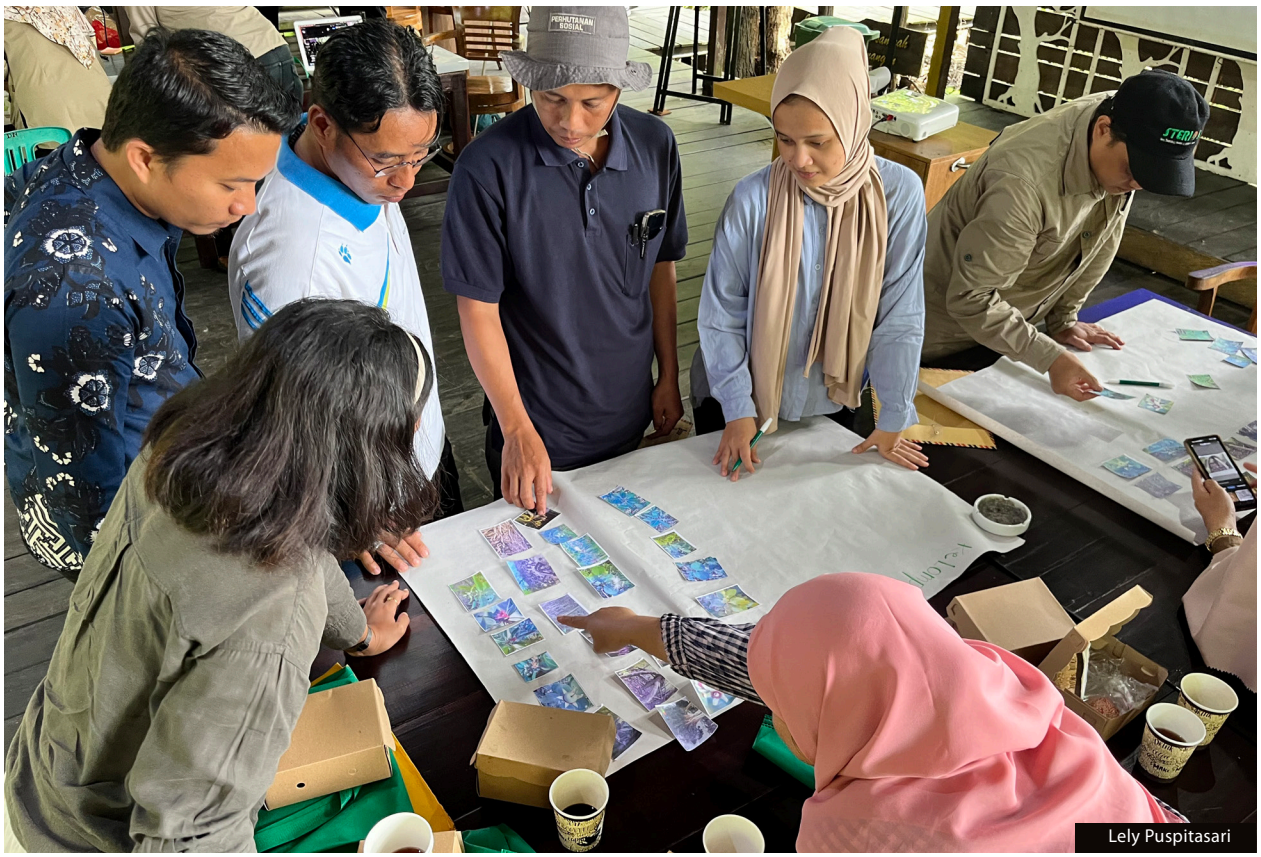
Environmental Leadership & Training Initiative

COURSE REPORT

Training of Trainers: Ecological Mangrove Rehabilitation

Balikpapan, East Kalimantan, Indonesia
March 1–3, 2024

A field course organized by:
Environmental Leadership & Training Initiative (ELTI), Yale School of the Environment
Yayasan Hutan Biru (Blue Forests)



Participants put together mangrove puzzles, sorting the pieces by species.

Background: Historically, Indonesia has had 4.2 million hectares of mangrove forests. However, the extent of these forests has decreased by 2.4 million hectares over the last thirty years. The decline is due to conversion for aquaculture, advancing infrastructure, and charcoal production. Despite a recent reduction in the rate of mangrove forest loss, from 2% to 1% annually between 2000 and 2015, attempts at restoring these natural ecosystems have encountered major hurdles. New Indonesian policy mandates to restore 600,000 ha of mangroves between 2020 and2024 and 1.82 million ha by 2045 are at high risk of failure given the poor track record of restoration efforts.

