Tree Planting Programme @ Universiti Teknologi PETRONAS

CEPA TEACHING MODULE

Implementation Partner:

Global Environment Centre

In Support Of:

PENGHIJAUAN MALAYSIA

CEPA TEACHING MODULE

COMMUNICATION, EDUCATION, AND PUBLIC AWARENESS (CEPA) TEACHING MODULE FOR UNIVERSITY TEKNOLOGI PETRONAS (UTP)

Project No: GEC/MA159/1

Project Name: TREE PLANTING @ UTP

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1.0 Introduction:

1.1 Communication, Education, and Public Awareness (CEPA)

The CEPA initiative was part of Yayasan PETRONAS's efforts to combat climate change, aiming to instill awareness and action-oriented behavior in the public through tree planting activities. This initiative provided targeted local communities and students with the chance to cultivate awareness and a sense of ownership towards nature and trees, acquire knowledge about conservation, develop skills in nursery development, and learn about monitoring and maintenance through training in best management practices. Relevant departments and local agencies were also identified as part of the training team.

The program's implementation demonstrated:

- The importance of conservation through tree planting activities as well as Environmental Education programme
- Citizen science for understanding a healthy ecosystem
- Carbon sequestration and climate action.

Under CEPA, an Outdoor Environmental Education Zone (OdEEZ) was established at Zone A near the Dino Park area to optimize and enhance the existing recreational park by the nearby lake, aligning with the goals of the CEPA program.

This module aimed to raise awareness among UTP students, staff, and the local communities about the importance of conservation through tree planting and to enhance their knowledge of citizen science in supporting a healthy ecosystem.

Throughout the module, readers were guided through the CEPA-implemented program (OdEEZ), which consisted of four main activities:

- OdEEZ Information Cabin
- Tree Monitoring and Educational Site (TMES)
- Pollination Garden
- Composting Site

1.1.1 Location of OdEEZ

The OdEEZ for CEPA programme at UTP is located at Zone A, UTP, near Dino Park.

Figure 1: Location of CEPA programme implemented at Zone A, UTP.

2.0 OdEEZ Component at UTP

There are four components established within the OdEEZ for CEPA programme at UTP:

- OdEEZ Information Cabin
- Tree Monitoring and Educational Site (TMES)
- Pollination Garden
- Composting Site

Each of the component will provide different knowledge and information to students and the general public.

2.1 OdEEZ Information Cabin

The OdEEZ Information Cabin plays an important role in the Communication, Education, and Public Awareness Program (CEPA) by functioning as a centre for disseminating environmental information to students, staff, and the general public. It raises awareness of environmental challenges through interactive exhibits and offers educational activities such as workshops and talks. With all these functions, the Information Cabin acts as an environmental education centre that supports sustainability and conservation.

Figure 2: Exterior part of OdEEZ Information Cabin in Zone A, UTP.

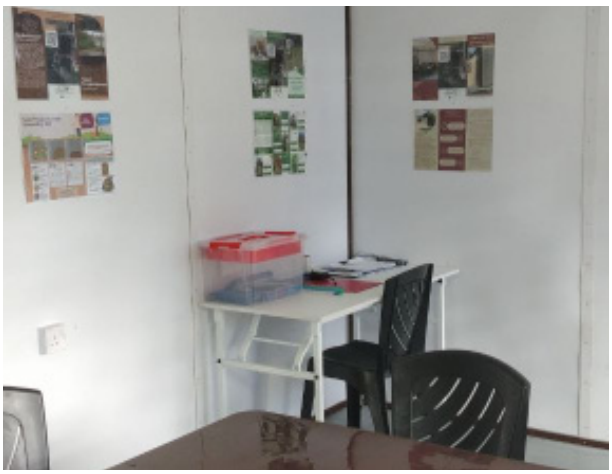


Figure 3: Interior part of OdEEZ Information Cabin in Zone A, UTP.

2.1.1 Available Materials, Activities and Their Purpose

In OdEEZ Information Cabin, one of the activities that can be done is exposing visitors and public to informational material displayed in cabin. The information includes overall tree planting at UTP, tree monitoring and education site (TMES), composting site and pollination garden as part of OdEEZ activities.

Students can explain to visitors and public on the importance of tree planting for the environment, carbon sequestration and climate change which aligns with the objectives of the tree planting initiative in UTP.

2.1.2 Cabin Facilities

To ensure the cabin works well there are several important facilities that play a role and help the cabin operate. Among the facilities and functions are as below:

Figure 4: Rain Water Harvesting System.
Used to collect and store rainwater for various non-potable applications. The stored water can be used for garden irrigation, washing outdoor areas and cleaning tools. This system helps conserve municipal water and provides an eco-friendly solution for small agricultural needs.

Figure 5: Solar System and Wind Turbine Ventilation.
Solar panels generate renewable electricity for lighting in the cabin. Wind turbine ventilators passively remove hot and stale air from the cabin, increasing airflow and keeping the interior cooler without using electricity. These work together to improve energy efficiency and ventilation.

