

# YOUNG FOREST RESTORERS

## ACTION BOOK



NAME : \_\_\_\_\_



## Welcome to YFR ...

The Young Forest Restorers (YFR) project provides teachers and pupils with science-based skills, knowledge and funding support, to enable them to perform effective forest ecosystem restoration :

- 1) Hands-on experience with seed collection, germination and growing forest trees in nurseries, as well as technical assistance with tree-planting.
- 2) User-friendly teaching materials including online learning and awarding of certificates to participating students.
- 3) Technical and financial support to establish on-campus tree nurseries to 4 schools per year.
- 4) A network, for swapping of tree-seed species among schools, via CMU's central seed bank, establishing a YFR community.
- 5) An annual “Forest Celebration” where schools can share their experiences and raise awareness of forest issues with the general public.

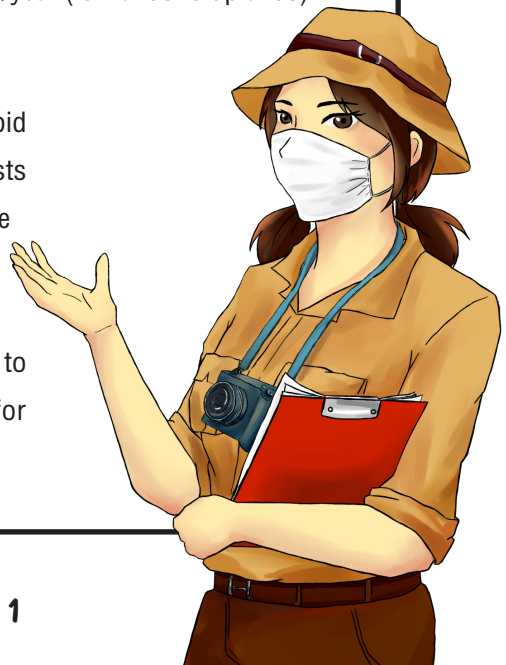
# Why restore forest ecosystems?

**When we restore a tropical forest ecosystem, we:**

- create a “green supermarket” which provides many different kinds of foods to local people (e.g., honey, mushrooms, bamboo shoots), medicinal plants and materials (e.g., bamboo, rattans, wood etc.),
- create a peaceful green space for recreation and enjoyment,
- create habitat for wild animals and plants (prevent species extinction and conserve biodiversity),
- reduce the risk of landslides,
- reduce soil erosion,
- prevent streams from filling with silt and overflowing (flash floods) and
- reduce the risk of drought (increase local rainfall).

Chiang Mai Province was densely forested, with various seasonal tropical forest types, from 300 to 2,500 metres altitude. Rainfall varies from about 1,000 to 2,000 mm/year (lowlands to uplands) with 6-month dry season.

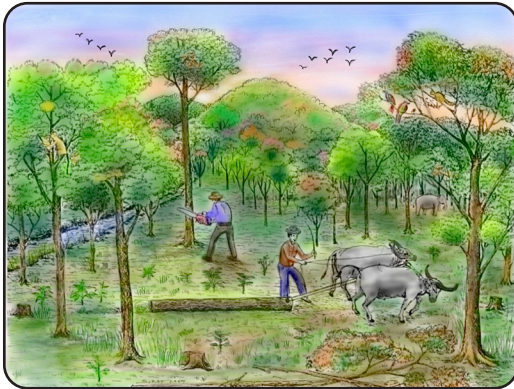
Following widespread logging and rapid population growth, forest now exists as fragments, interspersed with large deforested areas, even within national parks. A logging ban in 1989 created a need to replant logged-over sites, to restore native forest ecosystems for biodiversity - an ongoing process.



# 5 STAGES OF DEGRADATION

There are several ways to restore forest ecosystems. The methods applied in each case depend on how severely degraded the forest is. There are 5 stages of degradation, each one requiring a different combination of restoration techniques.