ELTI is an initiative of:

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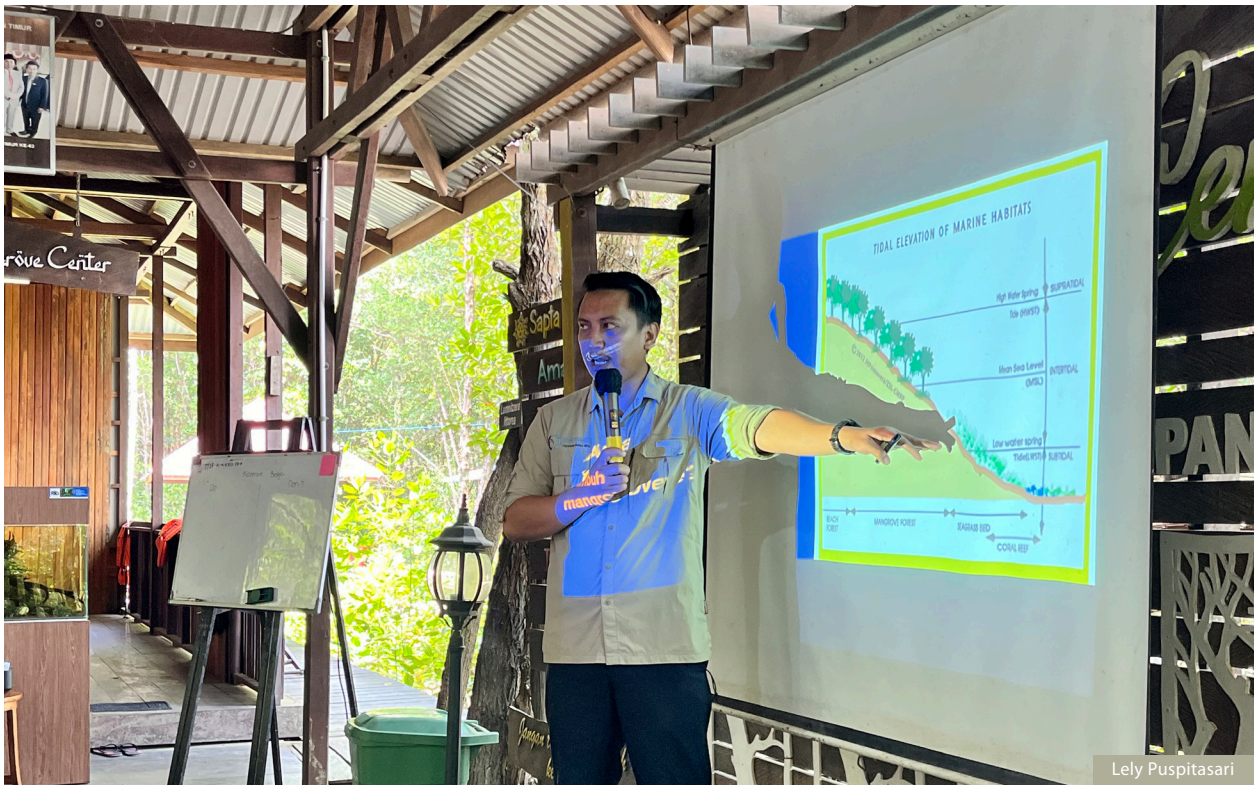
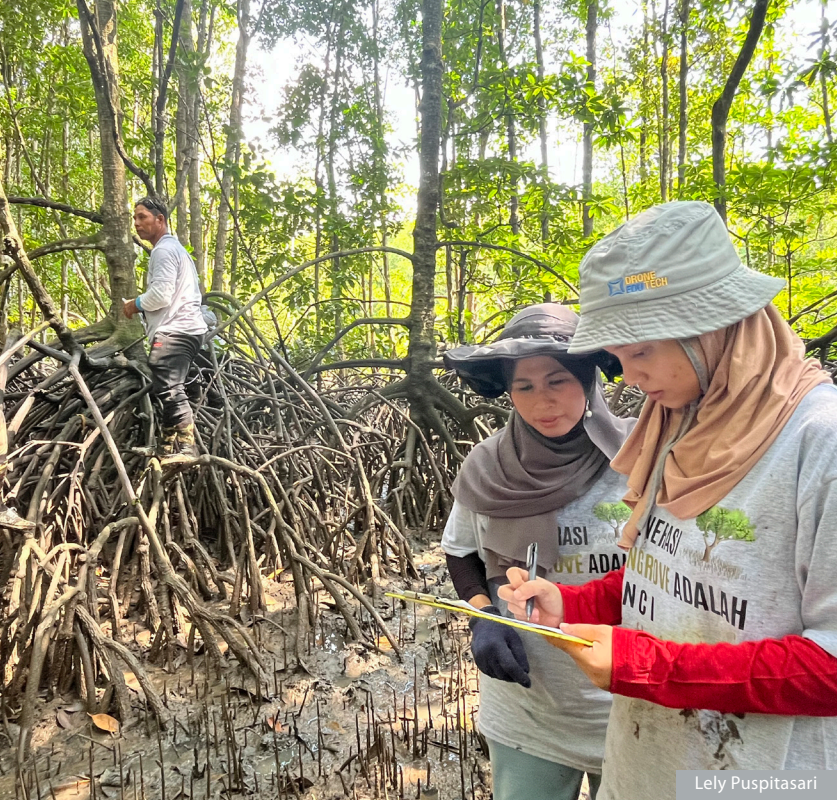