Figure 6: Information Displayed and Reading Material.
This cabin setup serves as an information and learning space. The displayed posters on the walls provide educational materials, likely covering topics relevant to the area or facility, such as sustainability practices or project guidelines. The desk offers a dedicated reading and note-taking area, with additional resources in the box for deeper learning.

2.2 Tree Monitoring and Educational Site (TMES)

The site surrounds the OdEEZ Information Cabin in Zone A serves as an educational resource for teaching tree planting, monitoring, maintenance, and data collection on growth, such as tree height, Diameter at Breast Height (DBH), Diameter at Decimeter Height (DDH) and carbon sequestration. It also displays the seven species used in the UTP tree planting program with detailed information.

2.2.1 Benefits of Tree Monitoring

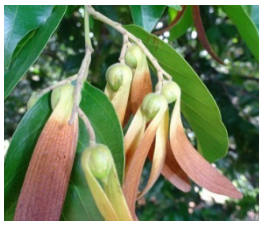
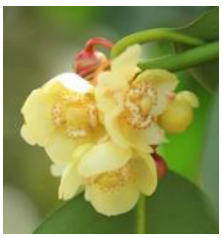
Tree monitoring is essential for maintaining healthy ecosystems, supporting climate goals, and ensuring sustainable land use. By regularly assessing tree health, growth, and environmental impacts, provide benefits such as:

1. **Protect Ecosystems:** Trees support biodiversity by providing habitats. Monitoring helps detect diseases or stressors, preserving entire ecosystems.
2. **Support Climate Goals:** Trees absorb carbon, helping reduce carbon dioxide(CO_2) levels. Monitoring provides data on their role in carbon storage and resilience to climate changes in the long run.
3. **Enhance Urban Spaces:** Trees improve air quality and reduce pollution. Monitoring ensures urban trees are healthy and identifies potential safety hazards.
4. **Preserve Soil and Water:** Tree roots prevent soil erosion and support water cycles. Monitoring helps maintain these benefits for water conservation and soil health.
5. **Boost Agriculture and Forestry:** In forestry and farming, tree health and growth data guide sustainable practices and crop protection.
6. **Inform Policy and Research:** Monitoring provides data for ecological research and supports informed environmental policies.

2.2.2 Tree Species Information

Table 1: Information of the seven species used in the UTP tree planting. *Image source from Google Search.*

No	Species	IUCN	Description	Planting Distance	Justification
1	**Khaya** African cedar / mahogany *Khaya senegalensis*  	VU	This large shade tree can reach 30 meters in height with a round, oval shape. It has thick leaves, 50-70 cm long, clustered at the branch tips. Young leaves transition from heart-red to light green, then dark green. Creamy white flowers appear in small clusters, and the round, blackish-brown fruit splits into segments when ripe, revealing numerous brown seeds.	8 x 8 m	This tree adapts well to various soils and is ideal for quick landscaping. It is suggested for its existing use of landscaping in UTP area and planting site.

No	Species	IUCN	Description	Planting Distance	Justification
2	**Beruas** Seashore Mangosteen *Garcinia celebica*  	NE	A popular shade and ornamental tree, reaching up to 20 meters. The crown is round when young and widens as it matures. Leaves are 15 to 35 cm, dark green on top and grey-green underneath. The flowers are golden yellow, protruding from the top of the canopy. The bean-like fruit turns from yellowish to brown when ripe and often remains hanging after the flowering season.	6 x 6 m	A very beautiful and elegant ornamental tree. It is also expected to give shade, due to its dense spreading crown. The flowers may be used as cut flowers.
3	**Putat** Freshwater Mangrove / Indian Oak *Barringtonia acutangula*  	LC	Has an arm's length long pendulous flowering stalks. Each stalk contains up to 75 flowers which are night-blooming. Small yet showy, these flowers are scarlet red with filamentous stamens. Fruit is small and buoyant which allows it to float and dispersed by water.	5 x 5 m	Due to its flowers, the tree has ornamental value to the landscape of this zone. Its flower nectar attracts bats, moths, and birds.
4	**Merawan siput jantan / Cengal pasir/kampung** *Hopea odorata*  	VU	Growing to a height of 30 m tall, it produces trifoliate foliage where each leaflet is elliptic to spoon-shaped. Flowers are dioecious, small, white, 4-petalled, produced along the axils. The fruit is a dry, elliptic to egg-shaped follicle that splits to reveal 1-2 seeds in each cavity (locule).	6 x 6 m	As Zone A is near to lake, making this species suitable with its added value of being a pollinator plant.
5	**Tenggek Burung/ Chabang Tiga/ Pepauh** *Euodia lunuankenda*  	LC	It is large, growing up to 40 meters tall. When young, its crown is a neat, dark green cone that turns almost oval as it matures. The flowers are small, yellow-white, and not attractive. The fruit is winged, light green, turning light brown when ripe.	5 x 5 m	This tree has ornamental fruits (winged-nut) that will give great feature of landscaping which usually were planted at the roadside, parks and gardens.
6	**Kapur** Bornean champhor tree *Dryobalanops aromatica*  	LC	A small tree that grows quite slowly up to 10 m tall. The crown is shady with broad branches, dense. The trunk is gray that will have small cracks and peels off, leaving a new skin that is blackish gray. The leaves are dark green and quite wide, thick and hard. The flowers are small, measuring between 3-5 cm wide with orange petals on the outside while the inside is white and yellow. The fruit is round, bright rose-red when ripe, up to 5 cm wide and has thin skin. Its flesh is edible but sour.	8 x 8 m	This tree can attract the birds and pollinator insects which will enhance biodiversity of the area. Suitable for planting along streetscapes, parks, gardens, and coastal areas/parks for its dense leafy crown.

