

Sustainability Class

# LIFE CYCLE OF TREES

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2011、5月31日

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# My Biography

2

## Academic Record

- 2008, Graduated from the Faculty of Engineering, Hokkaido Univ.
- 2008 – 2010, Post-Doctoral Research Fellow in Hokkaido Univ.

## Research Interests

- Sustainable Built Environment
- Renewable Construction Materials

## Contents

- Some Facts about Indonesia
- Trees Growth
- Trees Benefits
- Climate Change Impacts on Trees

# Some Facts about Indonesia 1 / 3

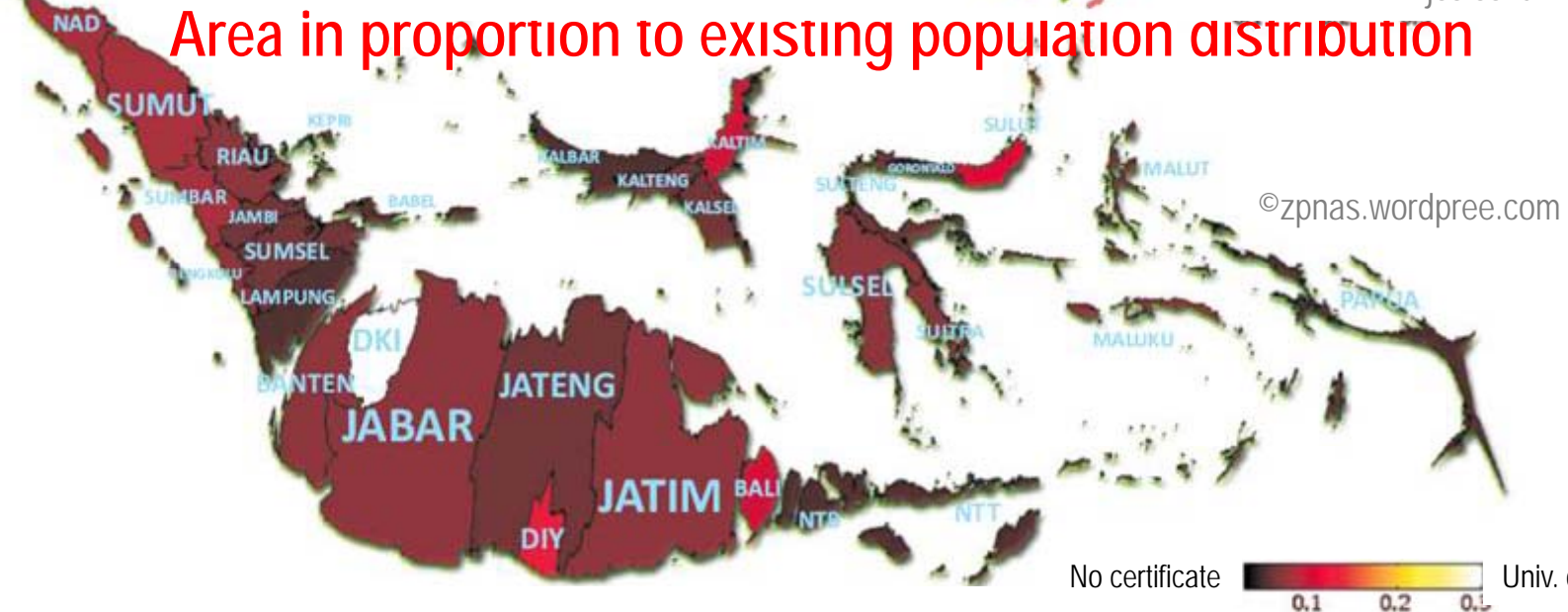
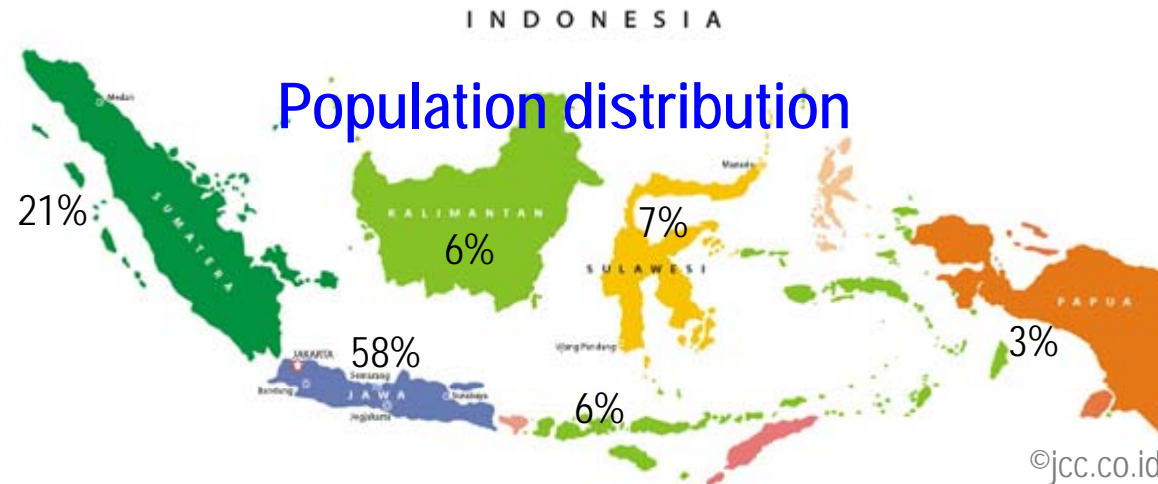
3