Rio Ahmad explains tidal elevation of marine habitats, highlighting its significance in determining the suitability of areas for different mangrove species and their ecological roles.

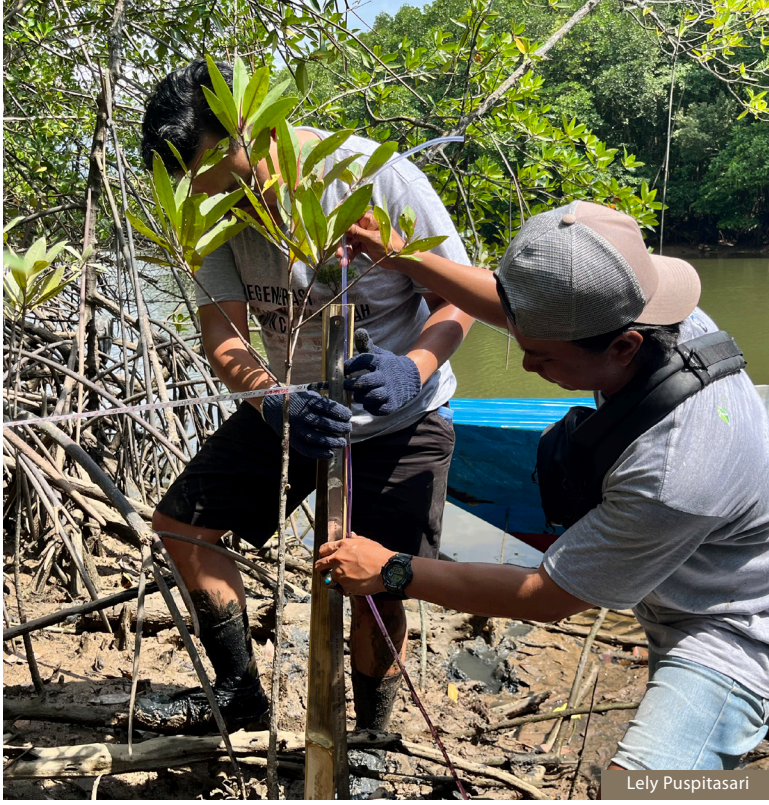
In planning mangrove rehabilitation, it is important to understand the various processes of mangrove deforestation and degradation and to manage them to reduce the continued threats to the mangrove ecosystems. Moreover, various mangrove rehabilitation techniques have proven successful, but the right approach needs to be chosen for each context. By far the most commonly used mangrove rehabilitation method both nationally and globally is planting. Mangrove rehabilitation, however, often doesn't require planting, because every year mangroves produce hundreds of thousands of fruits and seeds. With the proper hydrological conditions, these mangrove fruits and seeds can disperse into a rehabilitation site and grow on their own. In fact, mangrove seedlings need to be planted only if natural regeneration is not possible, if for example there are no mangroves left in an area, and planting should be undertaken only after hydrological improvements have been made.

The success of mangrove rehabilitation efforts is determined not only by proper rehabilitation implementation, but also by the right planning, monitoring, and evaluation. Unfortunately, many stakeholders involved in mangrove rehabilitation do not use this more comprehensive approach. To educate stakeholders, the Blue Forests-ELTI program conducted a course to train trainers in ecological mangrove rehabilitation (EMR) in Balikpapan.

Course objectives: The primary objective of this course was to increase awareness of EMR as a strategy and help stakeholders working in mangrove rehabilitation, including communities, the private sector, government, and project managers, appreciate the importance of understanding key biological and biophysical factors in EMR.



Course participants at right record data collected by the measuring team.



Course participants use a water level to measure soil elevation.

