

COURSE REPORT

Tropical Dry Forest Restoration in Human Dominated Landscapes

ELTI Training Landscapes
District of Pedasí, Province of Los Santos
May 2-7, 2022

A field course organized by:

The Environmental Leadership & Training Initiative (ELTI), the Yale School of the Environment (YSE),
and the Association of Livestock and Agrosilvopastoral Producers of Pedasí (APASPE)



Jacob L. Slusser

Students measure the diameter at breast height (DBH) of trees in a mature forest to estimate the amount of carbon biomass.

Background: Extensive, tree-less conventional cattle ranching, practiced throughout Latin America for nearly 500 years, is one of the primary causes for tropical dry forest degradation. Panama's Azuero Peninsula contains most of the country's original dry forest distribution. Unfortunately, very little cover exists in today's agricultural mosaic landscape. Consequently, the region suffers from a range of related environmental problems that negatively impact local agrarian livelihoods. With an erratic annual rainfall and a dry season lasting from five to six months, the region's extreme climate variations compound the stresses of unsustainable land use practices. As a result, the region is vulnerable to climate change and efforts to restore forest cover

ELTI is an initiative of:

Yale SCHOOL OF THE ENVIRONMENT
The Forest School



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Students estimate the merchantable height of a tree using a clinometer.

are particularly challenging. Nevertheless, advances in forest landscape restoration and ecological cattle ranching have been shown to enhance production and ecosystem services. To transfer this knowledge to future professional practitioners, ELTI has developed a field-based training course that teaches the principals and practice of forest restoration in these challenging human-dominated landscapes.

This training was offered to master's students from the Yale School of the Environment (YSE), enrolled in the course "Tropical Dry Forest Restoration in Human Dominated Landscapes," led by Dr. Mark Ashton. Over a period of six days, this course provided the practical basis to understand tropical dry forest ecology, degradation and forest restoration strategies in a complex human dominated landscape with diverse socio-economic degradation drivers. This field course was facilitated in ELTI's Panama Training Landscape, which conveys restoration principles and practice through its network of private properties that include interpretative trails, research sites, demonstration areas and model farms. In addition, participants interact with landowners during visits and learn firsthand about their motives for land management decisions.

Course Objectives: The overall goal of the course was to provide an experiential, place-based field experience to students to complement the course taken at YSE by demonstrating a range of approaches to tropical dry forest restoration in complex human dominated landscapes.

Content: This course was divided in three training modules, illustrated through introductory lectures, field-based demonstrations, and group exercises facilitated by ELTI staff and APASPE members, as follows:

Module 1: Tropical dry forest ecology and ecosystem services

Module 2: Deforestation, degradation and the effects on the integrity of ecosystem services

Module 3: Forest restoration strategies for tropical dry mosaic landscapes



Students are instructed on how to conduct a riparian buffer zone assessment.

Field-Course Format: This course took place over six days at ELTI's Training Landscape in the tropical dry forest ecosystem, located in the Province of Los Santos in the Azuero Peninsula. These sites demonstrate the varied biophysical and socio-economic contexts of different types of land use: (1) the Achotines Forest Reserve, containing mature and secondary tropical dry forest; (2) IDB Forestal, a native species timber plantation that incorporates cattle grazing in the understory; and (3) the APASPE model farms, privately-owned by members who have established silvopastoral and agroforestry systems, home gardens, and riparian buffer zones. The following activities occurred throughout the week:

Day 1: Course participants arrived at the Achotines Laboratory and were introduced to the operations and installations. Jacob Slusser and Saskia Santamaría (Panama Coordinator and Program Associate for the Neotropics Training Program, respectively) facilitated introductions. Afterwards, Jacob presented on ELTI's capacity development model and the objectives of the course. To prepare students for the following day, Jacob presented a lecture on tropical dry forest ecology and stand dynamics.

Day 2: Jacob led a field trip on ELTI's interpretive trail network, within the Achotines Forest Reserve. Students visited six different demonstration areas to discuss tropical dry forest species identification and phenology, functional characteristics, forest dynamics, and hydrological cycles in riparian areas. Students worked in groups to conduct soils assessments on macro-fauna, structure, and texture to compare differences between a xeric and mesic forest site. In addition, the students conducted a rapid forest inventory within the mature forest to quantify numerous ecosystem services in a baseline forest.

Students then visited a 25-year-old secondary forest naturally regenerating on former cattle pasture. During the visit, students learned about secondary forest succession and the important role of land-use history and legacy structures for influencing successional pathways. Beyond natural regeneration, the most



Students learn about timber plantation operations during a visit to Eco Venao.

passive and economical approach to forest restoration, students also visited demonstration areas that illustrated assisted natural regeneration (ANR) techniques, including; (1) protection from external disturbances; (2) reducing competition to facilitate desired species; and (3) enrichment planting.