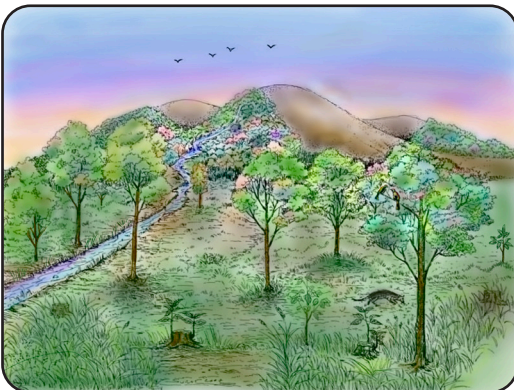
## Stage 1 - Light degradation



**Condition:** Large trees gone, but smaller ones remain e.g., after selective logging. Natural regeneration is abundant and not inhibited by weeds

**Action:** Protection. Prevent encroachment and fire from damaging natural regeneration. Prevent hunting of seed-dispersing animals.

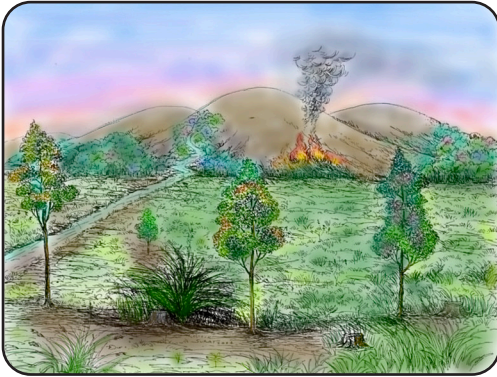
## Stage 2 - Moderate degradation



**Condition:** Natural regeneration still abundant but suppressed by weed growth.

**Action:** Protection + assisted natural regeneration (ANR). Remove weeds around young trees and apply fertilizer to accelerate tree growth.

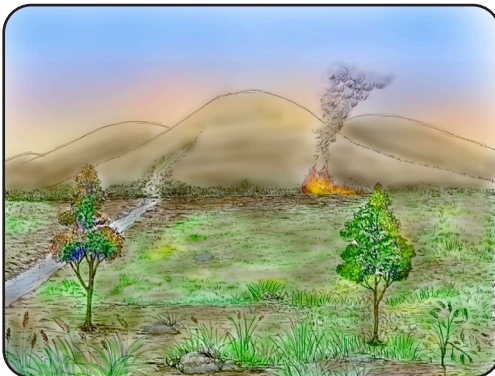
### Stage 3 - Deforestation



**Condition:** Natural regeneration insufficient to close canopy within 3 years.

**Action:** Protection + ANR + plant framework tree species i.e., reference forest tree species that rapidly shade out weeds and attract seed-dispersing animals (20-30 species) to raise stocking density to about 3,000 trees per hectare.

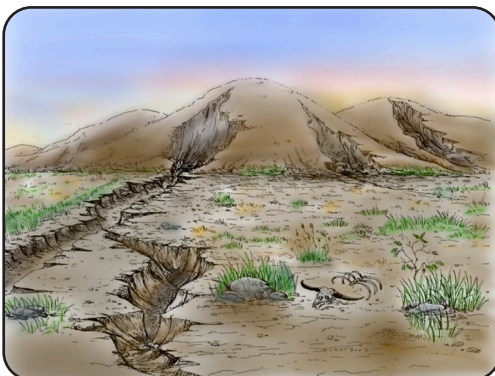
### Stage 4 - Landscape deterioration



**Condition:** Seed dispersal across landscape impossible, due to lack of seed-dispersing animals and/or remaining forest too distant.

**Action:** Maximum diversity methods. Plant all trees that comprise reference forest ecosystem, raising stocking density to 30,000 per hectare.

