firewood and feeding the flame, but companionship alleviates the boredom.

When the foliage has been thoroughly dried, Guaraní open the side of the *mbarbakuá* and spill the yerba onto the ground. The leaf is crushed and chopped with poles and machetes. Finally, the minero packs the coarse tea into burlap sacks for shipment to market.

A second important source of cash for Guaraní is citrus oil, called *esencia*. Essential oils are extracted from the leaves of bitter orange trees (*Vulgaris vulgaria*), which grow in stands in the forest. This essence of orange is used in perfume and as a natural flavor for food. The collection of orange leaves is



similar to that of yerba. When the foliage has reached its fullest, men climb into the trees and trim off the twigs that hold the most leaves. Like yerba collection, the production of *esencia* involves harvesting only the foliage of the citrus plants, most of which grows on shoots off the main branches.

Rather than dry leaves, collectors distill the heavy oils from the foliage in rudimentary stills that they build in the forest. A location is chosen near both firewood and a stream. Oil drums, copper tubing and wooden troughs are fashioned together with wire and rope. Water and leaves are packed into the metal drum and, when fired up, it sputters, smokes, and belches. Eventually, a thin stream of pungent, heavy oil is siphoned off the steaming brew through a shallow trough into a metal tin.

The sale of animal skins is a third source of cash for the Guaraní. The national and international footwear market demands a variety of leathers. Although the Guaraní hunt primarily for meat, much of the game they kill has valuable hides and skins. Two of the favorite quarry, deer (*Mazama americana*) and peccary, have skins that are easy to sell on the domestic leather market. People kill lizards (*Tupinambis teguixin*), caiman, and snakes, but flesh of these animals is less desirable and their skins harder to sell. Some animals are killed solely for their pelts. Few Guaraní will eat the meat of the South American fox (*Dusicyon gymnocercus*), but will hunt it for its pelt. Until 1979, the Guaraní set snares for jaguar and ocelot and sold the skins at high prices into the international market. This trade was stopped by international restrictions on the sale of furs from endangered species. Today, few Guaraní take the time or the risks to kill forest cats.

A final method of earning cash from the forest is the sale of timber products. Guaraní often fell and market selected hardwood into the international market. The extremely dense Urundaymí (*Astronium urundeuva*), for example, is often sold as fenceposts. This wood can withstand years of exposure to water; some timbers cut for the 18th century missions still stand strong and firm in the ruins of the Jesuit churches. This resistance to decay makes the wood ideal for fences in eastern Paraguay's moist soils. Urundaymí grows throughout the canopied forests of the Mbaracayú area, but at very

low densities. Men have to search out mature trees, cut a trail to their bases, and fell the timbers with axes within the close confines of the forest. While the technology is simple and cheap, the labor is heavy, slow, and unpleasant. Mosquitoes and sweat bees quickly fill the moist, still air of the forest and cover the bodies of the men. Once down, the timber is cut into two meter sections and split into rails. The loggers use wooden mauls to drive iron wedges into small cracks, forcing the dense wood to give way along its straight grain. Eventually, the trunk is divided into fence poles of approximately ten centimeters in diameter. Men carry these on their backs to a dirt track, where oxen take the load to a dirt road. Logging trucks carry the poles to market, either into Brazil or south to Paraguay's ranching area.

In sum, Guaraní horticulture, hunting, fishing, and commercial gathering integrate into a single agroforestry system. Guaraní agroforestry provides families with a variety of sources for food. This assures them a diverse diet and helps reduce the seasonal shortages in any one sector. Moreover, agroforestry gives households access to cash as well as subsistence goods. Commercial collecting provides families access to market products, without pulling them away from their gardens and traps.

## AGROFORESTRY AS ADAPTION

Guaraní agroforestry is adapted to the tropical ecosystem. Two aspects of the system protect the forest, even as it provides a satisfactory life for the Guaraní. First, agroforestry exploits diverse ecological niches, assuring that no single resource will be over-harvested. Second, Guaraní production uses small areas of the forest for a short time, then moves on and allows the ecosystem to regenerate. By exploiting the forest extensively, in both time and space, the Guaraní avoid the damage caused by intensive long-term exploitation of small areas.