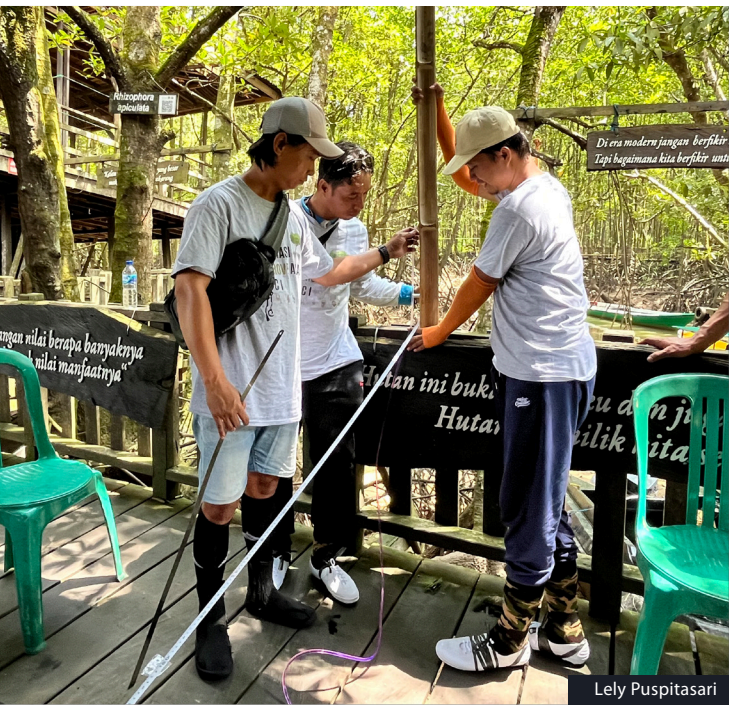
Course content: The course was divided into seven modules, presented in introductory lectures, group exercises, and field practice.

Module 1: Understanding the Diversity of Mangroves and Their Role
Module 2: Understanding the Mangrove Growing Area
Module 3: Key Factors of Success and Failure for Mangrove Rehabilitation
Module 4: Sustainable Mangrove Ecotourism to Support Mangrove Rehabilitation
Module 5: Mangrove Transect
Module 6: Six Steps of EMR
Module 7: EMR Technical Design and Rehabilitation Plan

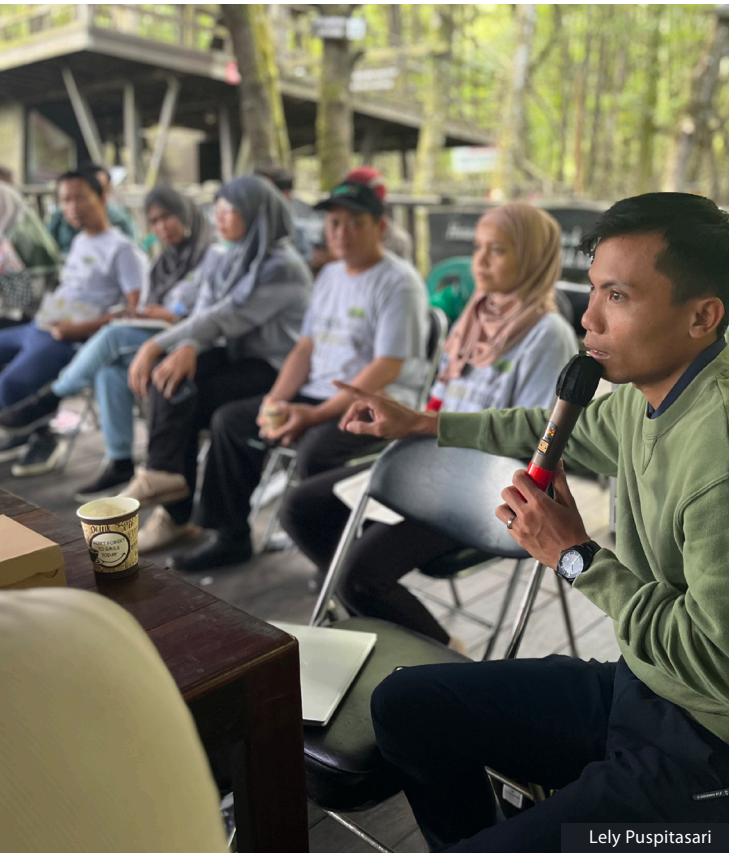
The course took place over two and a half days at the Graha Indah Mangrove Center in Balikpapan, East Kalimantan, Indonesia. It was led by Rio Ahmad (director, Blue Forests) and Yusran Nurdin (environmental technical advisor, Blue Forests) and facilitated by Lely Puspitasari (program coordinator, Blue Forests-ELTI Indonesia) and Sulton Afifudin (program assistant, Blue Forests-ELTI).