### Stage 5 - Soil degradation

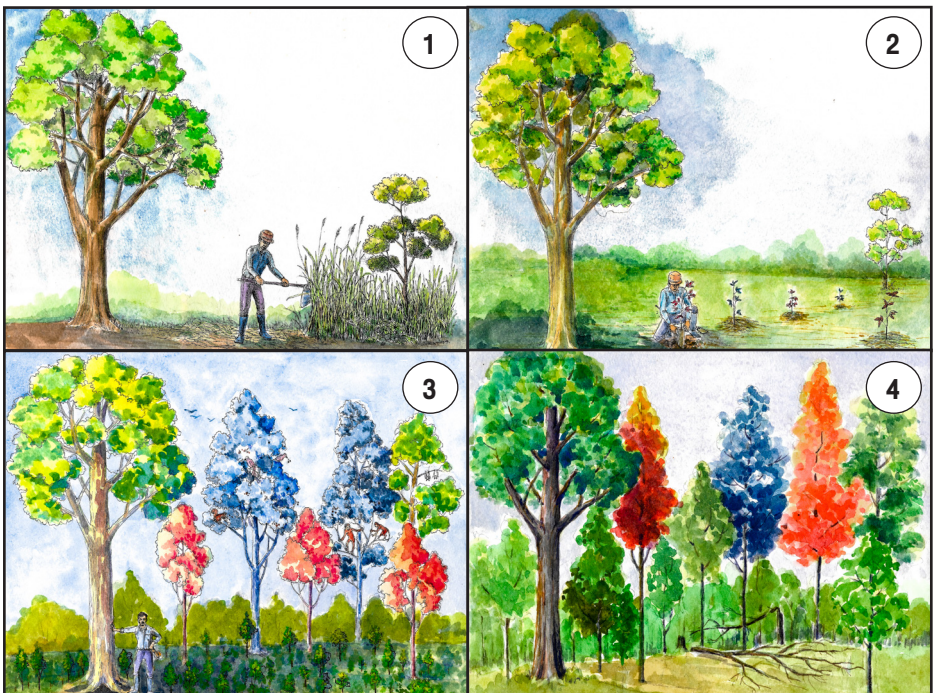


**Condition:** Top soil removed or eroded e.g., after mining.

**Action:** Plant fig trees and legumes, to repair soil physical condition and add soil nutrients. After soil conditions improve, then plant other tree species.

# FRAMEWORK TREE SPECIES METHOD

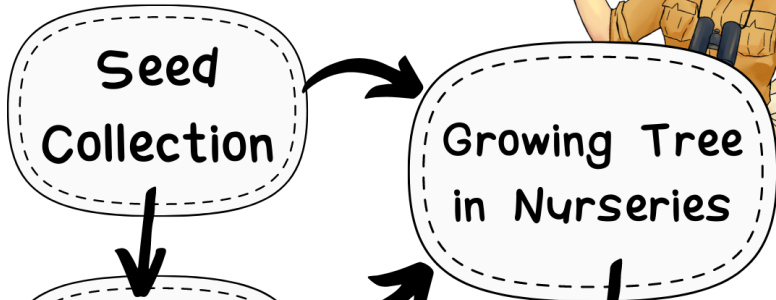
Rapidly re-establish forest ecosystems with high biodiversity by **1)** clearing weeds, preserving any existing tree seedlings or saplings, **2)** planting mixtures of 20-30 indigenous forest tree species that re-establish forest structure and ecosystem functioning, **3)** Pioneer species rapidly grow to form an upper canopy, which attracts seed-dispersing wildlife. Climax species slowly grow to form the understory, **4)** After 15-20 years, the pioneer species begin to die, recycling nutrients. Climax species form the main canopy, whilst naturally established trees (recruits) form the ground layer.



**The essential ecological characteristics of framework-tree species are therefore:**

- High survival when planted out in deforested sites.
- Rapid growth.
- Dense, spreading crowns that shade out herbaceous weeds.
- Flowering and fruiting, at a young age, to attract seed-dispersing wildlife.

# The Long Road to Restoration



# SEED COLLECTION

The establishment of forest trees usually depends on the availability of local seed sources and the dispersal of seeds into deforested sites. Seeds must land where conditions are suitable for germination and escape the attention of seed predators.



- Collect seeds when fruits are fully ripe (changing color, starting to split open)



- Maintain genetic diversity by collecting seeds from different trees within the same species (at least 10)
- Record species details, location, collection date/time, etc.

**It is better to cut fruits from the tree branches rather than to pick them up from the ground.**

In the seasonally dry forests of northern Thailand, many tree species fruit in every month of the year, so at least one seed collection trip is needed every month.



