The Forests of Taiwan: New Opportunities for Biomass Utilization

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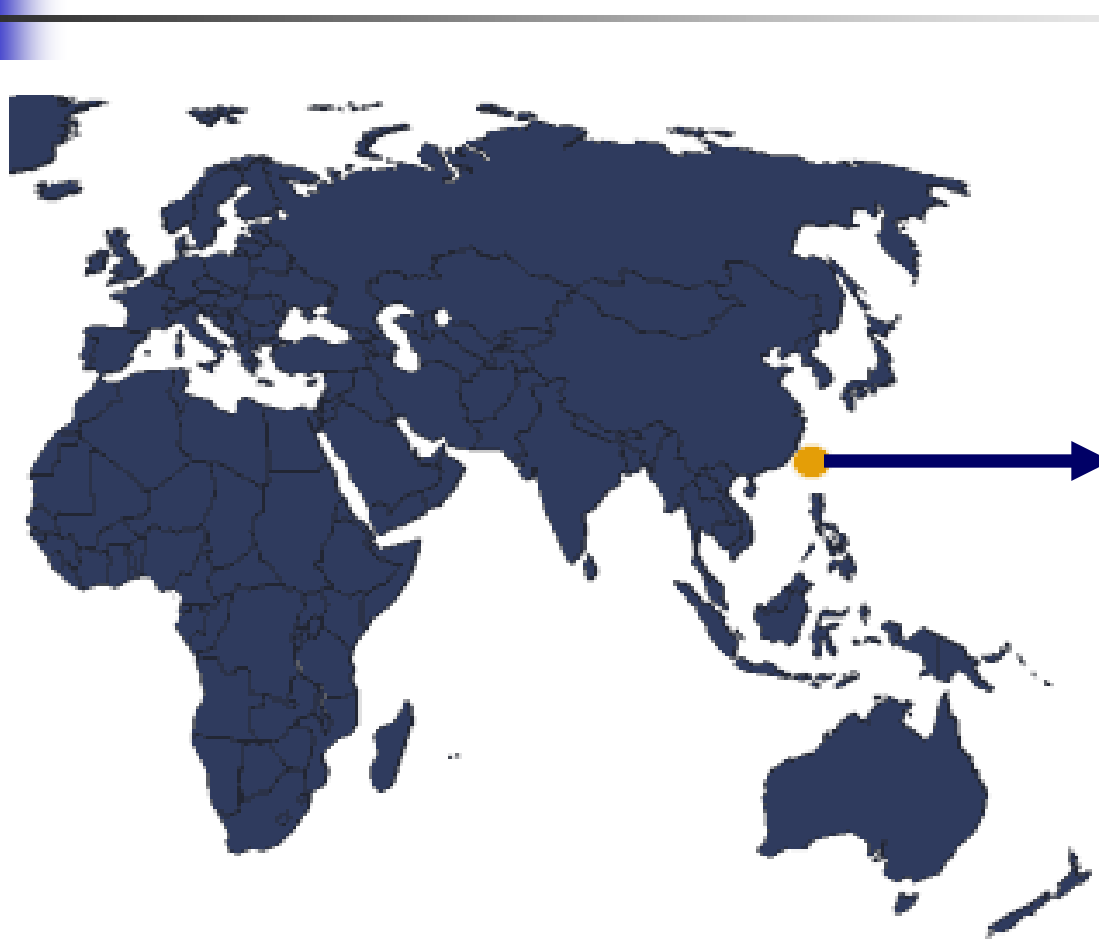
Where Is Taiwan?



Outlines

About Taiwan

About Taiwan’s forests

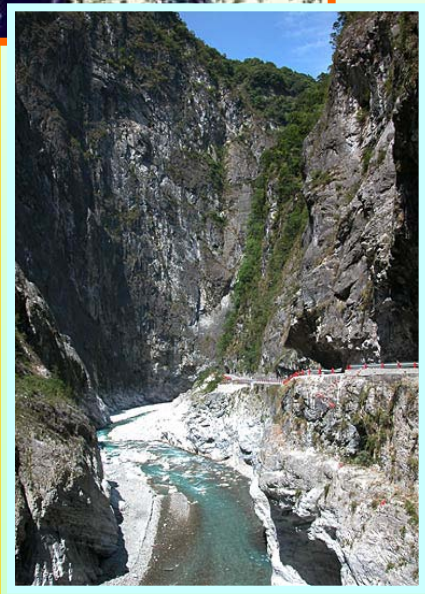
About my researches in past time

About my project in the WFI

Profile of Taiwan

- **Area :** 36,000 sq km (13,924 sq mi) (1/7 the size of Oregon)
- **Population:** 23 million (6 times the population of Oregon)
- **Capital :** Taipei city
- **Language :** Mandarin/Taiwanese/Hakka
- **Major Industries:** Machinery, textile, electrical equipment, electronic/computer goods