Day 1: The training began with a pretest to assess participants' knowledge of mangroves and rehabilitation. The pretest included questions on mangrove morphology, species, growing conditions, and rehabilitation. Following the pretest, participants introduced themselves, sharing their backgrounds and experience with mangroves. The facilitators then divided participants into three groups, each of which was given pictures of roots, bark, leaves, trees, flowers, and propagules from various mangrove species. The groups were tasked with assembling the mangrove puzzles and sorting them into species.

Ahmad used this exercise as a starting point for discussing the mangrove ecosystem, covering mangrove types, habitats, and tidal elevations. He also introduced mangrove species commonly found in East



Course participants practice using a water level.



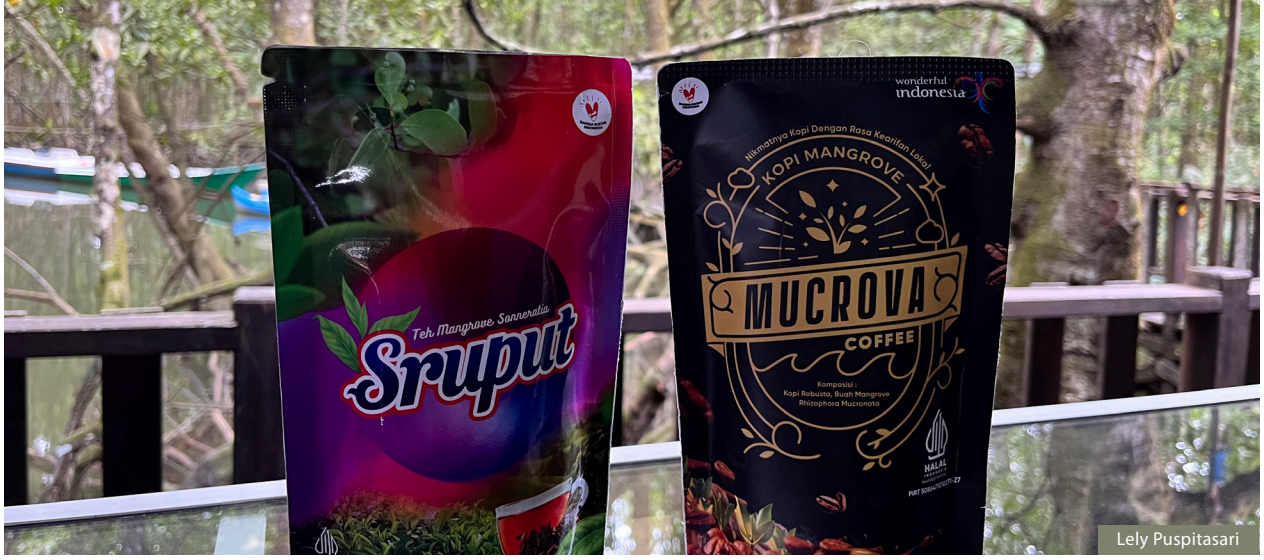
Course participants share their experience in rehabilitating mangroves in their respective areas.

Kalimantan, including *Sonneratia* spp., *Avicennia* spp., *Rhizophora* spp., *Bruguiera* spp., *Xylocarpus granatum*, and *Pemphis acidula*.

The second module of the day focused on understanding mangrove growing locations. The session emphasized the importance of propagule supply, tidal flooding, and currents in the successful rehabilitation of mangroves. Tidal flooding frequency and duration were highlighted as critical factors influencing the success of mangrove restoration, as different mangrove species exhibit varying levels of tolerance to water inundation.

The next session focused on how to create a mangrove transect for assessing mangrove conditions. In mangrove assessments, understanding the substrate or soil elevation is essential to identifying suitable areas and the species present at specific elevations. Ahmad explained various methods for measuring soil elevation, including use of a water level or an auto level. Because the course emphasized a manual approach, Ahmad concentrated on the water level method, guiding participants on how to use it effectively and how to calculate and interpret the collected data.