**SEED COLLECTION VDO**



## Seed Collection Datasheet

Common name : \_\_\_\_\_

Family : \_\_\_\_\_ Species : \_\_\_\_\_

Collection date : \_\_\_\_\_ Collection method : \_\_\_\_\_

Location : \_\_\_\_\_ Forest type : \_\_\_\_\_

GPS-Coordinates : \_\_\_\_\_ Altitude : \_\_\_\_\_

Tree girth (cm) : \_\_\_\_\_ Height (m) : \_\_\_\_\_

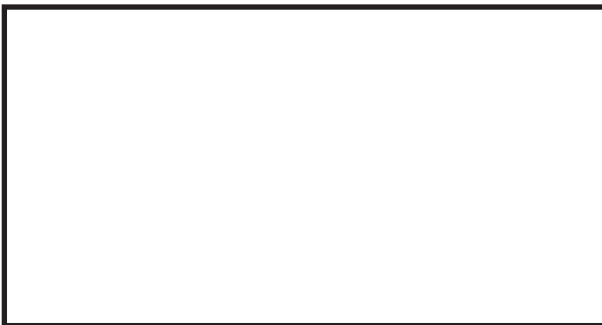
Number seeds collected : \_\_\_\_\_

Storage/transportation details : \_\_\_\_\_

Sowing date : \_\_\_\_\_

Collectors : \_\_\_\_\_

**Draw and color my fruits and seeds**



# SEED BANKING

**Seed banking** means storing dried seeds in a freezer until they are needed. Research at CMU’s Seed Bank is finding out which of northern Thailand’s tree species have orthodox and which have recalcitrant seeds.



The seeds of some tree species can remain viable for many years when frozen. They are called **“ORTHODOX”**.

Others are killed by drying and freezing. They are called **“RECALCITRANT”**.

- If you collect more seeds of a species than you need, you can deposit the surplus in the CMU Seed Bank, so other schools can use those seeds in the future.
- If you would like to grow tree species in your school nursery, but cannot find seed trees, contact the CMU Seed Bank to ask for seeds of the species.

YFR LINE GROUP



To let YFR members know when you deposit or withdraw seeds in the CMU Seed Bank, please request the species name the YFR LINE group. A list of the species available in the bank will be posted there from time to time.

To experience seed-banking procedures, please ask your teacher to contact the CMU Seed Bank for an activity session.

It is located in the Doi Suthep Nature Study Centre - location and contact details here:

<https://goo.gl/maps/S9RhWaWVzphGEMgL7>



# Seed Bank Datasheet

## Species information

Species name : \_\_\_\_\_ Common name : \_\_\_\_\_

Genus : \_\_\_\_\_ Family : \_\_\_\_\_

Growth form : \_\_\_\_\_

Seed/Pyrene size : \_\_\_\_\_ No. seed per pyrene : \_\_\_\_\_

## Specimen information

Collection date : \_\_\_\_\_ Collection no. : \_\_\_\_\_

Collector(s) : \_\_\_\_\_

No. individuals from which seed was collected : \_\_\_\_\_

No. collected seed : \_\_\_\_\_ Initial germination : \_\_\_\_\_

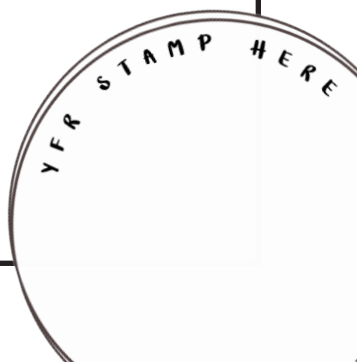
Location : \_\_\_\_\_

Forest type : \_\_\_\_\_ Altitude (m) : \_\_\_\_\_

Notes : \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



# SEED GERMINATION

Select the highest quality seeds available with no signs of fungal growth, teeth marks from animals or small holes made by insects.



For larger seeds: to get rid of the dead ones, throw the seeds into a bucket of water and skim off the ones that float.