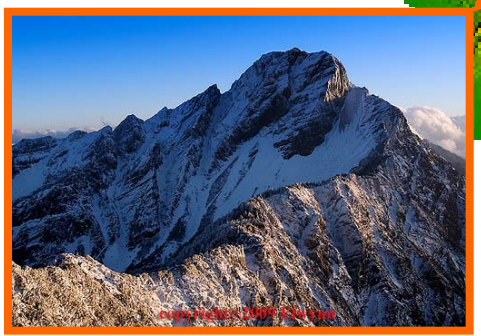
Geographic Characteristics

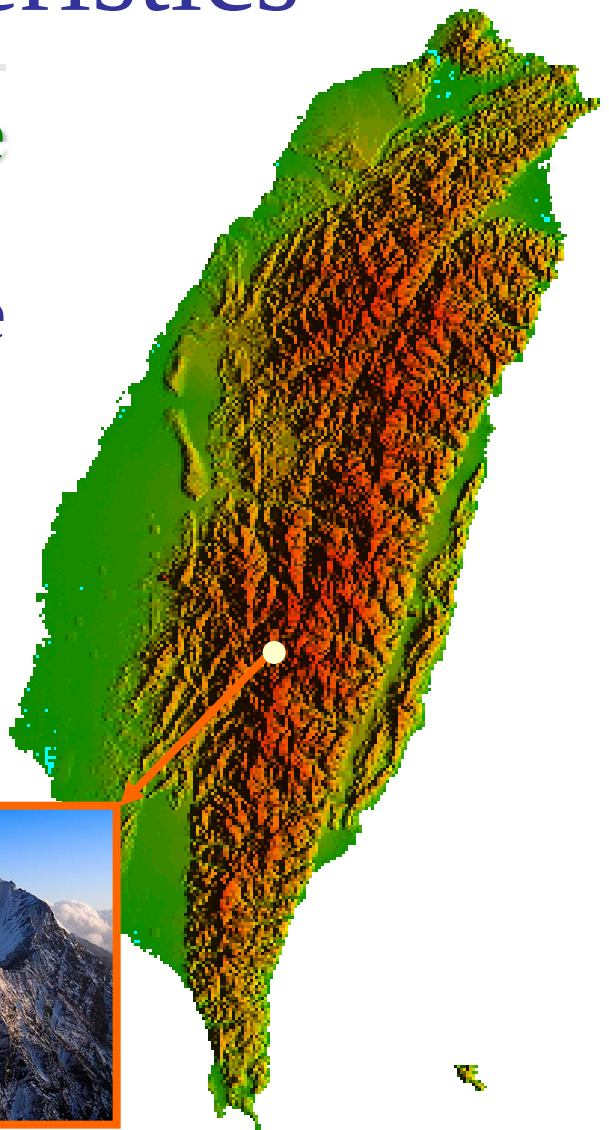


- Young island
- Located in active and intense plate tectonic movement area
- Seismic: frequent and powerful earthquakes
- Seasonal typhoons with torrential rainfall
- Temperature: >75°F
  Humidity: 80%
  Rainfall: 2500 mm (Portland: 950 mm)

Topographic Characteristics

- Central mountain stretches along the island from north to south
- 80% of the population resides on the west side plain
- Mountains over 3000 m (9850 ft) have 293 peaks
- Highest mountain peak: Yushan at 3,952 m (12966 ft) on the middle west side of island
  (also in Northeast Asia)