Day 2: The course's second day featured in-class sessions followed by an afternoon field practice. The in-class session was led by Nurdin, who spoke about key factors in the success or failure of mangrove rehabilitation. He identified several challenges, including land ownership issues and lack of technical understanding of mangrove rehabilitation. Land ownership issues often hinder efforts in areas suitable for rehabilitation. Consequently, many rehabilitation projects are carried out in mudflats, which are unsuitable for mangrove growth. Key factors for successful mangrove rehabilitation discussed in the session included understanding the area's history, including tidal elevation and hydrology; ensuring the availability of mangrove propagules or seedlings; identifying disturbance factors and obstacles to natural regeneration; addressing landscape modification and land ownership or management status; and encouraging community involvement and developing



Lely Puspitasari

Mangrove tea and coffee have become popular souvenirs from the Graha Indah Mangrove Center tourism area.

sustainable business models. Participants, who came from diverse backgrounds, shared their experiences with mangrove rehabilitation, discussing successes, challenges, and lessons learned. This interactive session helped participants understand how to improve rehabilitation efforts by observing natural mangrove growth patterns and drawing insights from past experiences, whether successful or not.

The development of sustainable business models is a key factor in the success of mangrove rehabilitation. Many mangrove areas are located near or within settlements where communities rely on mangrove forests for their livelihoods. However, not all livelihoods in these areas are sustainable for the ecosystem. For example, some communities use mangrove timber for charcoal, firewood, or construction, while others convert mangrove areas into aquaculture ponds. Working with local communities to transition from unsustainable to sustainable practices presents significant challenges.

One example of sustainable mangrove management in East Kalimantan is the development of ecotourism. Agus Bei, the trainer for this session and founder and manager of the Graha Indah Mangrove Center, shared his story. In the early 2000s, his village frequently experienced flooding during high tide. Determined to find a solution, Bei began planting mangrove seedlings near his house. Over time, the mangroves grew, and the local community realized that the restored mangrove forests effectively protected their settlement from flooding. The local communities began to benefit from the mangrove areas not only through reduced flooding but also through opportunities in tourism and fisheries. Women's groups in the community developed small businesses using mangrove leaves and fruits as non-timber forest products, creating innovative products like mangrove coffee and tea, Acanthus tea, mangrove brownies, and fish crackers. Meanwhile, men's groups found livelihoods as boat operators for river and mangrove excursions, tour guides, and fishermen. Bei shared how he and his community manage mangrove ecotourism in their area. He emphasized the importance of a long-term commitment to sustainability, urging other communities to prioritize ecological balance over focusing merely on the economic benefits of ecotourism. His story serves as a powerful example of how community-driven sustainable practices can lead to both environmental conservation and economic opportunities.

Participants then had a field practice on assessing mangrove growth zoning based on sea tides. The practicum took place in the Graha Indah Mangrove Center area. Two sites with a variety of mangrove species were selected, and participants were divided into two groups. Each group assessed the mangrove condition, identified species within the sample plots, and measured soil elevation. The participants collected data on

Course participants conduct field practice at the mangrove site.

environmental and topographical conditions from their transect areas and recorded the mangrove species found at each soil elevation.

After the field practice, the course continued with an in-class session on the six steps of EMR. Nurdin explained each step in detail, providing examples of activities involved in each phase of the EMR process. The six steps for successful EMR are:

1. Preliminary assessment of the ecological characteristics of individual mangrove species, including reproduction, dispersal, and seedling establishment. This step also involves studying changes over time, geomorphological conditions, and other environmental factors.

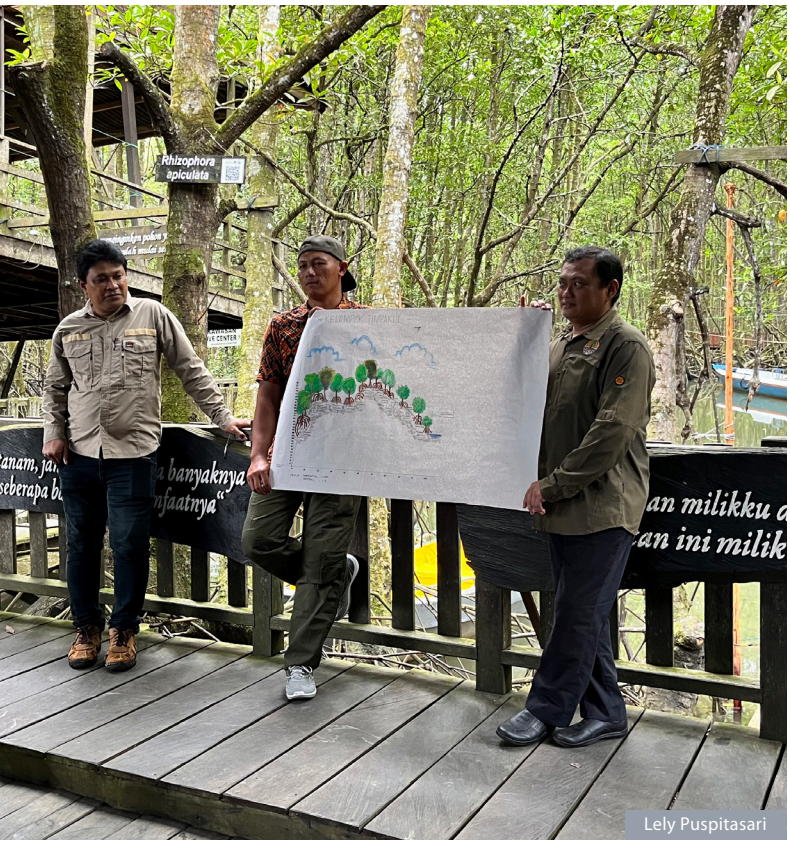
2. Biophysical assessment of the hydrological patterns influencing seedling distribution and establishment. This step also includes conducting ecological and disturbance surveys.