No	Species	IUCN	Description	Planting Distance	Justification
7	**Jemerlang / Batai laut** Yellow flame *Peltophorum pterocarpum*  	NE	Produces high-quality timber. It is a large tree that can grow up to 60 meters tall when mature. The crown is conical when young, becoming oval or nearly round as it matures. The trunk is straight, reddish-brown, cracked, and flaky. Its flowers are white and about 2 cm wide. The fruit has hard, egg-shaped seeds with large lobes and long wings.	5 x 5 m	This tree has ornamental flowers and wide silara when grown, which will give shade to the area.

Note: VU – Vulnerable; LC – Least Concern; NE: Not Evaluated

2.2.3 Tools and Equipment for Tree Monitoring

Below shows tools and equipments for tree monitoring activities:

Figure 7: Electronic calliper. Measures the diameter of trees with high accuracy.

Figure 8: Clinometer. Measures the height of trees.

Figure 9: Measuring tape. Measures circumference and distances.

Figure 10: Open reel tape measure. Measures longer distances.

Figure 11: GPS. Determines the exact location of trees.

Figure 12: Camera. Takes photographs to document tree conditions.

Figure 13: Paperboard. Used for labelling or making notes in the field.

Figure 14: Pen and marker pen. Writes on paperboard for labelling.

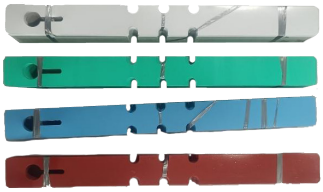


Figure 15: Tag. Identifies and labels individual trees.

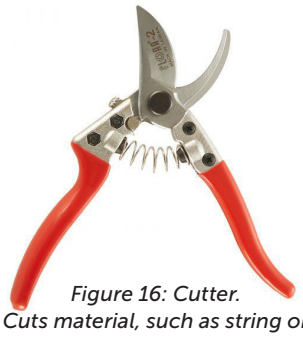


Figure 16: Cutter.
Cuts material, such as string or paperboard, as needed.

Figure 17: Scissors.
Cuts thinner material.

Figure 18: String.
Used for marking or measuring in the field.

PEMANTAUAN POKOK DI TAPAK PENANAMAN KM 45 LEBUHRAYA SIMPANG PULAI - CAMERON HIGHLANDS

TARIKH PEMANTAUAN: 28/08/2022

LORONG	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	JUMLAH	HIDUP	MATI
1	1	/	2	/	3	/	4	/	5	/	6	/	7	/	8	/	9	/					9	9	0
2	1	/	2	/	3	/	4	/	5	/	6	/	7	/	8	/	9	/	10	/			11	11	0
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3	1	/	2	/	3	/	4	/	5	/	6	/	/	/	8	/	9	/					12	11	0
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8	1	/	2	/	3	/	4	/	5	/	6	/	7	/	8	/	9	/	10	/	11	/	12	12	0
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11	1	/	2	/	3	/	4	/	5	/	6	/	7	/	8	/							5	5	0

Borang Lapangan Penilaian Karbon

Nama penilai: Juhazman Jamaluddin
Tarikh: 2 Februari 2022

Sampel Pokok	Lokasi	Kordinat GPS	Species Ditanam	Tarikh Ditanam (ddmmyyyy)	Ketinggian anak pokok pada tarikh penanaman (cm)	Diameter pada ketinggian dada (DBH) (cm)	Ketinggian anak pokok pada tarikh persampelan (cm)	Nota
1	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	125.0	1.98.5	2.33	Kering
2	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	113.7	127.2	2.15	Kering
3	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	140.0	153.5	2.54	Kering
4	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	116.5	131.7	2.07	Kering
5	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	153.0	166.2	1.08	Banjir
6	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	127.3	140.5	2.53	Banjir
7	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	145.0	158.2	1.55	Banjir
8	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	140.3	153.5	2.09	Gangguan dari babi hutan
9	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	118.3	131.5	2.59	Gangguan dari babi hutan
10	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	153.0	166.5	2.41	Gangguan dari babi hutan
11	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	125.0	1.99.7	1.99	Gangguan dari babi hutan
12	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	113.7	127.4	2.54	Gangguan dari babi hutan
13	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	145.0	158.7	2.07	Gangguan dari babi hutan
14	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	140.0	153.5	1.98	
15	Parit Haji Dollah	4°55'21"N 100°38'13"E	Bakau Kurap	10082021	116.0	131.5	2.53	
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Disediakan oleh:
Nama: Juhazman Jamaluddin
Tarikh: 2 Feb 2022

Diakikan oleh:
Nama:
Tarikh:

Diluluskan oleh:
Nama:
Tarikh:

Figure 19: Example of Monitoring Form.
Source: Global Environment Centre.