- Population: 237.556.363 (in 2010)  
2x of Japan's population; 10x of Taiwan's population
- Climate  
October - April, Raining season; April - October, Dry season  
An archipelago country; Located around the equator line  
Wet-Tropic (hot with very high humidity).
- Land area: 1.922.570 Km<sup>2</sup>; Sea area: 3.257.483 Km<sup>2</sup>
- Island: 17.504
- Ecological footprint = 1.21 gh/p; Biocapacity 1.35 gh/p (in 2007)

# Some Facts about Indonesia 2/3

4

- In contrast to Borneo and Papua islands, Java island has very high population density.
- We need to expand Java island and to shrink other islands.

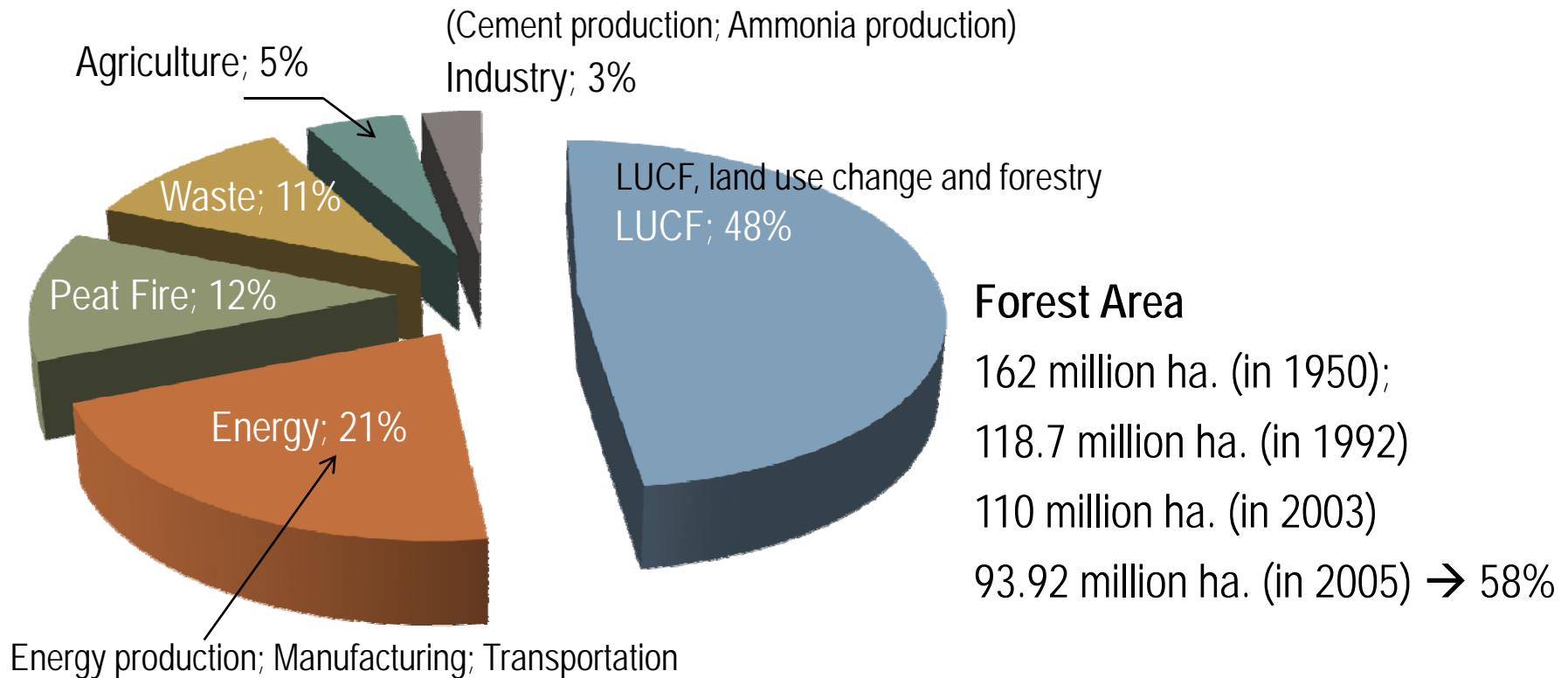


# Some Facts about Indonesia 3/3

5

Indonesia's net GHG emission in 2000 was 1.37 Gt CO<sub>2</sub>e

Source: Ministry of Environment, 2009



# Discussion 1

6