3. Conduct socio-economic assessment of human modifications that may prevent natural colonization, along with stakeholder and gender analyses, as well as land tenure and related issues

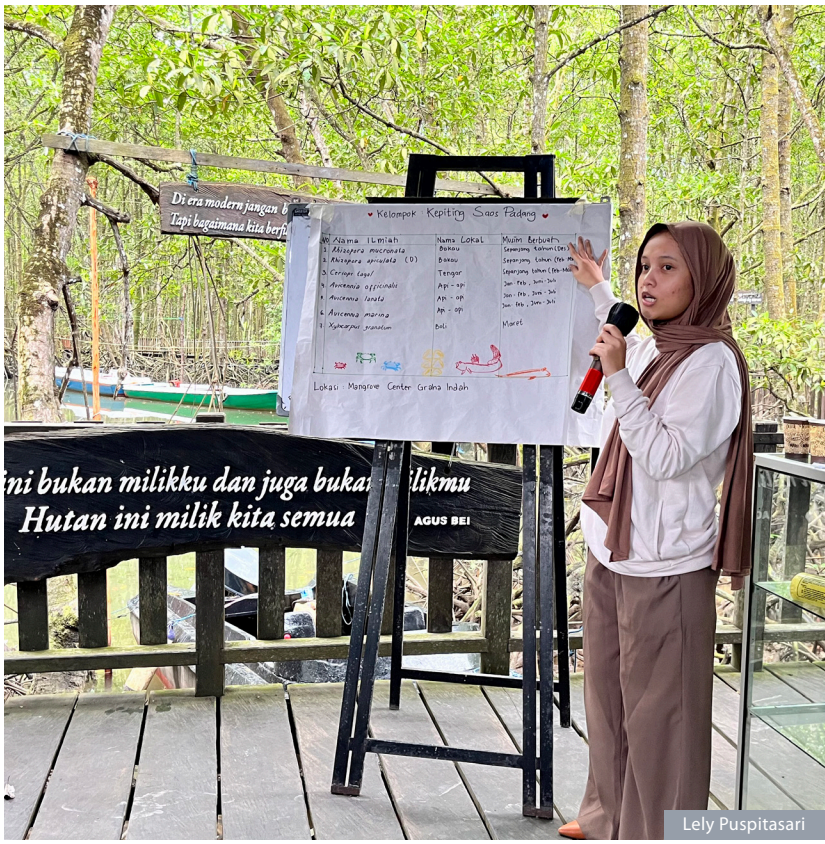
4. Appraisal and selection of the most suitable restoration site using information from steps 1–3. In addition to assessing physical and ecological parameters, this step involves resolving community concerns, such as land tenure and land use, to ensure long-term access to the site.

5. Design of an implementation plan focusing on restoring appropriate hydrology and encouraging natural recruitment and monitoring plans.

6. Implementation of rehabilitation and monitoring, including data analysis and effective communication of results. Propagules or seedlings should be planted only if natural recruitment is unlikely to succeed or if rapid vegetation cover is required.