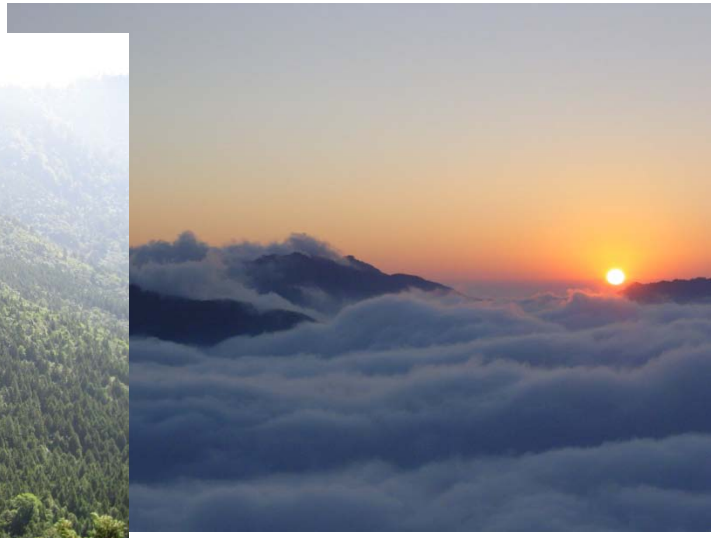
Biological Features

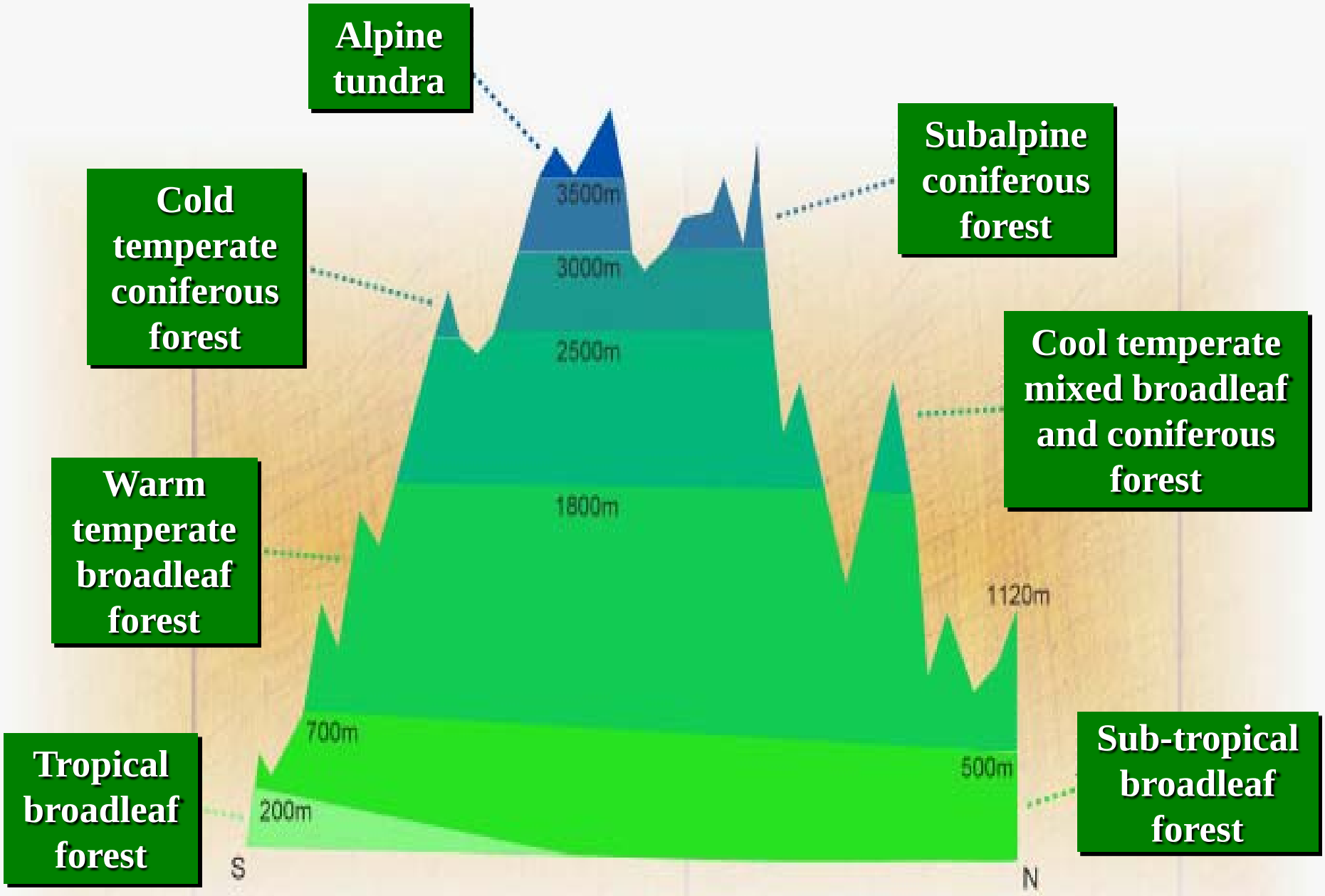
- Highly complex diversity
- Mammal: 100 species
- Bird: 456 species
- Reptilia: 98 species
- Fish: 2869 species
- Plant: 5738 species