## How should seeds be sown?

- Sow seeds into germination trays filled with medium (50:50, Soil:Coconut husk). The trays should be 5 cm deep, with plenty of drainage holes in the bottom.
- Sow below the surface of the medium to protect seeds from predators, drying out and from being washed away during watering.
- Water the germination trays lightly after sowing the seeds. Place the trays in shade to reduce drying out.



Sowing seeds is the final stage of seed handling. The three major factors that influence seed germination are **moisture, temperature, and light**



**Don't forget to label trays with species and date !!**

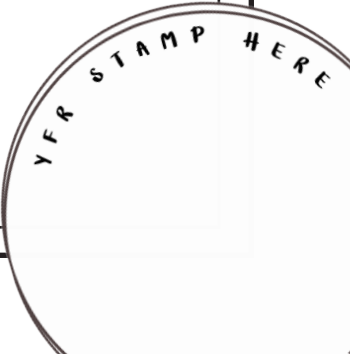
# Seed Germination Datasheet

Species : \_\_\_\_\_

Common name : \_\_\_\_\_

Pre-sowing treatment : \_\_\_\_\_ Sowing date : \_\_\_\_\_

Date	No. of germinated seeds	Seedling illustration
		<p>(% Germination) :</p> <p>(First seed) :</p> <p>(Median seed) :</p> <p>(Last seed) :</p> <p>(Median length of dormancy) :</p>



## Follow My Tree species

Species names : Scientific (*Latin*) : \_\_\_\_\_

Common name : \_\_\_\_\_

I collected seeds of this species on date : \_\_\_\_\_

Draw the fruit and seed here and insert a scale to indicate size :

Seeds germinated from date : \_\_\_\_\_ to date \_\_\_\_\_  
in our school nursery. How many days dormancy? : \_\_\_\_\_

I potted seedlings on date : \_\_\_\_\_ When they had x – y  
leaves : \_\_\_\_\_

Draw the seedling here (don't forget the roots) :

## Follow My Tree species

I planted trees of this species on date : \_\_\_\_\_ at location : \_\_\_\_\_

Paste a tree-planting selfie here :

I took care of the planted trees during the rainy season on dates : \_\_\_\_\_

This species grew [\_\_\_\_\_] to [\_\_\_\_\_] cm tall by monitoring date :  
\_\_\_\_\_ = [\_\_\_\_\_] days (after planting)

Insert photo of the tree species on monitoring day here :

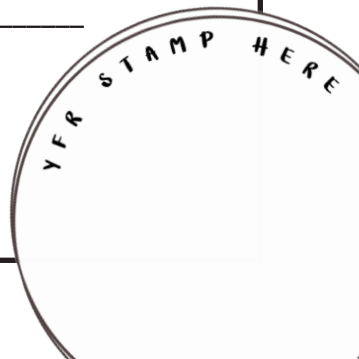
This species is useful because : \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

When completed why not post your tree on  
the YFR Facebook?

Facebook : Forest on Blackboard - Thailand

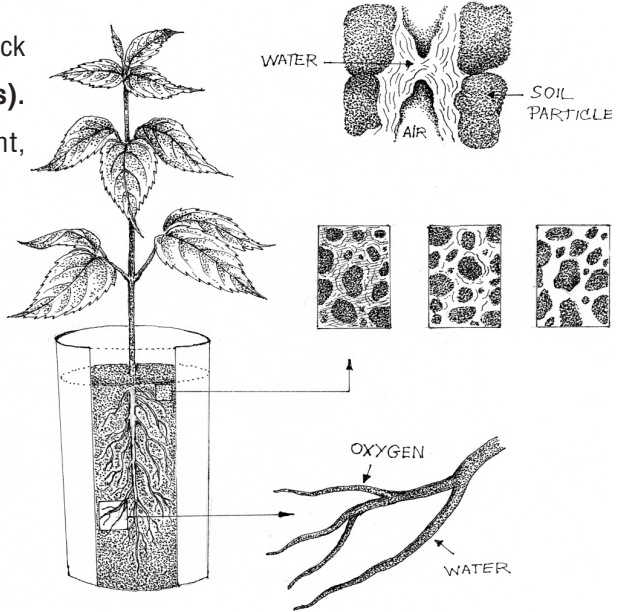


# SEEDLING POTTING

Seedlings are transplanted into containers for “growing on”. Containers must be large enough to allow growth of a long and dense root system.