## □ Indonesian (and developing countries) current situation

Increase of population; Increase of energy needs, increase of housing needs; increase of food needs; increase of transportation need; increase ....



If people is doing business as usual, ecological footprint will increase.

Please figure out how to fulfill those needs while reducing impact on the environment. Yu can discus with your friends within 5 minutes. Please share your idea.

# An example

7

## Housing issue

- Recycled buildings
- Eco-house

Good air circulation

Renewable/biodegradable materials

Efficient lightning system

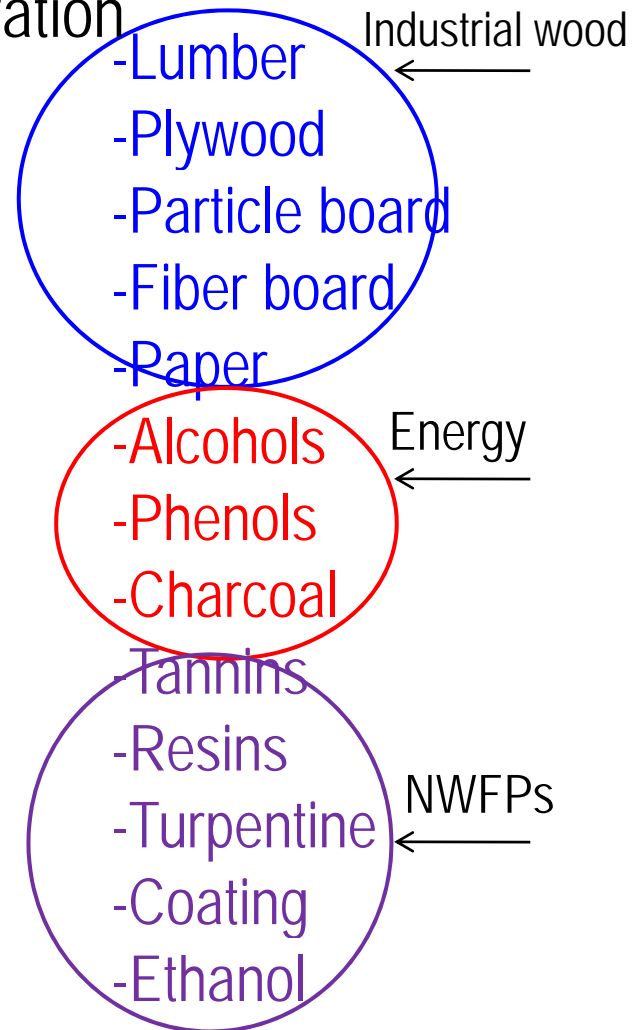
Harmony with nature



# Benefits of Trees/Forests: general

8

- Biodiversity and habitat preservation
- Industrial wood
- Non-wood forest products
- Energy
- Watershed protection
- Eco-tourism





# Environmental Benefits 1 / 2

9

- **Carbon sequestration**

As a results of photosynthesis, some atmospheric carbons are stored in trees and wood products through their lifetime .