Afterwards, students returned to the classroom to analyze the data and presented on the different indicators, including; diversity, carbon, soil/hydrological condition, timber volume and non-timber forest products (NTFPs) value of the forest. The session ended with a discussion about the day's activities.

Day 3: After breakfast and a review of the day's activities, Jacob presented on the social and economic history of deforestation and degradation drivers of tropical dry forests in Latin America and specifically the Azuero Peninsula. As a practical method of quantifying degradation on local farms, Jacob introduced students to the riparian assessment guide, which they would utilize to conduct a rapid assessment of degraded and intact riparian areas on a local farm.

Students then traveled to the town of Los Asientos and visited a farm with degraded riparian areas, due to conventional cattle ranching practices. Students were tasked to facilitate a diagnostic of: (1) soil health; (2) riparian buffer width; (3) stem density within riparian buffer; and (4) particle size count. With these data, groups utilized the assessment guide to assign a degradation index for their section of the stream and corresponding interventions to increase forest cover. Students then visited an intact riparian buffer zone with more than ten meters of continuous forest cover on each side. Groups compared the riparian assessment indicators in this area to the degraded zone, illustrating differences in the provision of ecosystem services. In the evening groups reviewed their riparian area rapid assessments and presented on their findings and recommendations to limit degradation and potential restoration strategies.

Day 4: Before embarking on field visits, Jacob delivered a lecture about the range of passive to active forest restoration strategies, highlighting cited studies from the region and the activities conducted by local landowners. Jacob focused on silvopastoral and agroforestry systems, which are strategies that have proven successful for landowners to enhance their traditional livestock-based livelihoods and improve ecosystem health.

Students visited the IDB Forestal property, that utilizes native species reforestation to restore forest cover on a former cattle ranch. After learning about the property's history, owner's objectives and management strategies within different plots, students conducted measurements within two different aged plantations to quantify growth rates to estimate forest carbon and merchantable timber. In the evening, students analyzed and presented their data from the day's activities. Additionally, they discussed the trade-offs of the range of restoration strategies and possible silvicultural practices which would be beneficial for different owner objectives.



Students learn about silvopastoral systems from Odielca Solís, ELTI alumna and APASPE member.

Afterwards, students visited Eco Venao, a 140-hectare reforestation project that also offers ecological lodging at Venao Beach, a popular tourist destination. Students met with Nico Nickson, a co-owner, who discussed the business's approach to forest restoration by conserving forest patches and reforesting with exotic and native species. He also emphasized their focus on offering low impact lodging via low density construction, structures made from locally sourced materials, and electricity via solar power. Students were given the opportunity to ask questions about their forest management operations, tourism development in the area, how local people are being included and whether other hotels are also focused on sustainability.

Day 5: After breakfast and a review of the day's activities, Jacob presented a lecture on how to integrate forest restoration into traditional livelihoods via agroforestry and silvopastoral systems (SPS). Additionally, Jacob highlighted the role of community-based farmer organizations in forest restoration by discussing the history and restoration activities of the Association of Livestock and Agrosilvopastoral Producers of Pedasí (APASPE), a group of cattle farmers that has worked with ELTI over the past decade.

Students spent the day meeting with the association members and visiting two model farms. The owners of these farms integrate diverse tree species into productive cattle farms via living fences, natural regeneration of trees in pastures, restoration of riparian areas, intensive SPS, mixed forage banks, grazing within forest plantations, and agroforestry. During the visit, APASPE members shared their experience of transforming conventional cattle ranches into silvopastoral systems and the resulting improvement of ecosystem services and increased on-farm production.

The day also focused on restoration of riparian areas. Although sources of water are critical for ranchers, they are often degraded due to deforested buffer zones and open riparian access to cattle. Students visited cattle aqueduct systems that utilize small reservoirs, reserve tanks, and solar powered pumps to provide clean water. Water delivery systems are an effective alternative to cattle freely utilizing riparian areas as a source of water. Therefore, these systems help conserve gallery forests and water sources and facilitate the division of pastures for more productive intensive rotational systems.

During a final discussion period, students discussed the challenges of conducting restoration in human-dominated landscapes due to the social and economic complexities. They highlighted the APASPE farmers as an inspiring example, where forest restoration strategies have been adopted by local people and replicated throughout their farms.



Students pose for a photo with APASPE member Odielca Solís in front of a "living fence" during the visit to her model silvopastoral farm.

Instructors and Coordinators: The course was facilitated by ELTI's Neotropical Training Program Staff: Jacob Slusser (Panama Coordinator) and Saskia Santamaría (Program Associate) and YSE Teaching Fellow Nora Hardy. Jacob developed the course curriculum, lectures and served as lead instructor. Saskia and Nora planned all the course arrangements and helped facilitate group exercises. Odielca Solís and Dolores Solís of APASPE facilitated visits to their model farms.

Participants: The course was offered to 10 master's students from YSE, who were enrolled in Dr. Mark Ashton's seminar course 683b entitled, "Tropical Forest Restoration in Human Dominated Landscapes."

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