

Agroforestry in Paraguay

Over spring break, a group of 19 students and faculty traveled to Paraguay. They spent the first two days of the trip at an agroforestry education center. Following are excerpts from the group journal for those days, by Emily Gunter, Chris Hopkins, Angela Moreland, Joe Pursley, and Jacek Siry.

Travels

After lay-overs in Miami and São Paulo, we are on our way to Asunción. On our descent, we fly over the wide, sediment-laden Paraguay River. As we step off the aircraft, there is no doubt we are in the right place--hot and humid. We are welcomed just outside customs by Jim Hamilton (NC State), Brian Condon (SEPA director) and Alberto Rautenberg (forest engineer). Outside the airport it is even hotter, so we get a sip of iced yerba mate (*tereré*) and readily board *Coche* No. 14. That is our bus, which regularly serves as an Asunción city bus. We are greeted by our driver, Roberto Moringa, throw our precious belongings in the back, and set out for the agroforestry center five hours away. Once the bus speeds up, it starts vibrating which gives it this supersonic feeling that is going to stay with us for the rest of the trip.

Finally, we leave the city and drive through rural Paraguay. Mostly we see vast pastures with a few cows wandering around, but little forest in sight. After a few hours, we leave paved roads and follow dirt roads towards some mountains rising in the distance. The road gets more jumpy by the mile. We cross cotton, sorghum, corn and sugar cane fields. We drive by a sugar cane factory and enter Santo Domingo, population about 1,500, where the agroforestry center is located. The road gets dustier, until after a sharp turn, the bus engine chokes--later it turns out to be a tree ("Paraiso gigante" (*Melia azedarach* var. *gigante*--about 2 years old and 15 ft tall) blocking the entrance to the center—so finally we have arrived after 36 hours of travel!

Introduction to SEPA

SEPA (Servicios Ecoforestales Para Agricultores) at first sight is a quad with a few red tiled buildings that host accommodations, a classroom, a kitchen, and an office. A water tower and trees complete the picture. Before it turns dark, we make a quick trip to a stream, passing through fields and forest. Upon return, we find a meal of manioc, local bread, rice, beans, and chicken. Brian Condon welcomes us to SEPA and tells us its history.

SEPA was established in 1997 by former Peace Corp volunteers. With their private funds they bought 20 ha of land and put in place some infrastructure. Initially, they thought about timber investment, but since more funding was needed to run the place, they changed their focus to agroforestry, soil conservation, and green manure. The idea was to create a model farm that is accessible to local people and that provides relevant working examples. SEPA won a large, three-year grant that funds staff and infrastructure improvements. SEPA currently employs 3 people in Asunción and 15 extension specialists in Santo Domingo. Those specialists are paid a minimum wage of \$200 per

month. This is a good wage, considering that some farmers make about the same amount in a year.

Discussion on our first evening focuses on whether the SEPA model could be scaled up to address the large scale development problems that many countries face. In addition to lots of hard work, SEPA's success seems to depend on several factors: (1) it is a small operation, (2) it has substantial funding, and (3) it does not have to deal with a corrupt and inefficient government. We head off to sleep on the question of whether SEPA would continue to work as well at a larger scale.

Touring SEPA

We rose early to a hearty breakfast and an ever increasing temperature. The extension agents and caretakers of SEPA had gathered to provide us with a first hand tour and explanation of the demonstration farm. A group formed around each extension agent (Ruben Espinola, Alfredo Cespar, Florinda Velasquez, and Luis Espinola) and headed out to view different plots.

On Ruben's tour, the first stop was a three-layered system of *Melia*, *Peltephorum*, and pigeon pea. The *Melia* provided a timber component while allowing enough light for the tall pigeon pea. The pigeon pea could provide food, fodder, nitrogen, fuel wood, and a substrate to help the *Peltephorum* grow straight. Just this first plot showed us the great complexity of agroforestry systems. One system after another showed great creativity and trial and error practices. If it worked, they would use it. If it didn't they would try something else.

On Alfredo and Florinda's tour, the first stop was the composting operation and the manufacture of an insecticide 'tea' made of *Melia*, garlic, and several other plants. A foliar fertilizer is made from *Leucaena* and pigeon pea. Some of the systems where these might be applied include a no-till combination of carnivalia, lapacho (*Tabebuia heptaphylla*), and guatambu (*Balfourodendron riedelianum*); and another combination of pigeon pea and Curupa'y ra (*Parapiptadenia rigida*) and Curupa'y-curu (*Anadenanthera columbrina*). They showed us bee hives, fruit trees, plantings (banana, coffee, yerba mate) under remnant forest, and enrichment plantings of timber species in that forest.