- **Carbon storage**

Dead trees can be converted to wood products or used as bio-energy, further delaying, reducing, or avoiding greenhouse effect.

- **Cool the earth**

Trees lowers temperature in two ways: remove carbon dioxide, reducing green house effect; and release water vapor which helps cool the earth.

- **Reduce levels of water run off**

# Community Forests: Pro-Poor

10

Forest regeneration through community participation can offer substantial economic benefit to millions of poor people, while sequestering carbon and reducing pressures on natural forests



# We need more trees

11

Tom Gardner-Outlaw  
Robert Engelman:



Forests produce wood-based commodities such as timber, wood-fuel, and pulp for paper and packaging, as well as medicines. Once cleared of trees, forested land can be used for crops and human settlements.

*Standing forests, however, offer environmental services—control of climate, and of air and water quality, for example—that no human technology can replace.*

As forests and wildlife both succumb to the spread of farms and settlements, those that remain become even more valuable for species conservation and for soaking up excess carbon from the atmosphere. Meeting such growing and conflicting demands highlights our dilemma:

*We both need more forests and need forests more than ever before.*

# Tree Growth: general

12

## □ Affecting factors

- Genetic, G

- Environment, E,

  - 1) physical: temperature; humidity; energy

  - 2) chemical: fertilizer

  - 3) biological: insect outbreak

- Interaction between G and E.

## □ Genetic significantly controls

- Tree straightness and wood density

## □ Environment significantly controls

- Tree height and tree diameter



# Tree Activities

13

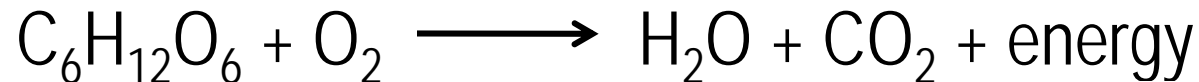
## □ Photosynthesis

Solar energy is absorbed by chlorophyll pigments inside leaves and is used to breakdown atmospheric CO<sub>2</sub> into its constituent.



## □ Respiration

Carbohydrates are oxidized as part of the metabolic reaction, and carbon is released back into atmosphere once again as CO<sub>2</sub>.



## □ Transpiration

Transpiration occurs when water vapor flows from leaves into the atmosphere.

# How can tree species be identified?

14

- **Flowers:**

color, shape, ...

- **Leaves**

color, shape, ...

- **(Outer) bark**

color, texture, ...

- **Cross-sectional appearance**

color, texture, brightness, odor, surface roughness, hardness, ...

- **Tissue**

size, shape, density, ...