Taiwan's Forests

- Vegetation coverage ratio: ca. 68%
- Forestland coverage area: ca.58%
  2.1 million ha (5.26 million acre)
- Possess major forest types in the world

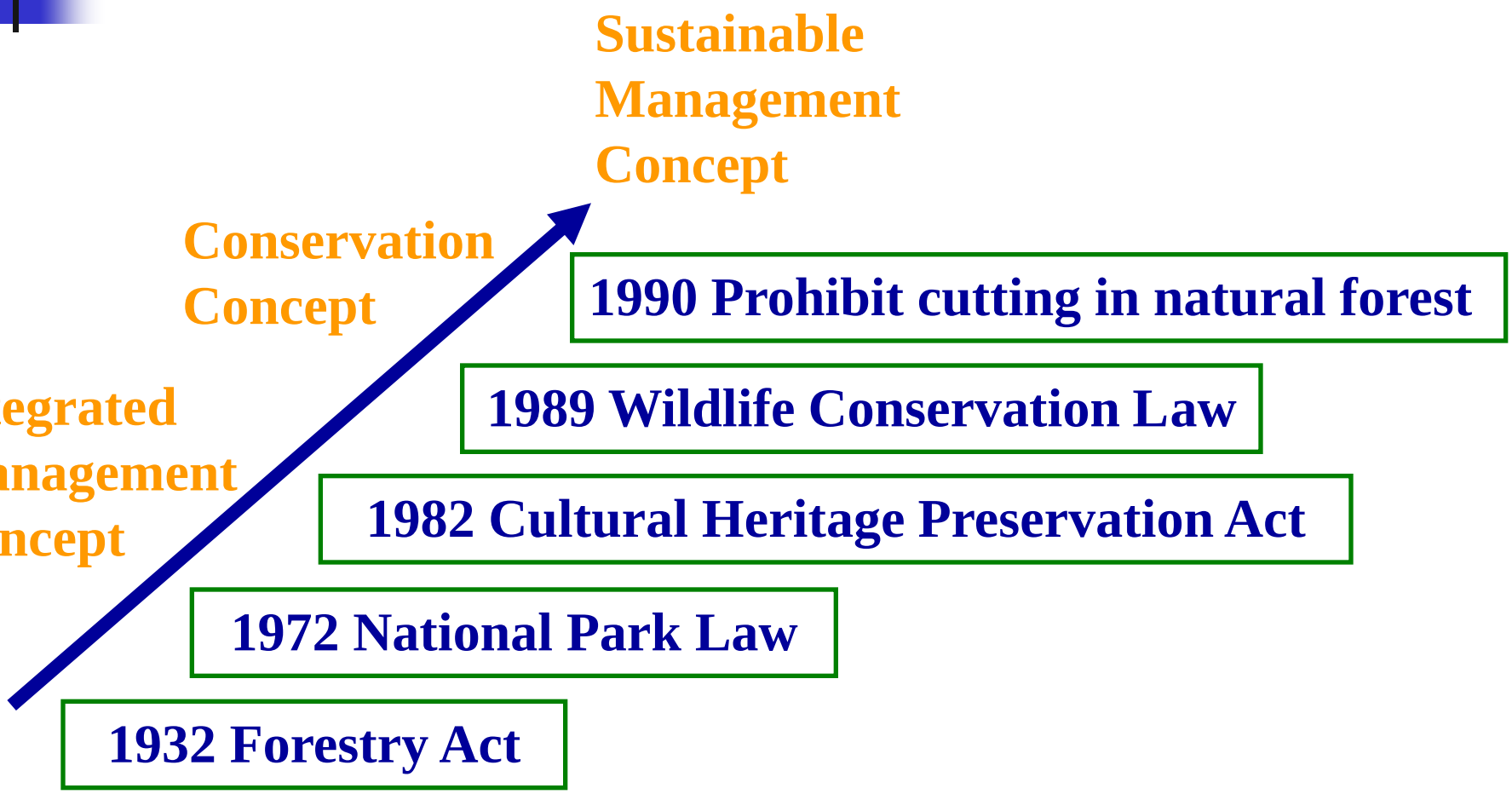




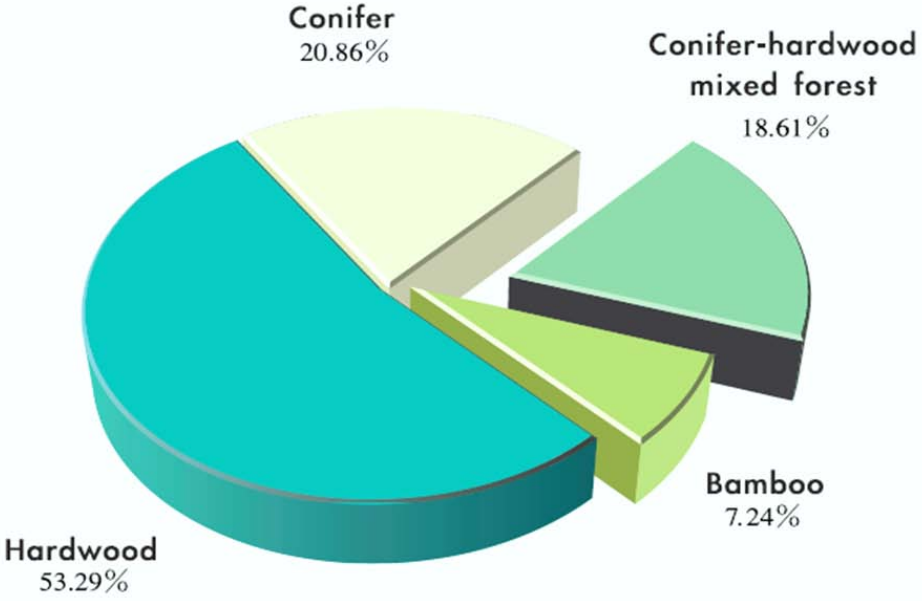


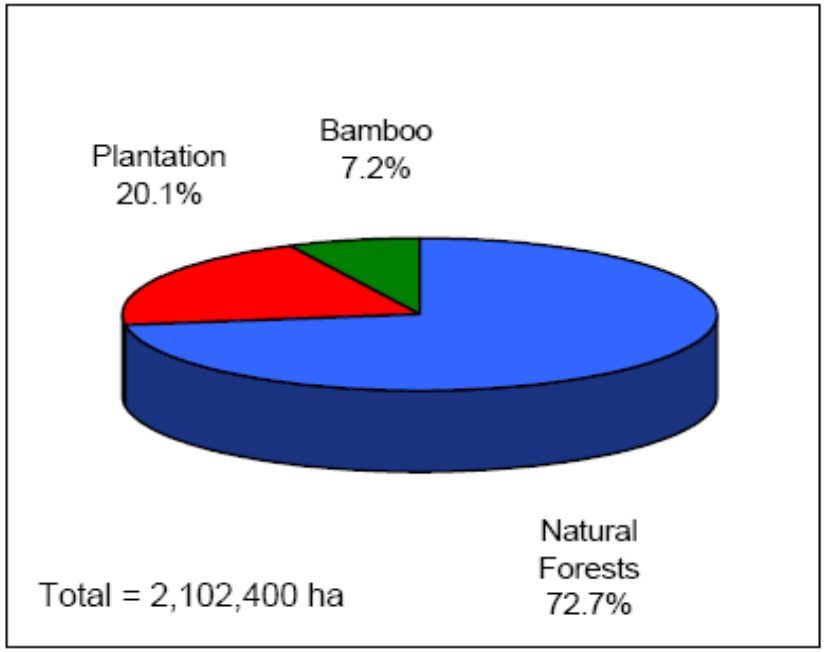
The Vertical Zonation of Forest Types in Taiwan