## Production Diversity

Guarani agroforestry exploits a variety of niches in the tropical ecosystem. Horticulture makes use of the dense flora, converting the overstory and underbrush to fertilizer for the thin forest soils. Burning the plant material frees the carbon, potassium and other nutrients critical to plant growth. Conventional agriculture depends on thick loam soils with high fertility and replaces nutrients with concentrated fertilizers refined from petroleum. There are no fertile soils and few fertilizers in the forest. Consequently, horticulture uses the infertile soils simply to hold plants, depending on the flora of the forest to fertilize their growth.

Unlike conventional agriculture, horticulture exploits the variety of nutrients within thin tropical soils. As we have seen, Guarani interplant many different plant crops in a plot. Diversity reduces the number of plants of any one crop in the garden and increases the crop varieties in an area. As crops differ in nutritional needs, this interplanting maximizes the use of diverse, but scarce, resources in the soil. This diversity in gardens mimics the natural environment. Tropical forests, themselves, are extremely diverse, allowing plants to maintain stable communities on scarce soil resources.

Hunting and fishing exploit a second set of resource niches in the tropical ecosystem. Traps harvest animals that forage in the warm, moist shade of the forest canopy. Deer, tapir, peccary, paca and armadillo convert the forest's plant material into protein that can be processed by humans. When hunting fails, men collect fish, caimans and turtles that feed in the slow moving rivers and ox-bow lakes. Fishing captures the rivers' fertility for human use. Fishing is especially important in resource diversification, in that moving waters bring fish that replenish streams and flood-plain lakes near indigenous communities. When tasty game or fish are unavailable, Guarani shift their hunting skills to less desirable foods. If needed, Guarani will kill monkeys and anteaters, gather ants and grubs, or fish for minnows and eels. Each will provide a filling and nutritious meal, even if it is less appetizing.

By exploiting a variety of animals, the Guarani avoid over-exploiting any one population. Guarani prefer to har-

vest animals near their communities, rather than travel longer distances to hunt one favorite type of game, such as deer. Even the guinea pigs (*Cavia aperea*) that live in the grasses around their houses can provide a good meal. Families will eat just about any bird or animal if other meat becomes scarce. This increases the hunting pressure on all game populations in a small area, but reduces the demands on any one population.

The nutrition won from the fauna and insects of the forest reduces the Guarani need to produce great quantities of high-protein food in their gardens. This reduces the size of their gardens and preserves a larger portion of the region in a forested state. Conversely, with some protein in their garden, Guarani are not forced to exterminate the last of any one game population as it becomes scarce. By dividing their food demands between two niches, they protect both from being ravaged to fill short-term food shortages.

Even the commercial activities of the Guarani are diversified over a range of ecological niches. Yerba gathering and essence production exploit the foliage of trees along the stream banks; hunting uses the furs of inedible animals; and lumbering harvests hardwood from high forests. As in food getting, this commercial diversity protects any one resource from over-exploitation. As yerba or fox become scarce near communities, Guarani shift their commercial gathering to more readily accessible commodities, such as reptiles or citrus leaves.

## Production Cycles

In addition to diversifying resource exploitation over many ecological niches, Guarani production spreads its demands for resources over time. Annual production cycles integrate into longer sequences in which families move their gardens and communities through the forest.

The work year of a Guarani family can be divided into four periods, each characterized by a distinct type of work. As women harvest in the gardens throughout the year and work little in wage labor or hunting, these four periods are most evident in men's work strategies. In the first work peri-

od, from July through September, households clear and plant gardens. From October through January, the second period, men spend a greater amount of time working for cash to buy food during the karuvai. Fishing characterizes the third work period of the year, from February and March. Finally, from April through June, men divide their labor equally between forest subsistence and commercial gathering.

While gardening destroys trees and hunting reduces local game populations, these effects are on micro-environments. The amount of forest under intense exploitation at any time is less than 5 percent of the area and when these areas become inhospitable, households and communities move into new fertile areas. Over the course of a Guarani's life, he or she might live in ten or twelve different areas, leaving behind a string of recovering micro-environments.