FORRU recommends using black plastic bags (9 x 2.5 inches). They are strong, lightweight, cheap and effective.

To prevent compaction of medium, mix forest soil with organic matter such as rice husk, coconut husk or peanut husks. Mixing forest soil with these ingredients improves drainage and aeration.



Students can make compost from locally available organic waste.



Recommended medium composition is forest soil, peanut husk and coconut husk, mixed in the ratio of 2:1:1.





## How to prepare medium

- Sieve the materials to remove large lumps and stones.
- Mix them together on a hard, flat surface using a shovel.
- Store the medium in a moist condition.

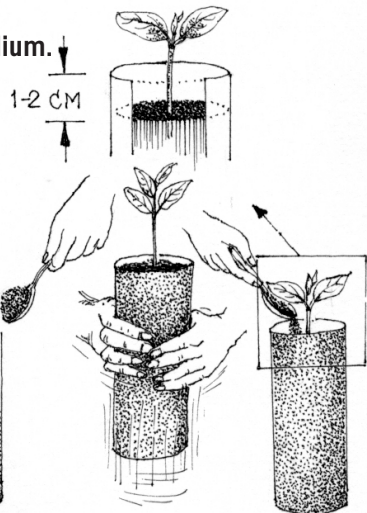
## Containers protect the trees

Within the container, the root ball remains intact with soil the whole time during transportation and planting.



SEEDLING POTTING VDO

1. Make space for the roots.
2. Lift seedling gently by the leaves.
3. Place seedling in container and fill in with medium.
4. Settle the medium.
5. Top up, leaving a space of 1-2 cm.

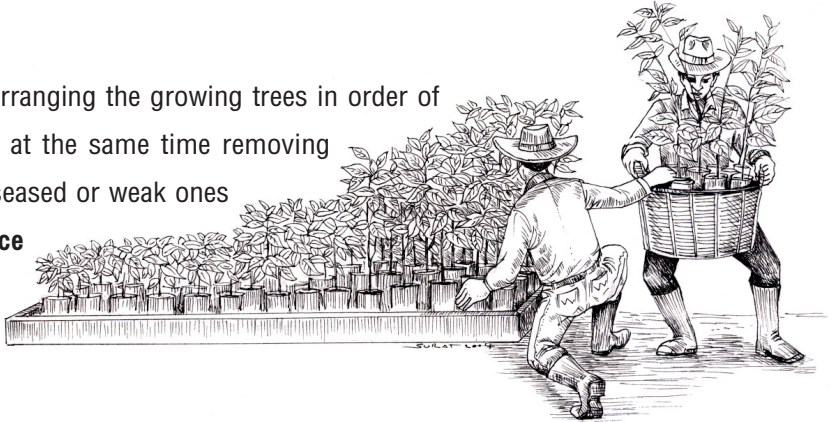


After potting seedlings, place containers in a shaded area and water the seedlings.

# SEEDLING CARE

Quality control is essential to give seedlings the best chance of establishing in the field and growing rapidly when planted out in deforested sites.

**Grading** - arranging the growing trees in order of size, whilst at the same time removing stunted, diseased or weak ones **at least once per month.**



**Root Pruning** - trim back any protruding roots with secateurs. This stimulates root branching and the development of compact root balls that will not fall apart during planting.



About 1-2 months before planting, move all saplings to a separate area, gradually reduce shade and the frequency of watering and stand them in full sunlight for their final month in the nursery.

**It is best to plant saplings when they are about 30-50 cm tall.**

# PRE-PLANTING

## PLANTING SITE

- Protect and expose any existing, naturally-established trees, seedlings, saplings or live tree stumps to make them more visible to workers.
- Place a bamboo pole, painted with a bright colour, next to each plant found and clear weeds 1.5 meter-diameter circle around.