2.2.4 Method

Notes: Tree monitoring should be done once every three (3) months.

1. Tree monitoring is done by selective sampling (selection of trees according to site condition), however in UTP, 20% trees that were planted will monitored and measured.
2. Mark the selected tree using tags and permanent marker pen.
3. Measure tree height using measuring tape.
4. Measure the tree:
    - Diameter Decimeter Height (DDH) 10 cm above ground if tree height is < 130 cm and diameter is ≥ 1 cm.
    - Diameter Breast Height (DBH) at 1.37 m above ground if tree height is ≥ 137 cm and diameter is ≥ 5 cm or 10 cm using the measuring tape, electronic calliper, pen and record the data in the monitoring form.
5. There are two (2) ways to measure DBH:

Using strings and ruler (method 1)

- To measure DBH of tree, take a string and wrap around the tree trunk to get its circumference at 1.37 m above ground.
- Measure the length of the string (circumference) using a ruler and calculate the DBH using the formula (DBH = circumference/π), where π = 3.14159 or 22/7.

Using electronic calliper (method 2)

- Using an electronic calliper, measure the DBH of tree trunk at 1.37 m above ground.
- The DBH will be shown in the electronic calliper (set in cm, not inches), and immediately record the data in the monitoring form.

Figure 20: Examples of tree tags.
Source: Global Environment Centre.

Figure 21: Examples of tree monitoring tools.
Source: Global Environment Centre.

Notes:

Three Different Measurements Taken On Plants:

- *Height (H, in cm/m) refers to the vertical distance between the base of the tree and the tip of the highest branch on the tree. For leaning stems, the height is measured along the length of the stem.*
- *Diameter at Decimeter Height (DDH, in cm/dm) is the diameter of the stem measured at 10 cm in height (which is 10 cm measured along the stem for leaning stems). ddh will be measured for qualifying stems ≥ 1 cm diameter and < 130 cm height.*
- *Diameter at Breast Height (DBH, in cm/dm) is measured at 1.37 m along the stem, which in the case of a vertical stem is 1.37 m above the ground. DBH will be measured for qualifying stems more than 5 cm or 10 cm diameter (Not applicable for newly planted saplings).*

2.2.5 Carbon Storage Calculation

There are a lot of methods and allometric equations design to specifically calculate carbon storage in trees of different species, as each individual species of trees have different densities in weight and compositions of moisture to dry weight. However, for the sake of education, we will cover carbon storage calculation in a more simplified way for exposure purposes.

The role of carbon dioxide (CO_2) uptake in forests extends more than just carbon sequestration. It is connected to the dynamic growth of trees, primarily through its influence on biomass accumulation. Biomass in this context refers to the sum of all organic material that constitutes a tree's physical structure – a tangible indicator of its growth. Trees distribute this biomass in two primary compartments: **Above-Ground Biomass (AGB)** and **Below-Ground Biomass (BGB)** as shown in picture below. Above-ground biomass encompasses the parts of the tree that are visible above the soil line, including the trunk, branches, leaves, and any fruits or flowers. Below-ground biomass consists of the roots, which, though less visible, are equally crucial for the tree's stability and nutrient uptake.