Forest Protection Laws

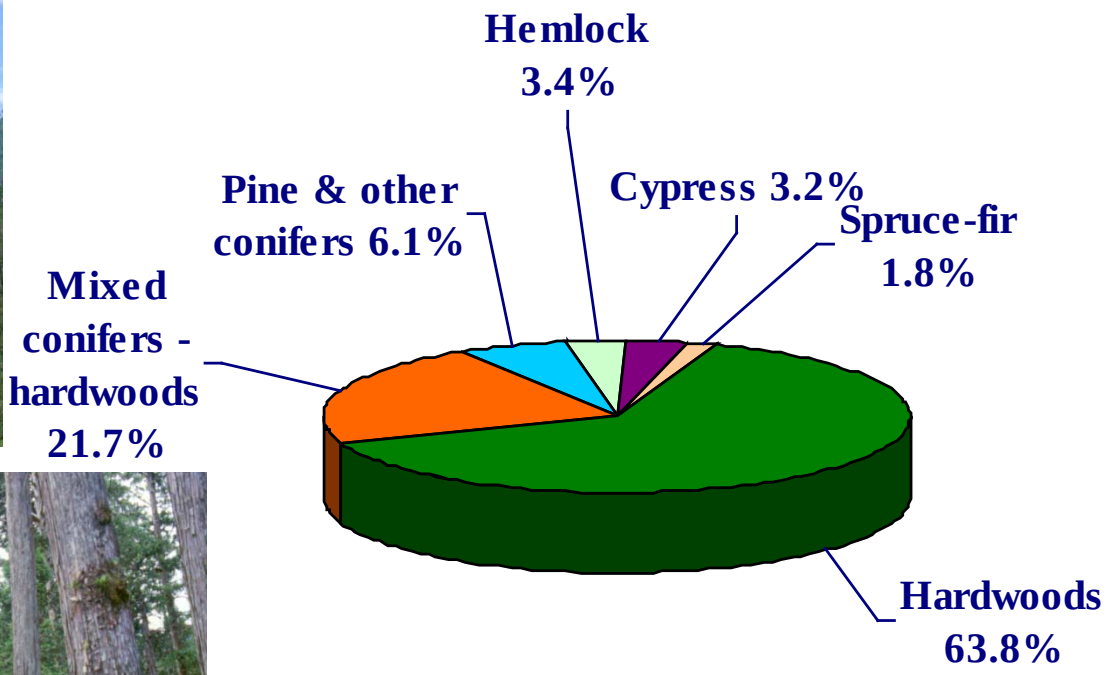


Forest types in Taiwan





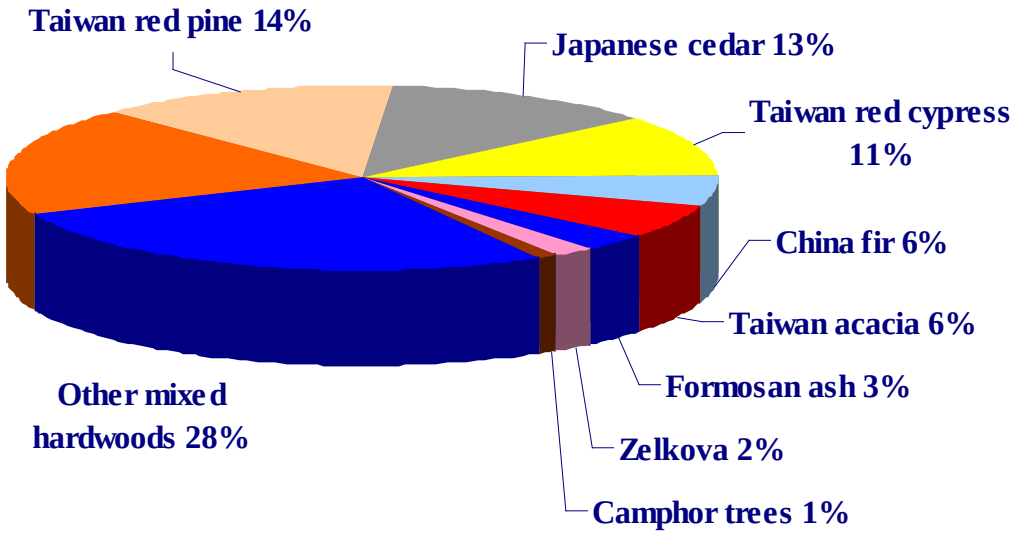
Main Natural Forests Species



Natural Forests Management

- **Goal:** productive restoration, biodiversity conservation, and ecological integrity maintenance
- **Measures:**
  - Setting up the study and monitoring sites under LTER project
  - Investigation and monitoring on succession mechanism
  - Silvicultural practices to stimulate natural regeneration
- **Strategies:**
  - Developing conservation management to alleviate disturbance effects of typhoon & land use change