Don Alfredo and Doña Florinda also talked about their commitment to SEPA. Alfredo told us that the parcels of land owned by the farmers become smaller over the years as they are divided among children. He has seven children. Farming practices in the region are changing, as for example, farmers now leave plant material on the ground to be plowed back in to the ground. Florinda pointed out that it was quite unique that she, as a woman, has the opportunity to work at SEPA.

Sunday afternoon in Santo Domingo

After lunch and a discussion session at SEPA, we headed out again in five small groups to visit families in the surrounding community. One group stopped in to see Don Beto.

His house has a thatched roof and bright red walls, declaring his loyalty to a certain political party. A practitioner of shifting agriculture for most of his life, Beto has cultivated the same 16 hectares for the past sixteen years. He related how he was about to move to another piece of land when SEPA came to the area with their ideas and gringos. At first he said he was scared but slowly took interest in the agricultural and agroforestry practices. The biggest change for him was the ability to store dry goods in silos for extended periods of time. He could then focus on cash crops and a forestry component. His agroforestry practices are still on the sunny side of shady, but he has hundreds of new saplings planted in areas that were hit hard by frost. He feels that his and others' involvement in SEPA has created a community that did not exist before.

After a quick tour of his farm, Don Beto led us to the cultural center of the community: the balneario. Gathered around a make-shift volleyball court and a decent size stream were about 70 to 80 locals. The sound of guitars and singing climbed out of the steep banks and hung in the humid air. Over a swim, a volleyball game, and socializing, the amount of communication between our group and the locals increased tremendously. They worked on their English and we on our Guarani and Spanish. As the sun began to set we parted from some but others walked the same road as us back through the campo. Slowly, group after group, family after family, individuals peeled off onto trails and other roads leading to their homes. Finally we found ourselves alone, walking under the "southern cross" and silently contemplating the cultural experience we just had.

Neighboring Farms

After an early breakfast, we break into two groups and head out to visit the farms of SEPA extensionists. These visits allow us to learn how the extensionists apply the methods promoted by SEPA on their personal farms. Overall, we get a feeling for how passionate these farmers are about their land, work, and agroforestry. They have a vision of hope and greatly desire to share all their knowledge and experiences with fellow agrarian countrymen. Additionally, we are able to view the various planting schemes used by each farmer.

Farm 1: The owner of this 10 acre farm began implementing agroforestry three years ago. He has 6 different types of mandioca, differing in growth rates, taste, and quality for tapioca production. The mandioca is for home consumption, and it is harvested as needed, because if the tuber dries out it becomes hard as a rock and inedible. Other crops include corn, soy, peanuts, and cotton.

The trees on the farm include a mix of natives and exotics such as *Melia azedarach* (Paraiso). Seedlings of natives are gathered from the forest, or seedlings that naturally regenerate on the farm are transplanted to appropriate locations. *Melia* seeds are obtained from local nurseries.

The multi-tiered system of trees and staple crops are planted so as to maintain sufficient light for the undergrowth. Notable elements of the agroforestry systems on this farm included mucuna, a nitrogen-fixing vine grown as a 'green manure', banana and citrus

trees, cameroon grass grown as fodder, and cattle. *Mucuna* is used to eradicate sugarcane and replenish the soils of fields planned for some other crop.

We learn that farmers can receive credit from the National Bank, which has a branch in every region. However, credit and other government assistance are provided essentially only for cotton and sugarcane. Due to low prices for these crops, many people are in debt and are expecting (and hoping for) a debt forgiveness program.

Farm 2: The owner of this farm has seven hectares of his own and also works seven hectares of his father's land. He recognizes the need to replant trees and is excited about work with SEPA. When he began here, he planted all sugarcane as a cash crop and bought meat to eat, yet soon found he was unable to afford this. He then turned to subsistence farming and agroforestry methods. His first corn and mandioca plants were very small due to soil depletion by sugarcane, but now with incorporation of green manure, his mandioca is growing tall and producing well. His mandioca is both for sale and subsistence, and he feeds the leaves to livestock.

