

## COURSE REPORT

### Ecological Restoration Strategies for Productive Landscapes

ELTI Training Landscape  
District of Pedasí, Province of Los Santos  
August 15-19, 2022

A field course organized by:

The Environmental Leadership & Training Initiative (ELTI), the Raptors and Forests of Panama Foundation and the Association of Livestock and Agrosilvopastoral Producers of Pedasí (APASPE)



Jacob L. Slusser

Participants learn about shade coffee agroforestry systems from Odielca Solís, owner of the El Ñopo Farm.



**Background:** The Darien Province and adjacent Wargandi and Emberá-Wounaan indigenous territories contain most of Panama's remnant natural forest ecosystems, rich in diverse flora and fauna. However, the region has suffered in recent years from increased deforestation and land degradation from unsustainable logging and conventional agriculture and livestock production. These practices have impaired ecosystem services, including the fragmentation of local wildlife habitat for emblematic mega-fauna such as the harpy eagle (*Harpia harpyja*), the national bird of Panama. To avoid further forest degradation and negative environmental

ELTI is an initiative of:

**Yale SCHOOL OF THE ENVIRONMENT**  
*The Forest School*





Saskia Santamaría

*Participants walking on the ELTI ecological trail system in the Achotines Forest Reserve.*

consequences, local communities need to be equipped with sustainable farming alternatives to meet their needs while also conserving the unique biodiversity of their region.

With the support of the Raptors and Forests of Panama Foundation, ELTI developed a field-based course for Emberá-Wounaan community leaders from the Darien Province and adjacent Emberá-Wounaan indigenous territories, who want to conduct ecological restoration and establish agroforestry systems. Over a period of five days, this course provided the practical basis to understand tropical forest ecosystems and how to implement a range of restoration strategies. In particular, participants learned about agroforestry systems, which help increase biodiversity and wildlife habitat, reduce forest landscape fragmentation, and enhance agrarian livelihoods by increasing farm resilience and food security.

**Course Objectives:** The overall goal of the course was to educate participants on the role that forests play to provide ecosystem services and the range of ecological restoration strategies that can be integrated into agricultural landscapes for conservation and sustainable production.

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





*Jacob Slusser explains the importance of maintaining high species diversity in agroforestry systems.*

**Module 1:** Forest ecology and ecosystem services

**Module 2:** Deforestation and land degradation

**Module 3:** Ecological restoration strategies for agricultural landscapes

**Module 4:** Agroforestry systems and the propagation of native tree species

**Module 5:** The role of community associations to conduct ecological restoration

**Module 6:** Farm management planning for conservation and sustainable production

**Field-Course Format:** This course took place over five days at ELTI's Training Landscape in the tropical dry forest, located in the Los Santos Province of the Azuero Peninsula. The Training Landscape is a network of research sites and model silvopastoral farms of the Association of Livestock and Agrosilvopastoral Producers of Pedasí (APASPE), that integrate two decades of scientific research and local experience into the course curriculum, educational materials, and demonstration areas. In combination with farmer-to-farmer learning, the sites illustrate how it is possible and beneficial to integrate trees and ecological processes into traditional farming systems. Consequently, the experience helps change mindsets and paradigms around unsustainable farming practices. Additionally, the Training Landscape demonstrates the varied biophysical and socio-economic contexts of different types of land use via the following sites: (1) the Achotines Forest Reserve, a tropical dry forest ecosystem with both old growth and younger secondary forest patches and an ecological trail system with demonstration areas; (2) IDB Forestal, a chronosequence of native species tree plantations, which also incorporates cattle grazing in the understory; and (3) the APASPE model farms, owned and operated by ELTI alumni and APASPE members who conduct a diversity of restoration activities on their cattle farms. The following activities occurred throughout the week:





*Jacob Slusser demonstrates how to monitor soil macrofauna and measure pH to estimate soil fertility.*

**Day 1:** Course participants arrived at the Achotines Tuna Laboratory and were introduced to the laboratory's activities and given a tour of the installations. After an initial icebreaker and participant introductions, Jacob Slusser (Neotropics Training Program, Panama Coordinator) facilitated a presentation about ELTI and the objectives of the course. Afterwards, he delivered a lecture on tropical dry forest ecology, forest degradation and ecosystem services, to provide a foundation of restoration principles that would be discussed throughout the week. Finally, Jacob utilized a dry forest tree species seed collection to discuss the functional characteristics and phenology of different trees that they would encounter in the Achotines Forest Reserve and model farms.