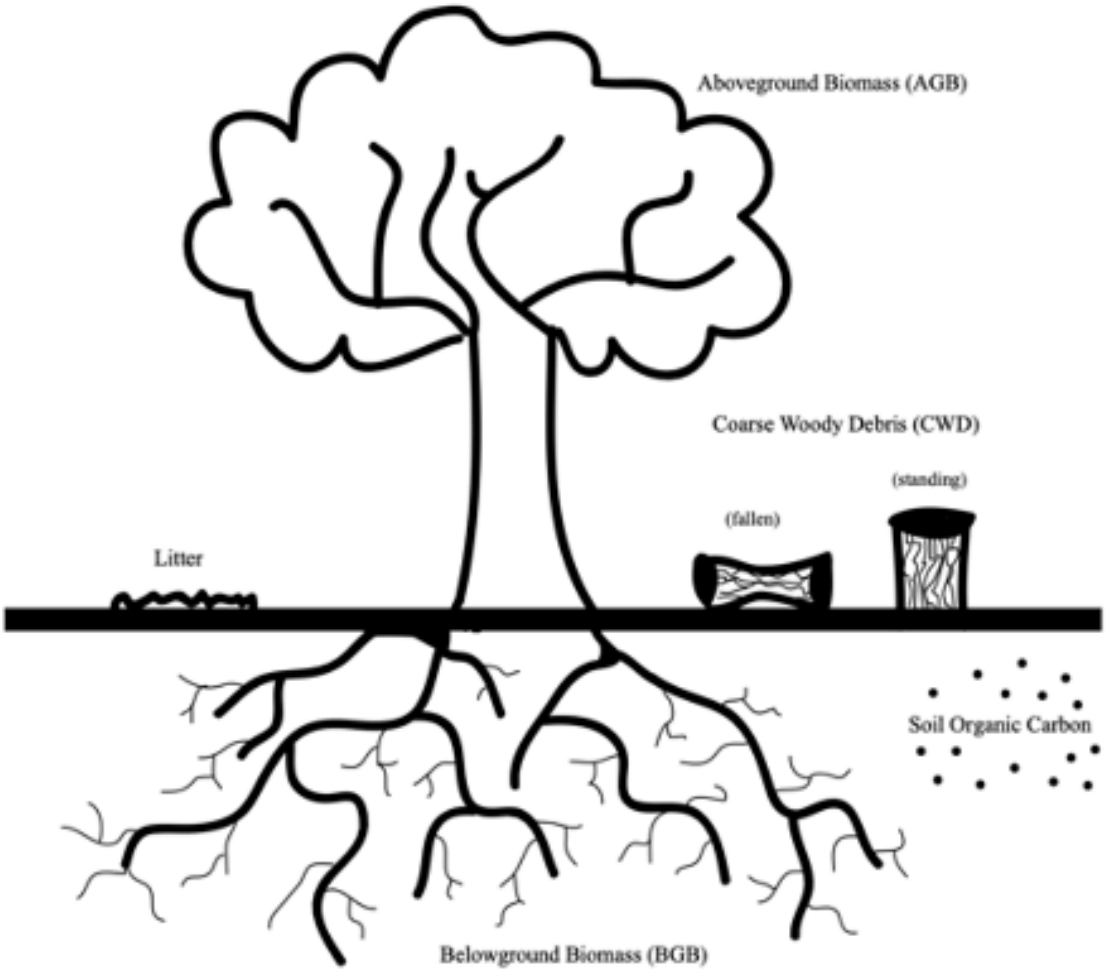


Figure 22: Tree Carbon Pool
Source: www.ecomatcher.com/how-to-calculate-co2-sequestration

To calculate the carbon storage of tress in general, two critical measurements are needed to be taken directly from the tree we are calculating, which are **Above-Ground Biomass (AGB)** and **Below-Ground Biomass (BGB)**. The calculation of these biomass values is based on a specific formula that incorporates these two parameters, shown below:

AGB = 0.25 x D2 x H

Where:

- AGB: Above-Ground Biomass (Kg).
- D: tree diameter measured at 1.37 meters from the ground (mm). This measurement is globally used as a standard to get a better result. However, if your tree is below 1.37 meters, you can still use the formula.
- H: tree height (cm).

The overall green weight of the biomass is estimated to be 120% of the AGB value, based on the assumption that the BGB, which comprises the tree's root system, accounts for approximately 20% of the AGB. Therefore, BGB can be calculated as follows:

BGB = 0.2 × AGB

From these formulas, the total biomass from a tree can be calculated as below:

Total Biomass (TB) = AGB + BGB = AGB + 0.2 x AGB = 1.2 × AGB

On average, a tree consists of 72.5% dry matter and 27.5% moisture content. To calculate the tree's dry weight, we could multiply the total weight of the tree by 72.5%.

Total Dry Weight (TDW) = TB × 0.725

Carbon occupies 50% of the total dry weight. Therefore,

Total Carbon (TC) = TDW × 0.5

With the value of total carbon, we can calculate the value of CO_2 equivalent sequestered on a tree. CO_2 has one molecule of Carbon and two molecules of Oxygen. The atomic weight of Carbon is 12u, and the atomic weight of Oxygen is 16u. The weight of CO_2 in trees is determined by the ratio of CO_2 to C is 44/12 = 3.67. Thus, to determine the weight of carbon dioxide sequestered in the tree, multiply the weight of carbon in the tree by 3.67.

CO_2 weight = TC × 3.67

Note that the CO_2 weight above represents the CO_2 sequestered in the entire lifetime of the tree. To ascertain the annual or yearly rate of CO_2 sequestration, divide the total weight of CO_2 absorbed by the tree's age.

Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide (CO_2) to mitigate climate change. It can occur naturally or be facilitated through human activities.