As the fertility returns to abandoned village sites, Guarani return to them. The forest is vast, but there is never an abundance of ideal sites, with fertile land for farming, rivers for fishing and streams for water and washing. Guarani return to these spots as soon as they have recovered from previous inhabitants. Thus, we can define a cycle of village movement where, over many generations, Guarani return to places occupied by their ancestors.

The Guarani have sustained a complex and dependable production system in the lowland forests, despite the region's fragile and scarce resources. What aspects of this economy assure its sustainability? First, the resource demands are diverse. By exploiting a variety of ecological niches in each area, the Guarani can earn what they need without undermining the integrity of that system. Second, the resource demands of indigenous production are extensive. By spreading their horticulture, foraging and commercial gathering over a large area of the forest, they limit the intensity of transformation in any one area.

The sustainable system of the Guarani is not simply for their subsistence; it has maintained a cash income for the Guarani for over four centuries. The Guarani have sold yerba from their forests since 1500 and have become dependent on the manufactured goods that it provides them. Guarani commercial gathering abides by the same environmentally

friendly strictures that govern sectors of their economy. First, the Guarani are not dependent on a single resource for commercial wealth; they sell a variety of commodities, depending on availability and the market prices. If yerba becomes scarce or its price falls, they shift their efforts to harvesting another type of good. Second, commercial gathering is extensive, rather than intensive. Gatherers harvest specific elements of the complex ecosystem, protecting the viability of the larger structure. As demand for a product increases, new areas are exploited without increasing ecological destruction near Guarani villages.

## GENDER AND THE DIVISION OF LABOR

When early morning visitors walk into Avarijú's houselot, they generally find the entire family sitting beside the fire drinking mate. Before the dew dries off the grass, however, they will be up and working. The house needs to be swept, the blankets thrown over the rafters, and traps must be checked. As the sun warms the earth, Avarijú leaves for his trapline and his wife slides the baby onto her hip and heads for the garden. The older daughters take the dirty clothes to wash at the river and Avarijú's son grabs a machete and heads into the forest to cut yerba.

How do Guarani spend their time? Who does what tasks? In industrial societies, workers specialize and perform only one type of work. Mechanics, steam fitters, lawyers, and daycare workers each perform a small part in a large and complex labor system. In contrast, an analysis of Guarani labor shows that all individuals are called upon to perform a wide variety of tasks. The principal division of Guarani labor is along gender lines. Besides horticulture, hunting, trapping, and commercial gathering, family members must maintain a building, cook food, care for children, attend to personal hygiene, as well as going to religious gatherings and community meetings.

Work time can be categorized as *productive labor* or *reproductive labor* (Minge Klevana 1980: 279). Productive labor generates the food and materials that the family needs to survive. Among the Guarani, productive labor is the horticult-

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ture, hunting, fishing and commercial work; it is done in the forest or fields. Reproductive labor is the work necessary to see that the family group is maintained and replaced. Among the Guarani, this work is usually done at home and consists primarily of childcare, cooking, house construction and maintenance. Where productive labor fills the household's needs on a daily basis, reproductive labor assures its continuation over generations.

Guarani households spend an average of 18 percent of their time in productive activities. Almost a third of family labor is in horticulture, slightly less to forest subsistence strategies and about 40 percent of its production is in commercial activities. Twenty-seven percent of Guarani household labor time is allocated to reproduction. Family members cook, care for children, organize the house, clean the yard, and sew.

Not all Guarani time is devoted to the necessities of life. Although the Guarani spend just about half (45.6 percent) their time working, over a third of their daylight hours are spent resting, relaxing and socializing. Work stops at nightfall, and the family again gathers around the fire to talk, think, and sleep. It is worth noting that the amount of time that the Guarani spend resting is greater than that allowed by work schedules in more industrialized societies (Schor 1991). Guarani men spend an average of a quarter of daylight hours working outside the home, roughly half the time needed to subsist in a European country (Minge-Klevana 1980). Far from being a group struggling to make a living in a harsh environment, the Guarani are relatively affluent. They satisfy their needs fairly easily, using the remaining time and energy to be with family and friends.

Guarani labor is highly organized, with each individual carrying out specific tasks as well as engaging in group-oriented work. For the most part, work is organized along gender lines. This is particularly evident in gardening, which demands the greatest total amount of labor of the three primary production activities -- an hour a day on average. Both men and women both in the garden, but they perform different tasks.