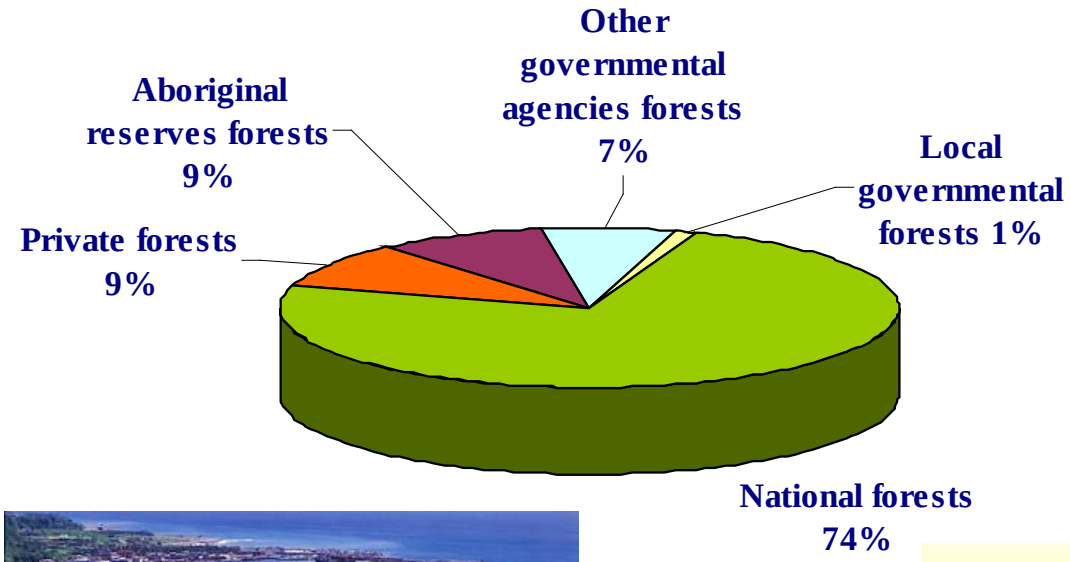
Main Plantation Species



Plantation Management

- **Goal:** productivity enhancement & sustainability maintenance in order to achieve a major resource for wood production, carbon offsets, amenities, water and soil conservation, etc.
- **Measures:** prunning, thinning, underplanting, snag & dead wood retention
- **Strategies:**
  - Adaptive Uneven-age management,
  - Prolonging rotation age (> 40 years at least)
  - Producing high grade wood for making value-added commodity

Forestland Ownerships



- National forests are governed by Taiwan Forest Bureau (TFB)
- Other governmental agencies are Taiwan Forest Research Institute, Universities, and Veterans Affairs Commission
- The average area of most private forestland only about 0.64 ha

Council of Agriculture
Executive Yuan
COA

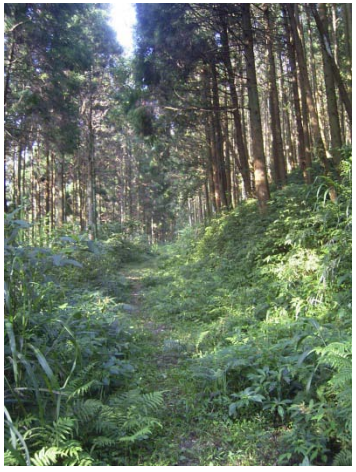
Taiwan Forestry
Research Institute
TFRI

- Botanical Garden Division
- Silviculture Division
- Forestry Economics Division
- Forest Management Division
- Watershed Management Division
- Forest Protection Division
- Forest Utilization Division
- Forest Chemistry Division
- Wood Cellulose Division
- Technical Service Division
- Fushan Research Center
- Lienhuachih Research Center
- Chungpu Research Center
- Liouguei Research Center
- Hengchun Research Center
- Taimalee Research Center
- Secretariat Office
- Accounting Office
- Personnel Office
- Ethics Morality Office

10 Divisions

6 Research Centers

4 Administrative units



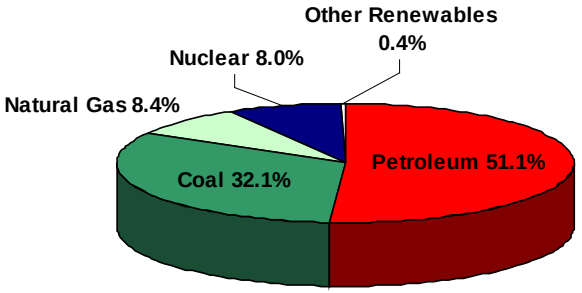
My Researches in Past Time

- Calculated the carbon sequestration of the economic trees and bamboos in Taiwan
- Organized a research team to help bamboo farmers constructed earth kilns and to teach them produced high value bamboo charcoal
- Researched production and properties of wood charcoal from forest residues of softwood (Biochar)
  (Biomass&Bioenergy 33(9): 1289-1294)
- Researched the production process improvement of wood charcoal with earth kiln (gained patent of Taiwan)