**Clear plots of weeds about 1-2 weeks before planting.**

## TREE NURSERY

- Select only the most healthy saplings from the nursery, after grading. Label the saplings with aluminium tags so they can be included in the monitoring program.
- Place all saplings upright in sturdy baskets and transport them to the planting plot, the day before planting.

The combined density of planted and naturally established trees should be about **500 trees per rai (or 3,125 per hectare)**, resulting in an average spacing of about **1.8 m apart**.

The objective is to close canopy and shade out weeds as quickly as possible and thus reduce the costs of weeding.

# TREE PLANTING

The best time to plant trees is **early in the rainy season**. This gives the maximum length of time to grow a root system deep enough into the soil to obtain sufficient water during the first dry season after planting.



Stake out the site with 50-cm tall bamboo stakes about 1.8 metres apart.



Dig holes twice the size of the containers.



Remove saplings from containers keeping root ball intact.



Place sapling in hole and fill in with loose soil.



Firm down soil around the planted sapling.

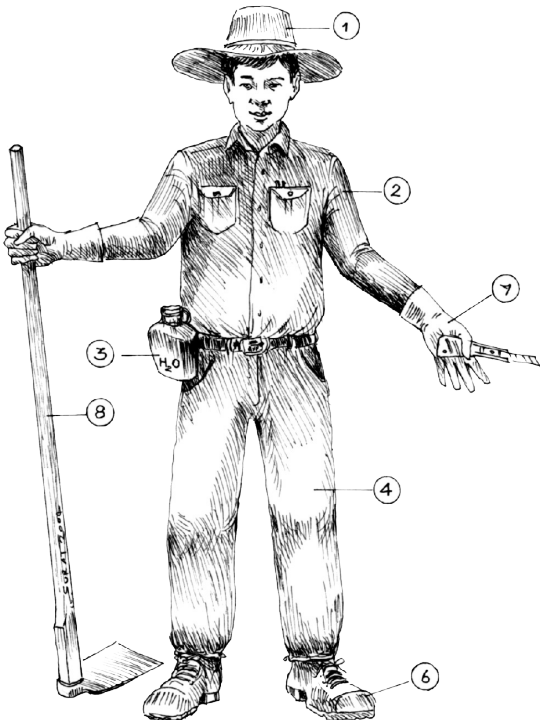


Spread 50-100 g of fertiliser in a ring 10-20 cm from the stem.

Make sure that all the trees are upright and labels are not buried. Refill any holes that have no trees. Remove any garbage or spare materials that are left behind.

## PERFECT PLANTER

The perfectly prepared planter, with hat (1) to protect from the sun; long-sleeved shirt (2); plenty of water (3); long trousers (4); a box cutter (5) to slash open plastic bags; strong boots (6) to protect his feet; gloves (7) and a hoe (8) to dig the planting holes.



TREE PLANTING EVENT VDO

# My Tree Planting Day

Date : \_\_\_\_\_ Starting Time : \_\_\_\_\_ Finish time : \_\_\_\_\_

Name of the location : \_\_\_\_\_

Area (in hectares or rai) : \_\_\_\_\_

How many trees were planted over the whole area that day? : \_\_\_\_\_

How many trees did you plant? : \_\_\_\_\_

Do you know how many tree species were planted? : \_\_\_\_\_

Write any tree species names you learnt : \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Take a photo looking across the site and record the GPS where you take the photo, using the phone app GPS TEST.

\_\_\_\_.\_\_\_\_.\_\_\_\_ ° N; \_\_\_\_.\_\_\_\_.\_\_\_\_ ° E

On monitoring day, take a photo from the same spot —see the difference.