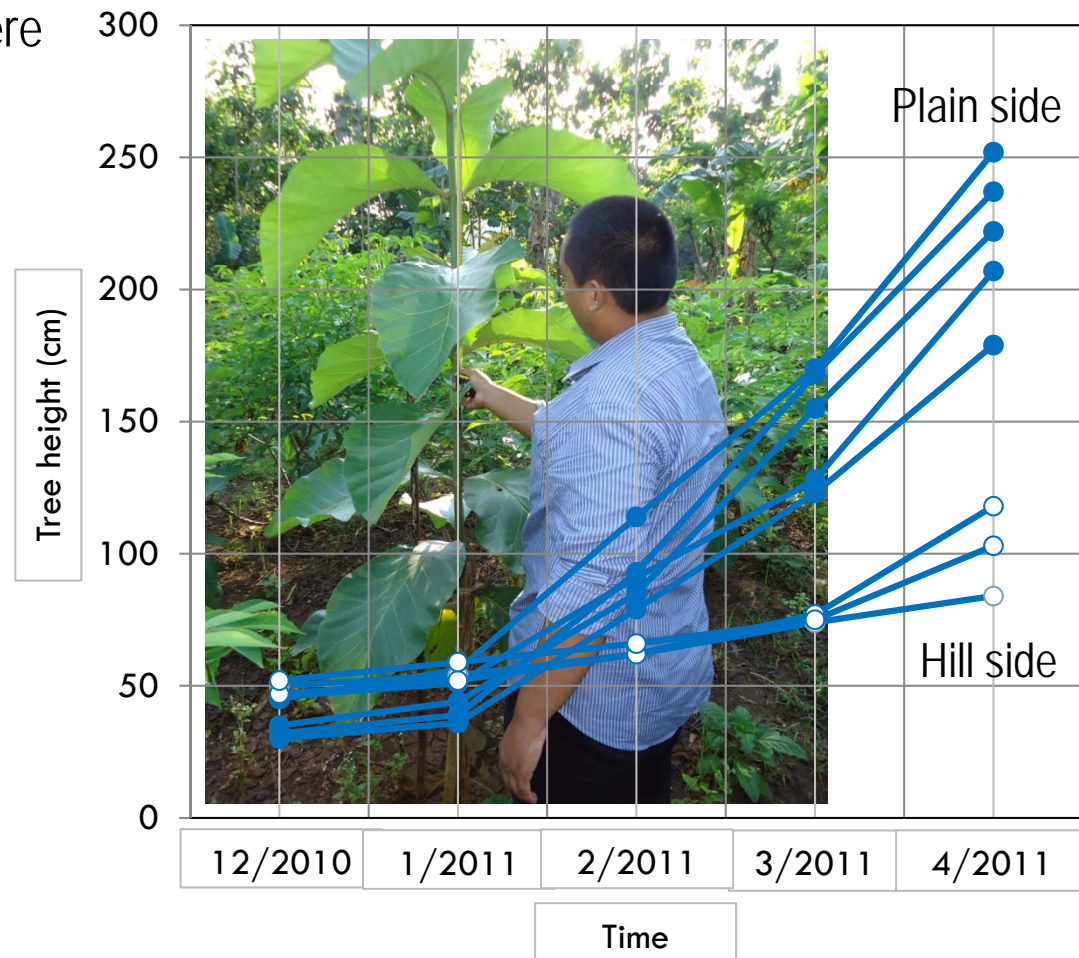
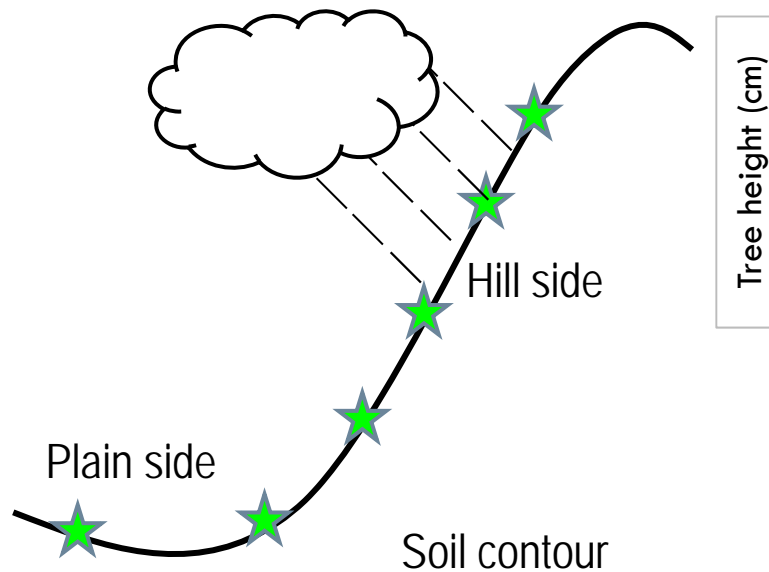


# Tree Growth: environment variation

15

## Tree height measurement

Seeds of the same tree species were planted at two different spots (plain side and hill side) according to this simplified soil contour.



# Tree Growth: section of tree trunk

16

Most tree trunk is dead tissue and serves only to support the weight of the crown.

From outside to inside:

**Bark** (outer bark and inner bark),

**Cambium** – reproductive tissue

**Phloem** – transports materials from crown to roots

**Xylem** (sapwood) – transports water to crown .

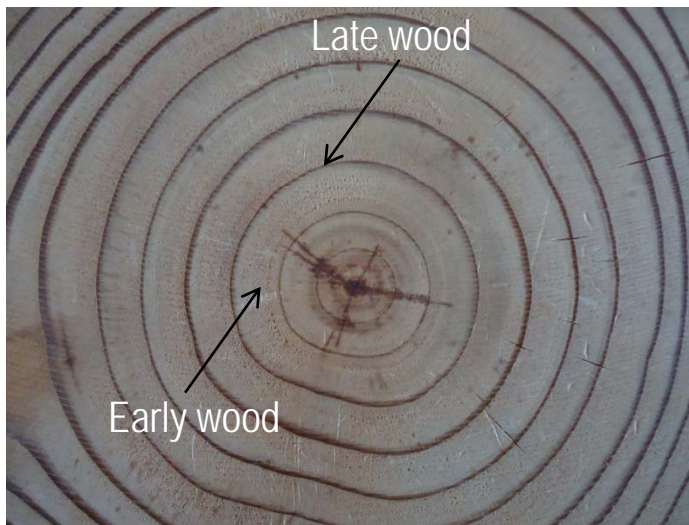
**Heartwood** -- consists of an inner core of wood cell that have changed both chemically and physically; the color is much darker than sapwood.