2.2.6 Importance of Carbon Sequestration

- **Reducing Campus Carbon Footprint:** By replanting trees and restoring green spaces, UTP can increase carbon sequestration on campus, directly reducing its carbon footprint. This aligns with the university's sustainability goals and efforts to combat climate change at a local level.
- **Enhancing Air Quality and Health:** More trees mean more CO_2 absorption and oxygen production, which improves air quality for the UTP community. Better air quality contributes to a healthier environment for students, faculty, and visitors.
- **Supporting Biodiversity on Campus:** Replanting with native and diverse species supports local wildlife by creating habitats. This encourages biodiversity and contributes to a balanced ecosystem within the campus grounds.
- **Educational and Research Opportunities:** Carbon sequestration projects at UTP provide practical opportunities for students and faculty to study environmental sciences, sustainability, and climate change mitigation firsthand. It allows for hands-on research on topics such as carbon capture, ecosystem health, and reforestation techniques.
- **Soil and Water Conservation:** Trees planted as part of replanting efforts help reduce soil erosion and improve water retention in the campus grounds, making the campus environment more resilient to heavy rainfall and droughts. Healthy soils also act as additional carbon sinks, adding to overall carbon sequestration.
- **Contributing to Malaysia's Climate Goals:** Local replanting initiatives at UTP contribute to Malaysia's broader national goals for reducing greenhouse gas emissions and increasing forest cover, aligning UTP with regional and national environmental objectives.

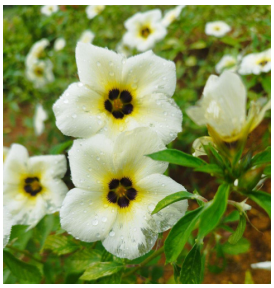
2.3 Pollination Garden

A pollination garden is a specially designed area to attract and support various pollinator species such as bees, butterflies, and hummingbirds. It aids in plant reproduction, enhances biodiversity, and maintains ecosystem health.

Figure 24: Pollination Garden Location

Table 2: Pollination garden species.

No	Species	Pollinators
1	**Bunga Pukul Lapan** Sage Rose *Turnera ulmifolia* 	Bees and other insects
2	**Kemuning Lada** Orange jasmine *Murraya paniculata* 	Honeybees, bird
3	**Jenjarum** Pin Flower Yellow *Ixora Javanica* 	Bees, butterfly, bird
4	**Orkid Buluh** Grass orchid *Arundina graminifolia* 	Ant, beetle, fly, thrips, wasp
5	**Bunga Susu** Cape jasmine *Gardenia jasminoides* 	Bees and butterfly

No	Species	Pollinators
6	**Akar Cempaka Hutan** Yellow Allamanda *Allamanda cathartica* 	Bees, Butterfly
7	**Bunga Padang** White Alder *Turnera subulata* 	Bees, Butterfly

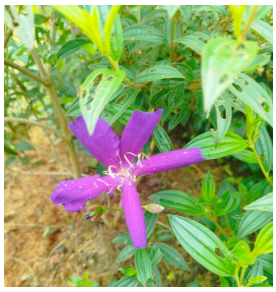
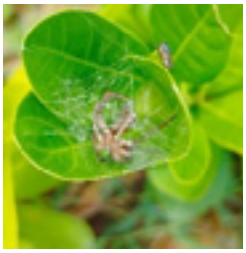
No	Species	Pollinators
8	**Senduduk** Singapore Rhododendron *Melastoma malabathricum* 	Bees, wasps, butterfly
9	**Jenjarum** Pin Flower *Ixora concinna* 	Caterpillar, butterfly

Figure 25: Pollinators and other fauna found at the site




Dragonfly



Spider

Bee

Moth

Gulf fritillary

Ant

Grasshopper

2.3.1 Benefits of Pollination Garden

- Enhances biodiversity conservation by supporting various pollinator species.
- Boosts plant productivity through the process of pollination.
- Enhances landscape beauty and environmental quality.
- Provides opportunities for education, nature appreciation, and recreational activities.
- Promotes awareness of the importance of pollination in ecology.

2.3.2 Maintenance for pollination garden

Maintenance for a pollination garden involves loosening the soil, fertilising and regular watering. These activities help keep the plants vibrant, attract pollinators, and prevent invasive species or pests from taking over, ensuring a thriving and sustainable ecosystem.

I. Loosening the soil around the plants

Helps improve water flow and nutrients to the roots. Loosening or aerating the soil regularly helps prevent compaction, which can restrict root growth and reduce plant health. This process needs to be done carefully to avoid root damage and to ensure a fertile environment for both plants and pollinators. Soil should typically be loosened every 2-3 weeks (if possible).

II. Fertilising (recommendation: natural or organic)

Fertiliser application involves regularly assessing plant health and soil quality to ensure plants are receiving adequate nutrients without overfertilising. Observing leaf colour, growth rate, and flowering pattern helps identify nutrient requirements. Fertilisers should be used sparingly, as overuse can harm beneficial insects and pollinators. Adjustments can be made based on plant response and seasonal growth needs, promoting healthy blooms and an attractive environment for pollinators.

III. Watering

Monitor watering involves regular checks of soil moisture and plant health to ensure optimal hydration. Observing soil dampness at root level helps determine if plants need watering, typically aiming for a depth of about 6 inches. By watering early in the morning or late afternoon, moisture is maximised, and plants are less stressed. Adjustments should be made based on weather conditions, with less watering needed during rainy periods and more during dry spells. This attentive approach supports plant health and ensures the garden remains attractive to pollinators.