**Day 2:** To complement the prior evening's lecture, Jacob led a walk on ELTI's ecological trail system within the Achotines Forest Reserve where participants visited six different demonstration areas covering the following topics: dry forest species identification, functional characteristics and successional guilds of key tree species, forest regeneration, successional phases, and gallery forests. Jacob quizzed participants on tree species and how to utilize tree attributes to identify them. In addition, participants worked in groups to conduct soil assessments on macro-fauna, soil structure, texture, infiltration, and pH, comparing differences between mesic and xeric forest stands. Participants gained a better understanding of the species, dynamics, interactions, and processes that maintain healthy forest ecosystem services.



*Participants visit a rosewood timber plantation to learn about species selection and silvicultural treatments.*

Participants also visited a younger secondary forest, the result of a twenty-year-old abandoned cattle pasture. They observed the difference in species composition and structure from the mature forest and how natural regeneration can be an effective strategy to recover forest cover in a degraded area if conditions are adequate.





*Odielca Solís explains how to establish and manage forage shrubs in a silvopastoral system.*



*A participant practices transplanting seedlings.*

After the walk, Jacob presented on the range of restoration strategies that can be utilized in agricultural landscapes. Following the lecture, Jacob led a field visit to IDB Forestal, an active restoration example consisting of mixed and monoculture timber plantations. Participants were informed on the owner's objectives: timber, ecotourism, and aesthetics, and how these influence the management of the property. They visited different aged plantations and species mixtures to discuss how to conduct tree species selection based on varied site characteristics. Additionally, Jacob discussed at length, the importance of silvicultural treatments to ensure that agroforestry systems and timber plantations achieve optimal performance.

After returning to Achotines, Jacob delivered a lecture about tree nursery construction, operations, and native species propagation practices.

**Day 3:** Jacob presented on agroforestry systems, not just as a model for sustainable production, but as a toolbox of different strategies to facilitate ecological restoration and increase farm resilience. He illustrated a range of different tailor-made systems according to the different site conditions and farmer needs.

Participants traveled to the small town of Los Asientos to meet APASPE's members and visit the El Ñopo Farm of Odielca Solís, APASPE Treasurer. Participants were given a tour of the farm by Odielca, visiting several restoration strategies and new technologies implemented, such as a solar powered cattle aqueduct system, drip irrigation system, agroforestry systems with shade coffee, Persian limes and short statured plantains, forage bank, intensive silvopastoral system, restoration of riparian areas via natural regeneration and native species reforestation conducted in a wildlife corridor. During the visit, Odielca addressed many of the challenges and lessons learned from implementing restoration and agroforestry systems over the past decade. Participants were very impressed of the productive





*Participants practice measuring contour lines with an A-level.*



*Participants develop their restoration strategies before sharing them with the landowner.*

participants were tasked with pruning branches in a rosewood and mahogany plantation, with a special pruning saw and clippers.

**Day 4:** The final full day of training focused on putting the course concepts into practice. Participants visited the Los Yescos farm and received a guided tour by owner and APASPE member, Dolores Solís. During the visit they learned about the restoration strategies conducted, such as a home garden, solar powered