Other crops include lemon grass (used as a flavoring in *terere*), tobacco, gourds, pineapple, banana, and citrus fruit. He recently started grafting fruit trees. In addition to crops, he raises chickens and has bee boxes. Scattered throughout his fields, he has planted seedlings of valuable timber species.

Farm 3: Don Mario Espinola is planting mostly for his own consumption, and he never has to buy vegetables. He claims that he brought agroforestry to the area seven years ago. He had started grafting fruit trees when Jim Hamilton was a Peace Corps volunteer in the area and currently achieves success rates of 10-90%.

He noted gains in milk production from agroforestry feeding practices of 400 to 900%, with the feeding of *Leucaena* to lactating cows. He also experimented with fishponds but found them to need very careful management and is no longer actively maintaining them.

His most profitable agroforestry system has been the bee keeping. He estimates that he has earned 1 million guarani (about \$300) from 4 hives since its inception. He receives about 10,000 guarani per liter of honey and expects to sell 100 liters this year alone. He also tried sericulture (silkworms), but this failed for unspecified reasons. His current strategy is to sell small livestock (pigs and chickens) for profit, rather than crops.

Other agroforestry/conservation practices on his farm include

- Logs placed on contours to prevent erosion
- Lapacho negro (*Tabebuia rosea*) trees interplanted with pineapple
- Cultivation of cotton and canavale together
- Paraiso (*Melia azedarach*) and yerba mate (*Ilex paraguensis*)
- Cedro (Spanish cedar - *Cedrela fissilis*) plantings in a line, some with *Hypsiphylla grandella* damage
- Diverse home gardens (lima beans, grape vines, macadamia nut trees, ducks, chickens)

- Selling seeds for green manure cultivation to other farmers.

Farm 4: The owner of this farm, Don Alfredo, was very focused on explaining the details of agroforestry and showing us the maximum amount of his farm. His approach was to try to tell and show us everything. He was being a bit 'retro' in his approach to agroforestry in that he was again experimenting with sugar cane production but combining it with canavalia (AKA pig bean or sword bean) and possibly *Crotalaria* (sun hemp) starting next year. We also saw upland rice used as a green manure. He noted that he replants his mandioca with stems from other areas (perhaps reducing the chance of nematode infection of a particular variety). He also plants lupine with his mandioca as a ground cover and green manure.

He is converting his yerba mate plantation to local hardwood species such as guatambu (*Balfourodendron riedelianum*). He is leaving even malformed trees to grow so they can be harvested for firewood.

Don Alfredo said that he gets his ideas from the radio, as well as from his father and older generations of Germans in Paraguay who have introduced him to alternative farming practices. His approach also demonstrates something of applied agronomic research. For example, he compared his mandioca production to that obtained in an adjacent field owned by his brother in law, reminding us of a split plot design trial.

Final Afternoon

Our last activity at SEPA was to develop and apply a method for quantifying the differences between agroforestry systems. Our method involved the following four measurements:

- (1) Diversity of plants: total number of species;
- (2) Type of plants: woody, herbaceous crop, or weed;
- (3) Time horizon for production: short term-seasonal products, long term-many years, or continuous - produced year after year; and
- (4) Percentage of canopy and of litter cover: 0-25, 25-50, 50-75, 75-100.

Once again, we split into groups and sampled the following five agroforestry systems:

1. *Melia azedarach* and Yerba mate (*Ilex paraguariensis*)
2. Rosado sin quema (no-burn site prep)(nuevo)
3. Forest enrichment
4. Piña, pigeon pea, and *Melia azedarach*
5. *Melia azedarach* over native species

Canopy cover is lowest in systems 1 and 5, and highest in system 4. Litter cover is also lowest in system 5, but highest in systems 2 and 3. The greatest number of species are found in system 1 (9 species), although only 2 of those are woody species. Not surprisingly, the greatest number of woody species are found in system 3 (5 out of a total of 8 species). Complete results, as well as other details of our visit to SEPA, are provided

in the trip journal, posted on the course web site:
<http://courses.ncsu.edu/classes/for491u005/tour.html>

After thanking our hosts at SEPA, we loaded back up onto our bus and were on our way to Coronel Oviedo. Look for journal entries from our visits to saw mills, Shell (Yguazu) Forestry, and Foz de Iguazú in future issues of *Sylvanet*!