My Project in the WFI

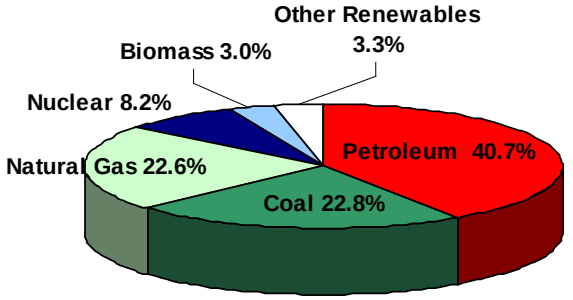
- Explore the development of biomass utilization in USA

Taiwan Energy Consumption by Fuel Type
2007



Source: Taiwan Bureau of Energy, MEA (2008)

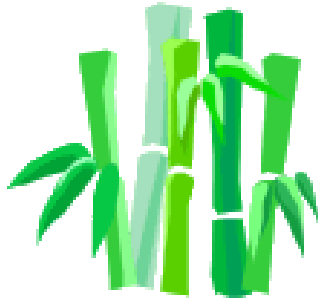
U.S. Energy Consumption by Fuel Type
2005



Source: U.S. Department of Energy, EIA (2006)

My Project in the WFI

- Explore the development of biomass utilization in USA
- Combine the appropriate technologies here and our native resources to find a new way of biomass utilization for Taiwan
- Learn the successful extension experience of biomass utilization in USA
- The results will emphasis on the actual benefits for locate community during the processing



Bioindustry in USA

Bioenergy: for heat and electricity

materials: firewood, chips, wood pellets

Biofuels: ethanol, biodiesel

materials: chips, wood fiber

Biobased products: compost, post and pole, wood plastic composites, erosion control products, shavings for animal bedding, and other traditional products

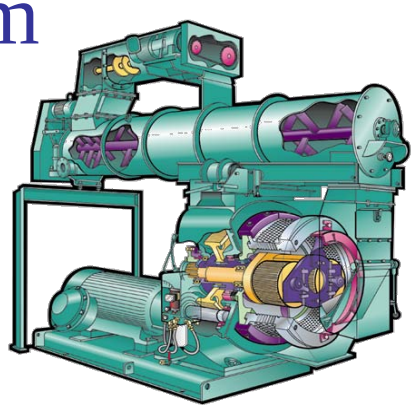
Why Use Bamboo?

Bamboo is:

- Fast growing
- Easy and cost inexpensive to harvest
- Abundant bamboo resources for supply

Why Choose Pellets?

- Less technical requirement
- Low capital investment
- Less environmental impacts
- High market potentiality
- Feasible to develop local energy system with pellet boilers



What Is Bamboo?

Woody grasses

Almost stems or culms with hollow

Attaining stand maturity within 5 yr

Usually flowering only once in life

Propagation by vegetative method: cutting from culm, branches or rhizome

Distribution elevation: 0-13,000 ft

Height of bamboos: 4 in - 130 ft

Bamboo Applications

Construction and reinforcing fibers

Paper, textiles and board

Craft products for living

Combustion provide energy

Food (bamboo shoot)

Bamboo Classification

Species: World: 1250 species within 75 genera

Asia: 1000 species

Taiwan: 85 species

Sympodial (clumped)

Monopodial (spreading)

Taiwan's Bamboo Resource

Total area: 152,000 ha (ca. 375,601 acre)

Main species:

Phyllostachys pubescens (Mosa bamboo) ⇨ 3.1%

Phyllostachys mainoi (Makino bamboo) ⇨ 52.5%

Dendrocalamus latiflorus (Ma bamboo) ⇨ 24.1%

Bambusa oldhamii (Green bamboo) ⇨ 4.8%

Bambusa stenostachya (Thorny bamboo) ⇨ 10.6%

Bambusa dolichoclada Hayata (Long-branch bamboo) ⇨ 4.9%

Potential Benefits

- To enhance bamboo resource utilization
- To increase bioenergy use
- To reduce emission of carbon dioxide
- To create job opportunities in communities



Challenges

- Properties of bamboo pellets are unknown
- Amount of bamboo resources need updated
- Need to adapt wood pellet manufacture process to bamboo pellet
- Need supportive policy incentives



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TAIWAN FORESTRY RESEARCH INSTITUTE

WORLD FORESTRY CENTER