2.4 Composting Site

Compost is a fertiliser that is produced when decomposable organic matter is broken down by microorganisms. This process benefits the environment because compost can be used as a natural fertiliser for gardening and farming. By recycling organic matter, valuable nutrients from the recycled organic materials can be utilised for plants and improve soil structure, thus reducing garden waste management problems.

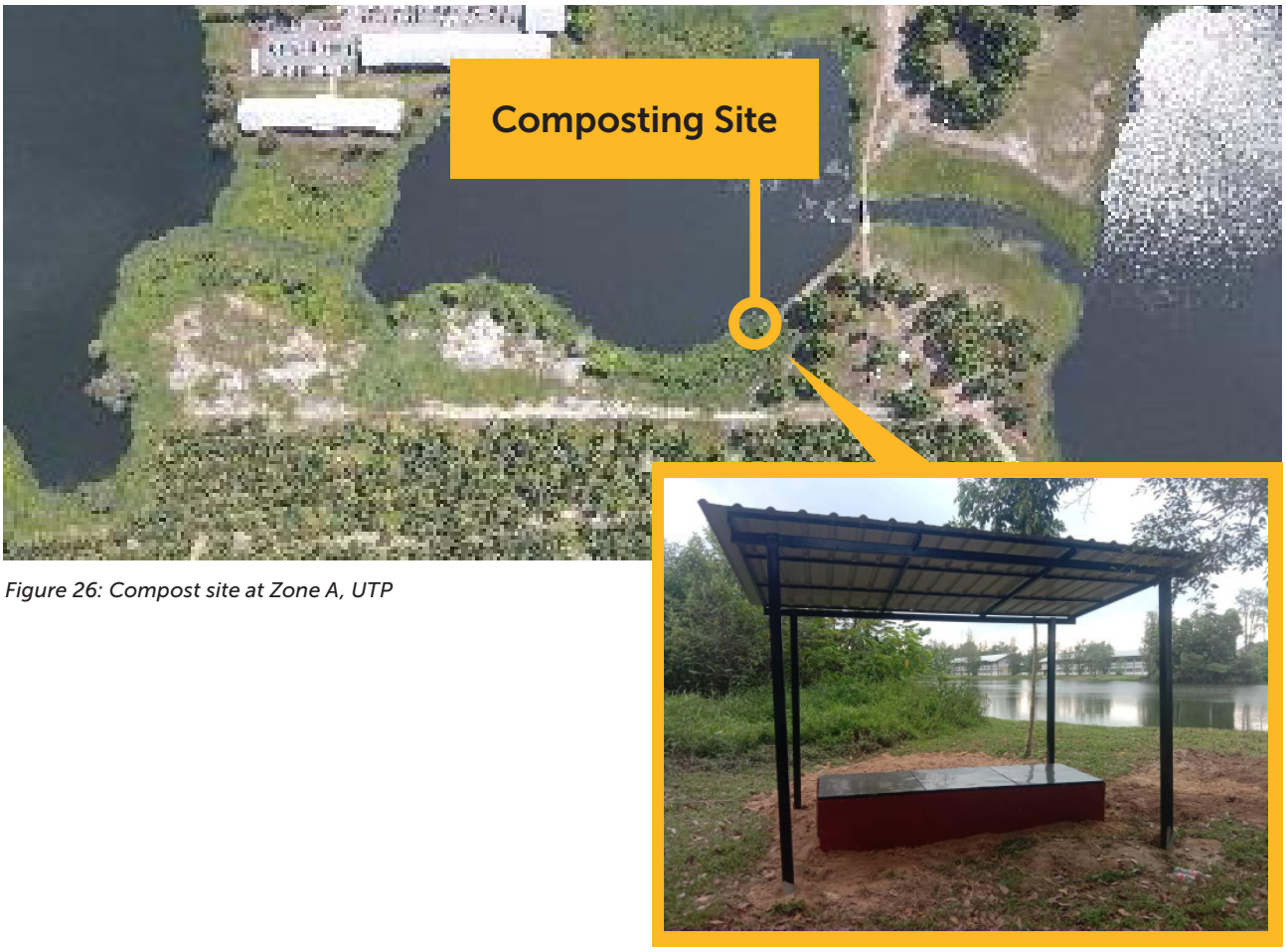


Figure 26: Compost site at Zone A, UTP

2.4.1 Pit Compost 3-Box System Used at UTP

For proper waste management and natural way to produce organic fertiliser.

Equipment/Materials: shovel, water supply, organic waste: green materials (fruit peels, vegetable wastes) and brown materials (dry leaves, small branches), soil.

Method:

Box 1 (Early stages): Compost production

- Fill with the first 15-20cm layer of dry leaves for aeration and drainage.
- Next layer, add green and brown materials. Cover with dry leaves and soil to prevent from odour and flies. Continue layering until full.
- Add some water during and when completely filled box to keep moist and decomposition can occur but not too wet to rot the waste.
- Turn and mix the compost once every 2-3 weeks. Remember to keep the compost moist.