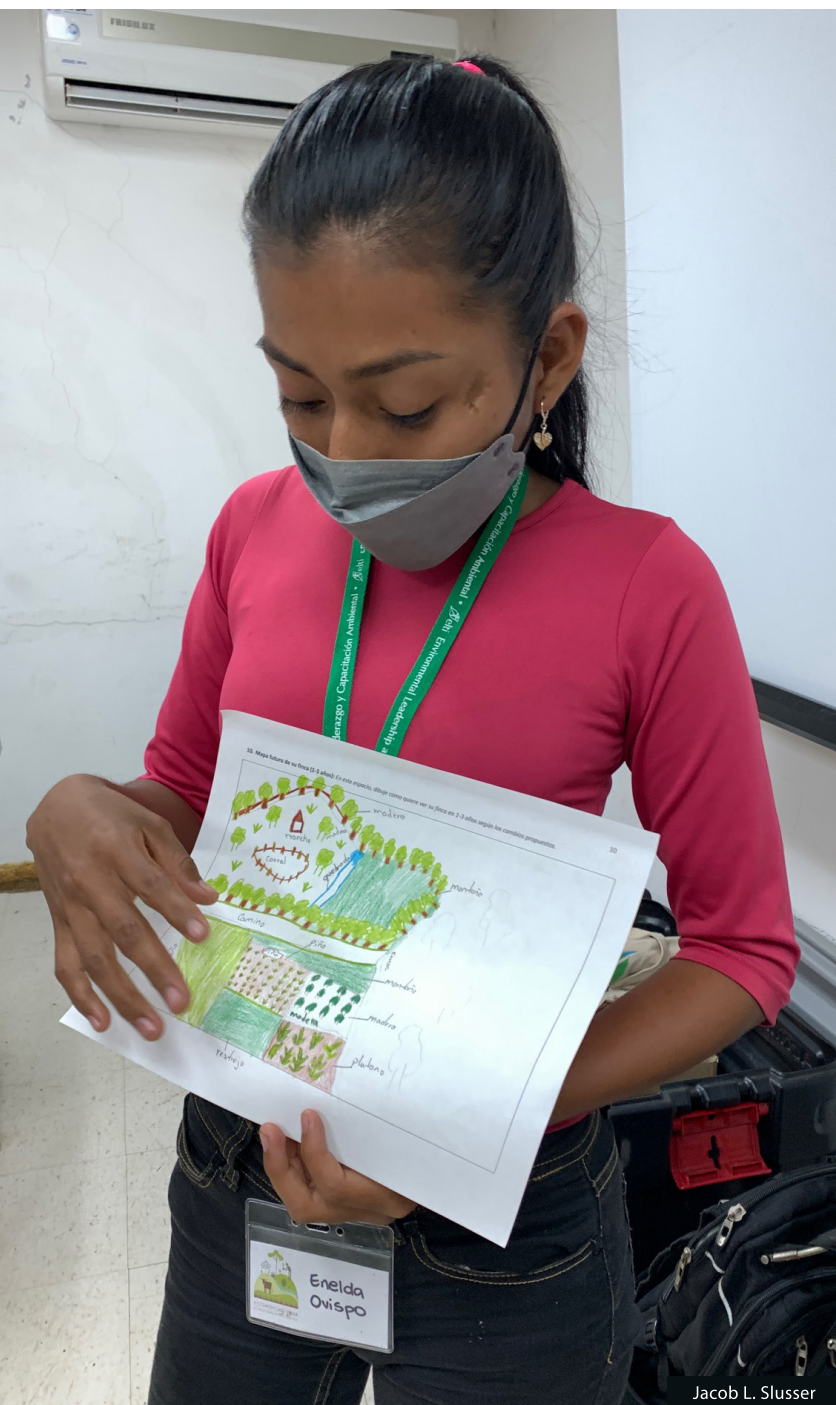
results from such a small farm and inspired by Odielca's perseverance and faith in sustainable practices despite initial setbacks.

After lunch, participants returned to Odielca's farm to focus on the establishment of a small-scale tree nursery and techniques for propagating native tree species. To start, Jacob quizzed participants on the site considerations to create a nursery. Next, they learned about tree seed types, harvesting techniques, storage, and scarification processes, and then practiced seed treatments and sowing methods. Participants learned how to make substrate and fill nursery bags and other containers. Finally, they transplanted seedlings from the seed germinator bed into prepared bags. To conclude the nursery session, Jacob reiterated common mistakes to avoid and best management practices.