The different responsibilities lead to different work rhythms. Men's greatest work is early in the agricultural

cycle as the spring rains approach. Teams of men and boys leave early for the designated garden plots and work diligently felling trees and clearing undergrowth to get a plot ready for planting. After the plot is cleared, however, males spend weeks at a time without entering the garden, devoting themselves to hunting, fishing and commercial gathering. Women, in contrast, need to harvest food from the garden every day. Most women go to the garden each morning to dig manioc and sweet potato for the daily meals. During the harvest, they may spend the entire morning there, picking beans and corn.

The Guarani household is equally dependent on the labor of men and women. In total, women work more in the gardens, but men do most of the other productive tasks. When women head off to dig manioc or sweet potato, men go into the forest. They hunt, fish, collect produce to sell, or do paid field work. In terms of food, women bring in the garden produce, often the carbohydrates that sustain the family. Men, on the other hand, are responsible for the meat and purchased goods that the family needs.

Where men do a range of productive labor, women perform a greater portion of the reproductive tasks of the household. The responsibilities of cooking, cleaning, and childcare fall largely on the shoulders of women. The average woman spends about an hour cooking each day. When a woman returns from the garden in the morning, she must peel the manioc, get water, and put the pot on to boil. Throughout the day, she is often tending a pot of rice, corn or beans. In addition, women spend three hours doing other household tasks, such as sewing and cleaning. The houselot needs to be swept and clothes washed. Childcare takes place in the midst of other work. Infants watch from a shoulder sling and toddle behind their working mother as they grow.

The economy of a Guarani household demands the work of both men and women. The various demands of the garden, forest work, and childcare force men and women to coordinate their activities. The necessity of both sexes is clear when a man or woman is forced to live alone. The recent widow, or the man whose wife has left him, is left with half a household. A man might have a new shirt or a kilo of meat, but no man

like  
Guarini's  
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in his garden. A single woman may have a garden teaming with produce, but no yerba to drink. Few people keep house alone. Most individuals are forced to link up with a partner or move in with relatives.

Anthropologists suggest that a person's economic contributions give them power in society. In societies where women are excluded from production, they are dependent on men for their day-to-day needs. Because of this dependence, their power is diminished in relations with men (Leacock 1972; Friedl 1978). The division of labor in Guarani production provides women considerable independence. Women's garden work brings in a major source of food and contributes to her status within the household and community.

## PRODUCTION AND GUARANI AUTONOMY

Besides stability and sustainability, the economy of the Guarani has allowed them to maintain a level of autonomy from the national society. The first Europeans came into this area in the 16th century. Their mestizo descendants have had continual and, at times, intense relations with the Guarani. The yerba market has integrated the Guarani into an extensive international commodity market.

Despite their close contact with the larger society and economy, the Guarani have not assimilated into it. Even as their goods flowed across cultural boundaries to Paraguayans and Brazilians, the Guarani maintained their own identity and culture. When Avarijú sells yerba in the local mestizo town, he is very aware of the cultural distance between himself and the mestizo merchant. He lives in a different community, practices a different religion, and pays respect to a different type of political leader.

Economic independence has given the Guarani power to maintain their cultural identity. Even as they trade in the international economy, Guarani control the level of their involvement in it. When the prices offered for their produce drop too low, they stop selling; when merchants raise the prices on store goods, they don't buy.

Prices of yerba, skins and wood change drastically and often. Price fluctuations are often in response to international

demand. Alternately, they reflect local factors, such as road conditions or transport price. The cost of goods that Guarani buy often spirals as they become scarce. It is not uncommon for commodity prices to be doubled or halved over a single season, even without the occasional greedy merchant who wants to gouge the purchaser. These economic vagaries make it difficult to plan household budgets; Avarijú heads into the forest to collect yerba without any guarantee of the price he will be paid, nor the quantity of store goods he will be able to buy.

Fortunately, by maintaining a dependable source of subsistence from horticulture, fishing, collecting and hunting, the Guarani do not have to rely on commercial markets. The economic stability of a Guarani family is in their garden, not in the yerbales or the *obrajes*. The young man who professes love but does not clear a garden, is considered a Don Juan rather than a suitor. The surest sign that a young couple is going to settle down as a family is the field they plant together. It is considered risky to let a garden go fallow and depend on wage labor for food. Families who choose this route make themselves vulnerable to the whim of the market and the patron.