Box 2 (After ≥50% decomposed): Decomposition

- In 1 month, move the Box 1 compost materials to the Bin 2 for further decomposition process: turn, mix and cover with soil, as well as pour some water. With the help of worms in the soil, other insects and microorganism the process of decomposition is speed up.

Box 3 (After ≥90% decomposed): Compost Product

- After 2 months, Box 2 compost material is placed to the Box 3 for stoarage and ready to use for the trees.

At the same, Box 1 will be filled in with the new compost product and Box 2 will receive compost from Box 1, this process will continue to sustain the soil health and organic nutrients for the planted trees.

Figure 27: Steps to use 3-box compost
Source: www.quickcrop.ie/blog/a-guide-to-making-homemade-compost

2.4.2 Other Methods

A. Direct Composting

Direct composting involves burying organic materials, such as kitchen scraps and yard waste, directly in the garden soil where they decompose in place.

Equipment/Materials: shovel, water supply, organic waste: green materials (fruit peels, vegetable wastes) and brown materials (dry leaves, small branches), soil.

Chop or Shred: Cutting larger pieces into smaller sizes can speed up the decomposition process.

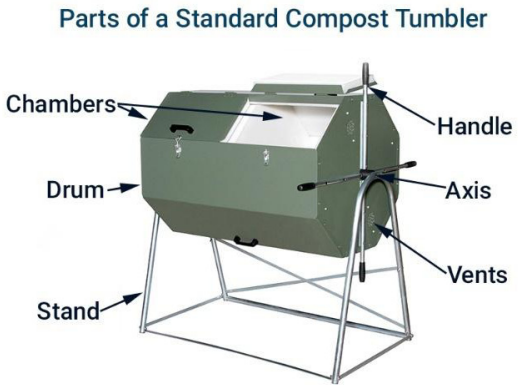
Layering: Alternate layers of green and brown materials to maintain a balanced mix and promote aeration.

Moisture: Ensure the materials are damp but not soggy to facilitate microbial activity.

Method:

1. Loosen the soil in the chosen area using a shovel or garden fork.
2. Gather the materials that collect suitable organic waste, including:
   - Greens: Vegetable scraps, grass clippings, and coffee grounds.
   - Browns: Dry leaves, shredded paper, and straw.
3. Create a base layer that start with a coarse layer of materials like small branches or straw for drainage.
4. Add Organic Waste that layer your kitchen scraps and yard waste, alternating between greens and browns.
5. Cover with Soil After adding the organic waste, cover it with a layer of soil to keep pests away.
6. Moisten the materials ,lightly water the area if the materials are dry, ensuring they are damp but not soggy.
7. Monitor and Maintain which is check the composting area periodically, adding more materials and adjusting as needed.
8. Allow Time for Decomposition let the materials decompose over several months, enriching the soil.
9. Use the finished compost once the materials have broken down into dark, crumbly compost, mix it into your garden soil or use it as a top dressing for plants.

B. Tumbler Composting



A compost tumbler is essentially a closed compost bin or drum that's rotated to mix the contents inside. Some tumblers are mounted on an axis to make turning easy. Others are rolled on a sliding base or directly on the ground. The drum may consist of one or more chambers that you fill with kitchen scraps and other waste. The chambers are usually sealed, making them rodent and racoon proof.

Method:

1. Select a compost tumbler made of durable materials, ensuring it has good ventilation and a tight seal to keep pests out.
2. Gather Materials by collect organic waste, including:
    - Green Materials: Fruit and vegetable scraps, grass clippings, coffee grounds.
    - Brown Materials: Dry leaves, straw, shredded paper, and cardboard.
    - Aim for a balanced mix of roughly 2 parts brown to 1 part green.
3. Place the tumbler in a sunny location to help speed up decomposition.Ensure it is easily accessible for adding materials and turning.
4. Layer the materials in the tumbler, alternating between green and brown materials. Avoid adding large pieces; chop or shred larger items to facilitate faster decomposition.
5. Keep the contents damp but not overly wet. If the mixture is too dry, add water or moist greens; if too wet, add more dry browns.
6. Rotate the tumbler every few days to mix the materials and aerate the compost. This promotes faster decomposition and reduces odor.
7. Check the compost for temperature and moisture. A well-maintained tumbler should feel warm and have a pleasant earthy smell.
8. After 4 to 6 weeks, the compost should be dark, crumbly, and have a pleasant odor. Open the tumbler and use a shovel or pitchfork to remove the finished compost.
9. Start adding new materials as you remove the finished compost, allowing for continuous composting

For more methods in composting, scan QR code for more information.

3.0 Conclusion

Hopefully this module can guide readers especially UTP students/staff on how to plant and monitor trees, manage natural resources nearby and maintain interest in conserving the environment, and guide local communities to further spread awareness on the importance of planting trees and managing the environment as well as for supporting the effort to conserve mother nature for our own sake, and especially for the preparation of future generations.

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