For the reforestation activity, Jacob led a field-based session on how to design and measure spacing for agroforestry systems. He demonstrated the use of an A-level to mark contour lines and three-meter poles to measure a triangular planting pattern, both of which are used to facilitate soil and water conservation on hillsides. Participants were given the opportunity to use the tools to become familiar with them.

Afterwards, Jacob demonstrated ideal tree planting practices in terms of sapling size requirements, site selection, hole depth, and fertilizer types. Participants were then tasked with planting trees within the fence rows of the farm, with Jacob providing additional guidance and suggestions. Additionally, Jacob demonstrated monitoring and maintenance practices such as mulching, fertilizing, pruning, and thinning. After the demonstration,





Jacob L. Slusser

*A participant presents her farm management plan.*

the participants during a graduation ceremony and a group photo was taken. Afterwards, participants, APASPE members and ELTI staff joined together for a final dinner to celebrate the completion of the course. Additionally, the Emberá and Wounaan indigenous participants facilitated a culture share by demonstrating their traditional dances and exhibiting locally-made artisanries.

**Day 5:** Participants departed to their communities.

water system, silvopastoral system and agro-successional plots integrating timber, agricultural crops, and cattle forage species. Some areas of the farm suffered high levels of degradation due to conventional cattle ranching practices. Participants focused on these degraded areas of the farm to work in groups to conduct a rapid assessment via a site diagnostic framework. Based on the results, participants developed strategies to meet both the site conditions and owner objectives. Groups presented their plans and received feedback from Dolores as well as ELTI course instructors.

For the final exercise, participants worked on their individual farm management plans designed for their properties. Jacob provided an introductory lecture on the ten-step process, such as: drawing a farm map, analyzing, and rating their current farm via eight indicators, planning activities to resolve farm problems, and then updating the farm map to illustrate planned interventions. Each participant presented and received feedback. Although conducted as a course exercise, the farm plan is a tool that participants will use to implement restoration efforts upon returning to their community. In addition, with the help of the Raptors and Forests of Panama Foundation, participants will utilize the plan to establish model agroforestry farms that can serve to train others in the future.

To close the course, participants filled out course evaluations and submitted them to ELTI Staff. Certificates were presented to





*Participants and facilitators pose for a group photo during the graduation ceremony.*

**Instructors and Coordinators:** The course was facilitated by ELTI's Neotropical Training Program Staff: Jacob Slusser, MSc. (Panama Coordinator), Jorge Gutiérrez (Field Technician), and Saskia Santamaría (Program Associate). Jacob developed the course curriculum, training materials, lectures and served as lead instructor. Jorge helped conduct model farm visits and group exercises. Saskia planned all the course arrangements and helped facilitate group exercises. APASPE members Odielca Solís and Dolores Solís facilitated model farms visits, explaining in detail their experience transforming their farms via a variety of restoration strategies. In addition, course collaborator José Vargas (Director, Raptors and Forests of Panama Foundation) and David Bejerano (Technician, Raptors and Forests of Panama Foundation) assisted with logistics and group exercises.

**Participants:** The course was offered thanks to a grant from the Interamerican Foundation of the United States Federal Government, awarded to the Raptors and Forests of Panama Foundation. Fifteen participants were Emberá and Wounaan indigenous community leaders from the Darién Province and adjacent Emberá-Wounaan indigenous territories and two participants were biology students from the University of Panama, supported by a grant from Panama's National Secretariat of Science, Technology, and Innovation (SENACYT), awarded to the Achotines Laboratory.

**Outcomes and Follow-up:** 17 farm management plans were developed during the course. ELTI will work in collaboration with the Raptors and Forests of Panama Foundation to provide continued support to put the farm plans into action and help alumni to become community environmental leaders and inspire others. The course received an overall 4.8 rating (out of 5) from participants, who were enthusiastic to implement their individual farm plans.

---

*This event was possible thanks to Arcadia Fund, whose Environmental Conservation grants support programmes that protect and enhance biodiversity, and provide field training and academic research.*