Many patrons have tried to use debt bondage to keep collectors working in the forests. Patrons use cash advances to draw mestizos into forest work, loans that they must work off by collecting yerba or felling timbers. Totally dependent on patrons for food and equipment, these workers are underpaid for their production and overcharged for their necessities. They become wage-slaves to the commercial economy. Guarani, on the other hand, have been able to avoid debt-bondage because, with food in the garden and forest, no family is forced to sell yerba cheaply, nor to buy trade goods at an inflated price. Patrons who drop the price they pay for yerba find that Guarani collectors refuse to sell. Merchants who try to extract high prices for their goods, find that Guarani consumers retreat into their gardens.

In fact, the economic independence of the Guarani makes patrons cautious about lending to them. Since Guarani do not need the economic support of the patron, it is possible for them to abscond from their debts. The merchant who pro-

vides food and equipment to a Guaraní family may find that they have abandoned their house and disappeared into the forest to join relatives elsewhere.

This is not to say that the Guaraní power in the marketplace is equal to patrons, or that Guaraní always avoid usurious debt. Merchants wield considerable influence in local communities. The patron seeking to collect on a debt to a Guaraní can depend on the full force of law and the brutal assistance of the local militia in punishing miscreants, if they can find them. Patrons also use their positions to artificially manipulate local economies. Paraguayan patrons have been known to dynamite bridges to control workers' access to markets.

## GUARANI CONSUMPTION

Popular stereotypes suggest that indigenous peoples become enamored with new-found commodities from the world's bazaar, that people like the Guaraní put themselves innocently into lifelong debt for trinkets they do not need. This is not true of the Guaraní. When Avarijú goes to the market, he buys a few basic goods that he considers necessities. There are always more desires than money, and he weighs each choice against reasonable alternatives. After centuries of market experience, the Guaraní have learned to balance the purchase of a few things they cannot produce with their own subsistence production. The Guaraní market basket would be considered small and boring by most modern consumers. Food is the primary item, averaging about 40 percent of the average family's purchases. This includes a monthly average of about two kilos of rice, pasta and flour; a kilo of meat; and a half liter of cooking oil. Everyone buys a little salt, which is cheap and liked by all.

After food, cloth and clothing are the next most important purchases of Guaraní consumers. This gives a new shirt or pants (but probably not both) to most people every year. Soap, like salt, is purchased by all households. Guaraní consider personal hygiene a virtue and even the most tattered clothes are washed daily. The average family also spends about a fifth of its budget on tools, usually machetes, force,

and axes for subsistence agriculture. Finally, goods such as tobacco, tape recorders and alcohol, the stereotypical indigenous peoples' purchases, make up only a very small portion of the total expenditure. When Avarijú has paid for his necessities, he is lucky if a few cents remain for a piece of hardtack for the kids or tobacco leaf for himself.

Guaraní purchases provide useful goods that are not available in the forest. Salt, machetes and axes, medicines and soap have improved the lives of the Guaraní dramatically. None would be available if not for commercial markets. Even the polyester shirts, imported from Taiwan, wear far longer than the rough woven cotton that the Guaraní used to make themselves.

In addition, the market provides food when other sources of nutrition are unavailable. With the end of the corn harvest, farmers turn to pasta and rice from the market. Although hunting and fishing provide important protein, the marketplace provides a dependable (if expensive) source of meat. Just as subsistence production protects the Guaraní from total dependence on the commercial economy, the marketplace defends families against periodic shortfalls from hunting and horticulture.

In sum, the Guaraní have adapted their agroforestry to the environment of the tropical forests. They exploit a variety of ecological niches, and distribute their resource demands over time. The Guaraní have, thus, won a satisfying life from a fragile and infertile resource base.

The diverse economy of the Guaraní offers more than economic stability; it also provides social autonomy. By satisfying their basic needs from the forest, the Guaraní enter the market without becoming dependent on it. They retain the power to leave the commercial system and cut themselves off from Paraguayan society. Thus, the Guaraní have been a part of the market for four centuries without assimilating into the larger society.