Paste photo looking across the site here



#YFR #YOUNGFORESTRESTORERS

# TREE MAINTENANCE

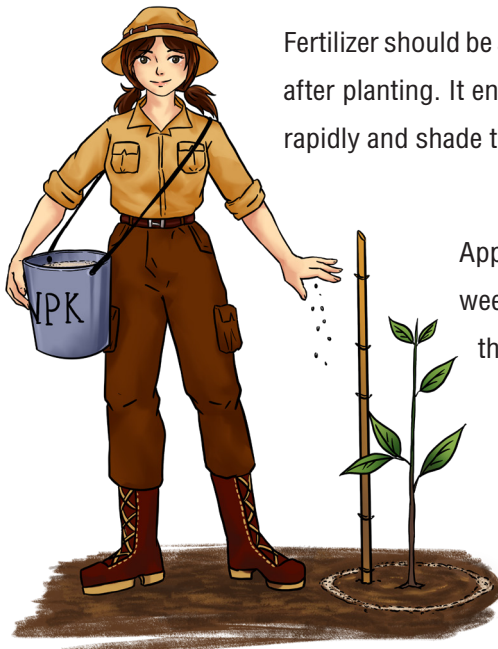
## HOW OFTEN IS WEEDING NECESSARY?

After planting, it is recommended to weed **at least 3 times** during the the **first two rainy seasons** before the weeds grow above the height of the planted trees.

The frequency of weeding can be reduced in the third rainy season after planting, as the crowns begin to meet and form a forest canopy. By the fourth rainy season, the shade of the forest canopy should be sufficient to prevent weed growth.



## HOW FREQUENTLY SHOULD FERTILIZER BE APPLIED?



Fertilizer should be applied during the **first two rainy seasons** after planting. It enables the trees to grow above the weeds rapidly and shade them out, thus reducing weeding costs.

Apply **50-100 g** fertilizer, immediately after weeding, in a ring about **20 cm** away from the tree stem.



## Helping Planted Trees

I helped planted trees to survive and grow on (date) : \_\_\_\_\_

At (site name) : \_\_\_\_\_

By removing weeds around the base of the tree [  ],  
removing vines from the tree stem and crown [  ],  
applying fertilizer [  ], raking away pine needles [  ]

*(tick the task(s) you did)*

What are the purposes of the task(s) you performed? : \_\_\_\_\_

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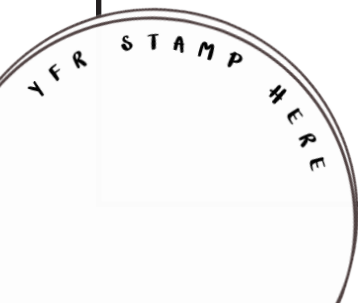
Which tree species did you help? : \_\_\_\_\_

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Paste photo of performing tree maintenance task here



#YFR #YOUNGFORESTRESTORERS



# TREE MONITORING

Monitoring is done to discover if tree planting results in the desired effects and to identify problems with species selection and planting techniques.

Measure the trees **1-2 weeks after planting**, to provide baseline data for growth calculations and to assess immediate mortality.

After that, monitor annually at the end of each rainy season.



- Measure tree height from the root collar to the highest meristem.
- Measure crown width at the widest point, to assess canopy closure.
- Use vernier calliper with a scale to measure root collar diameter (RCD).
- Use a scoring system for weed cover, tree health, and shade cover.

Take a photo looking across the site at the same GPS location where you took the photo on planting day—see the difference.

Paste photo looking across the site here



#YFR #YOUNGFORESTRESTORERS

**Ready to do the quiz and earn your YFR certificate.**



**Go to FOB website..**

**► [fob.science.cmu.ac.th](http://fob.science.cmu.ac.th)**



# We can do it !!



## CAMERA TRAP MONITORING



# Forest Restoration Research Unit (FORRU-CMU)

We are a research institute within Chiang Mai University, N. Thailand. Founded in 1994, we have been carrying out research, to develop improved techniques to restore tropical forest ecosystems for biodiversity conservation, environmental conservation and carbon storage.

Our unit has also established an education team, providing environmental education, based on the results of our research, to a wide range of different stakeholders and seeks to integrate biodiversity conservation into the needs of communities living in and around tropical forest ecosystems.

We work in Thailand and have established satellite units, based on the Chiang Mai model, in Kanchanaburi and Krabi Provinces as well as exporting our research methods to neighbouring countries to assist forest authorities.

We believe that if local people are directly involved in growing and planting trees used for forest restoration, they will develop a sense of “stewardship” of the restored areas and thus future deforestation will be minimized.

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[forru.org](http://forru.org)



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