# Tree Growth: section of tree trunk

17



Japanese wood からまつ



Indonesian urban forest wood

Each year tree grows a pair of annual rings. In the spring, the wide layer usually grows. It is called "early wood". In the summer, a darker layer is usually produced. It is called "late wood". Annual rings are typically in temperate forest trees and tropical forest trees that have regular, annual dry season. In tropical humid rainforests, tree grows continually and do not have rings.

# Tree Growth: young vs. old trees

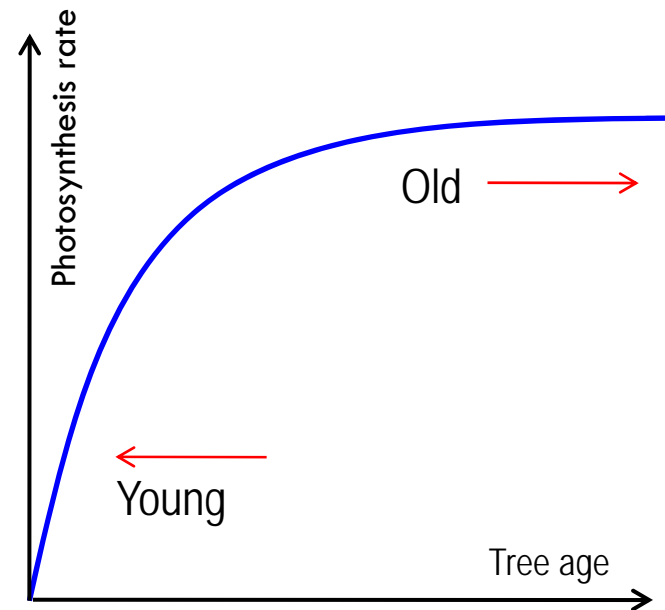
18

As trees age, the rate of photosynthesis decreases. Older trees tend to have less foliage, so there is not as much available chlorophyll.

Older trees have more carbon energy stored in their tissues and don't need to photosynthesize as rapidly as younger trees.

Young trees are still effective to offset the atmospheric CO<sub>2</sub>. However, old trees are no longer effective.

Old tree occupies more space than a young tree. For instance, in the same area of land (10 m by 10 m) that is commonly occupied by one old tree can be replaced by four young trees (each young tree occupies 5 m by 5 m).



# Tree Growth: young vs. old trees

Young wood is generally weaker and less durable than the old wood --- When young wood is used for construction, the service life will be short and maintenance cost will be high.



Old trees posse threats as they may fall down because of wind or weakened root.

# Discussion 2

20

In spite of hundreds tree species, people probably would be planting trees that has significant economic benefit.

What do you think? Please discuss with your friends within 5 minutes and voice your conclusion.

# Climate Change Impact

21

- Long dry season will render most trees species more vulnerable.
- In some area, climate change makes wet dry season. Rainfall in dry season gets rid some kind of leaf-eater caterpillar.
- Trees will become more vulnerable to pests.
- Mixed trees/forests stands best suited to an uncertain climate



Natural predator (ducks) was deployed to fight against snail-like pests.



# Conclusions

22

- ❑ Trees play many ecological roles including reducing the greenhouse effect.
- ❑ Young trees offset the atmospheric CO<sub>2</sub> more effectively than old trees.
- ❑ Converting old and dead wood into wood products or bio-energy further delays the greenhouse effect.
- ❑ Forest regeneration to community participation offers great economic benefit.

# Essay homework

23

Climate change leads to a new balance of tree ecosystem. Therefore selecting tree species to be planted along with a frequent monitoring are crucial to form a global knowledge with local identity.

Can you find some more possibilities of CC impact on trees? Please write some lines and send your answer to [ali.awaludin@ugm.ac.id](mailto:ali.awaludin@ugm.ac.id)