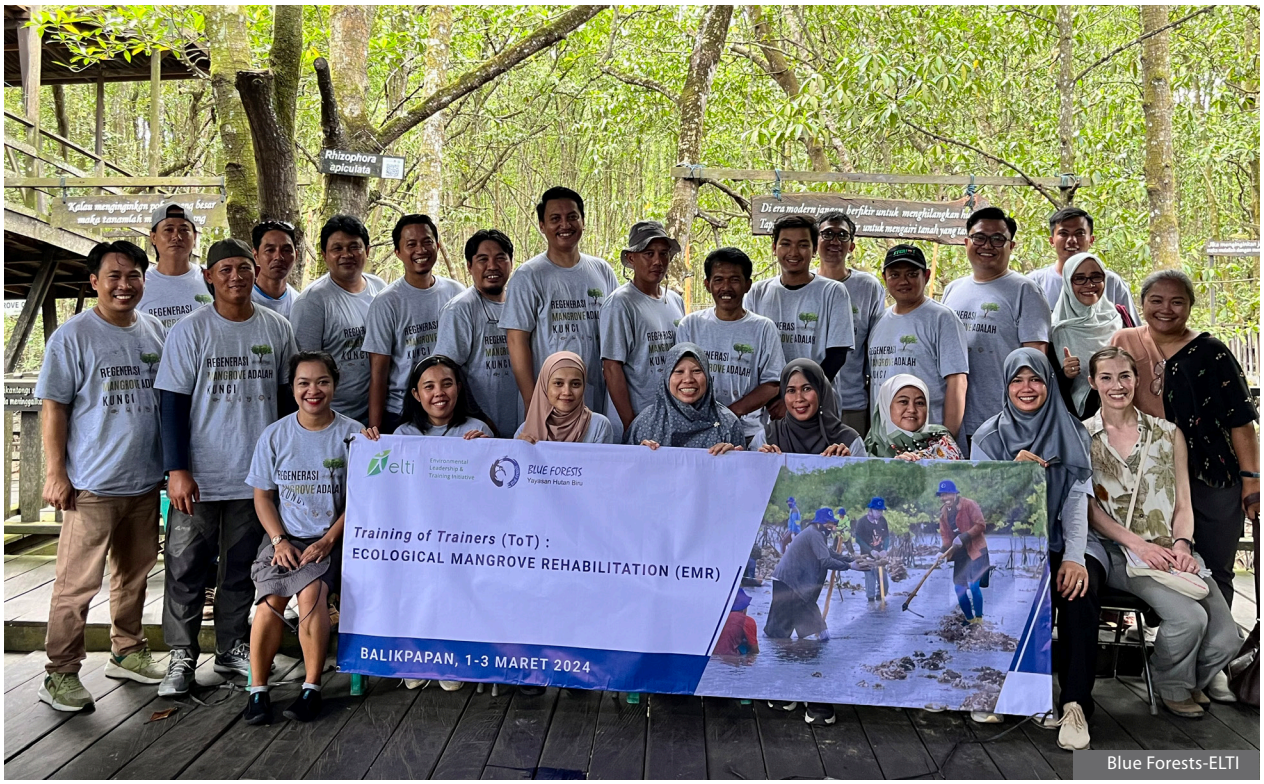
Course participants present their mangrove transect analyses.



Course participants present their mangrove transect analyses.

Day 3: The final day of the course was dedicated to creating mangrove transect drawings based on the data collected by each group during the second day. This exercise helped participants visualize and analyse mangrove site conditions and species distribution at different elevation levels. The drawings represented the results of the transect assessments and mangrove explorations in the form of mangrove profiles. These interconnected sessions—field visits for transect assessments and mangrove explorations, followed by drawing the transects—provided participants with a deeper understanding of mangrove ecosystems and the specific characteristics of the areas where they grow. This included the ability to identify disturbance factors that inhibit mangrove growth and regeneration. Each group presented their findings, followed by a session in which participants responded to questions and feedback from the trainers and other participants. This collaborative process further reinforced the learning outcomes and enhanced participants' skills in mangrove assessment and rehabilitation planning.

The final session focused on developing a rehabilitation plan. Nurdin introduced the technical planning for mangrove rehabilitation form used by the Peat and Mangrove Rehabilitation Agency (Badan Rehabilitasi Gambut dan Mangrove [BRGM]). Use of the form facilitates the compilation of information required for planning mangrove rehabilitation, including biophysical and socio-economic conditions. It also provides templates for the technical design of rehabilitation tailored to an area's eco-hydrological and socio-economic conditions—important input for the preparation of the work plan and budget. The session aimed to equip participants with practical tools and knowledge to create effective, well-informed mangrove rehabilitation plans that consider both environmental and community needs.



Course participants at the Training of Trainers: Ecological Mangrove Rehabilitation.

Participants : The 19c course participants (12 men and seven women) came from various institutions, including the Ecotourism Awareness Group (Pokdarwis), academia, Capital City Agency, National Research and Innovation Agency (BRIN), Penajam Paser Utara Environmental Agency, local village government, Environmental and Forestry Instrument Standardization Agency (BSILHK), the private sector, and NGOs.

Outcome and follow-up: The participants were highly interested and enthusiastic as they learned about EMR, an approach different from the common method of simply planting mangroves. The participants also expressed interest in applying for ELTI Leadership Program support for mangrove rehabilitation when such projects are initiated in their villages or workplaces.

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.