

Sustainable Forest Utilization Concepts in Central Europe – A Model for the World?.

Prof. Dr. Dr. h.c. Gero Becker
Chair of Forest Utilization

Alumni Summerschool | July 21, 2014

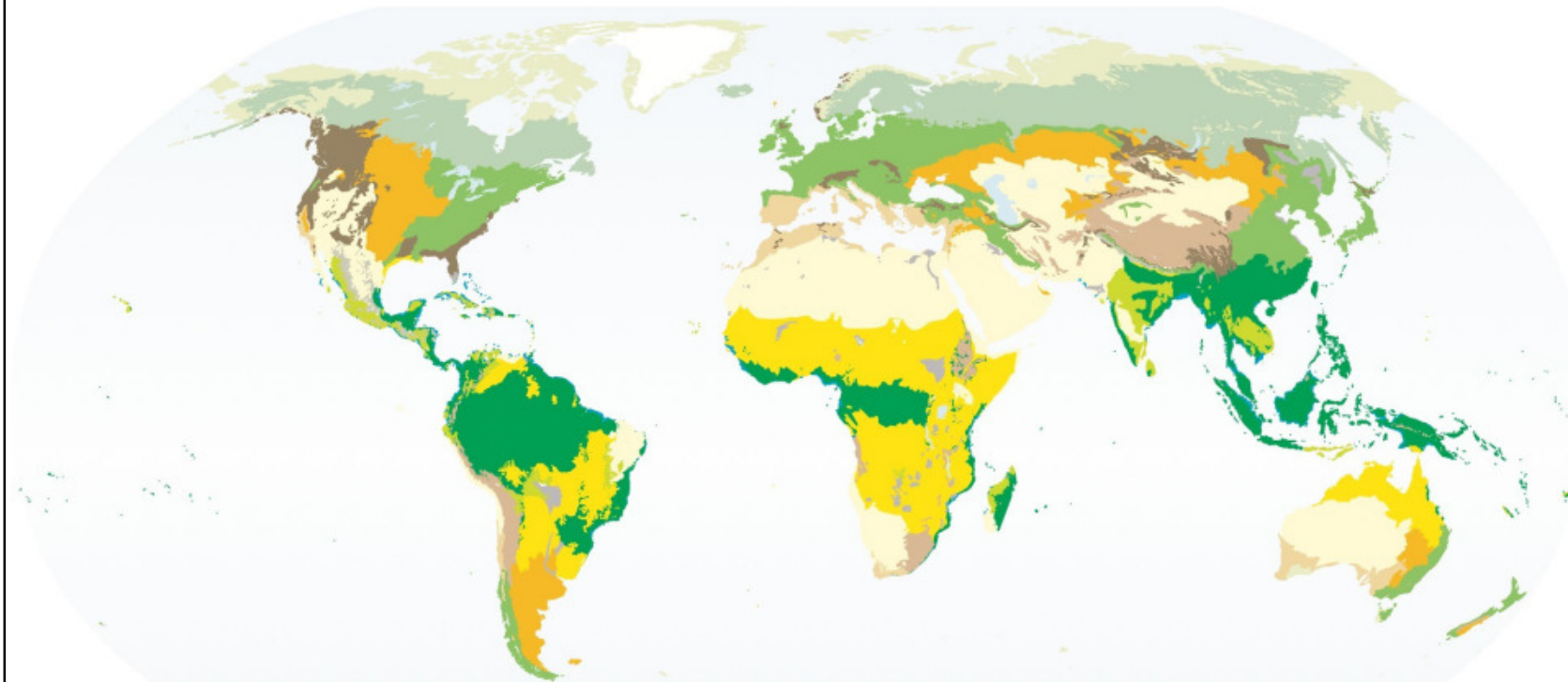
Albert-Ludwigs-Universität Freiburg

UNI
FREIBURG

Learning Objectives

- Gaining knowledge on different forest/ wood resources worldwide and their importance for wood supply
- Get to know about the global importance of major forest/ wood products

Distribution of World Forest Types



Biomes

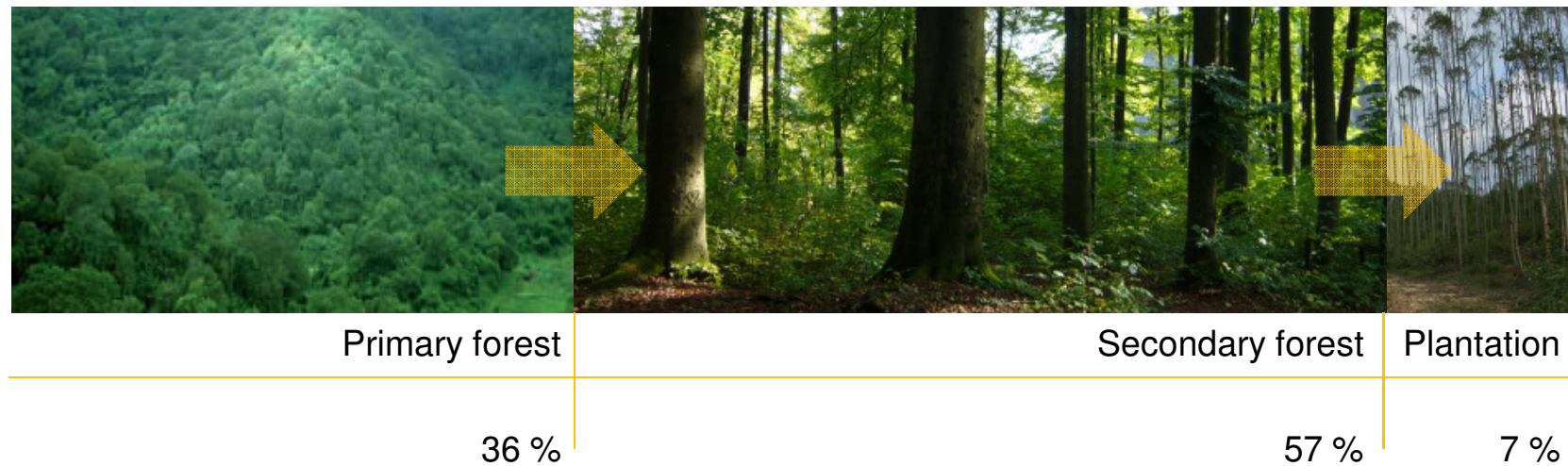
- Tropical and sub-tropical moist broadleaf forest
- Tropical and sub-tropical dry broadleaf forest
- Tropical and sub-tropical coniferous forest
- Temperate broadleaf and mixed forest
- Temperate coniferous forest
- Boreal forest / Taiga
- Tundra
- Mediterranean forest, woodland, and scrub

Source: MA 2005. Map designed by Emmanuelle Bournay, Paris.

- Tropical and sub-tropical grassland, savanna, and shrubland
- Temperate grassland, savanna, and shrubland
- Montane grassland and shrubland
- Flooded grassland and savanna
- Mangrove
- Desert and xeric shrubland
- Rock and ice

source: UNEP, 2012

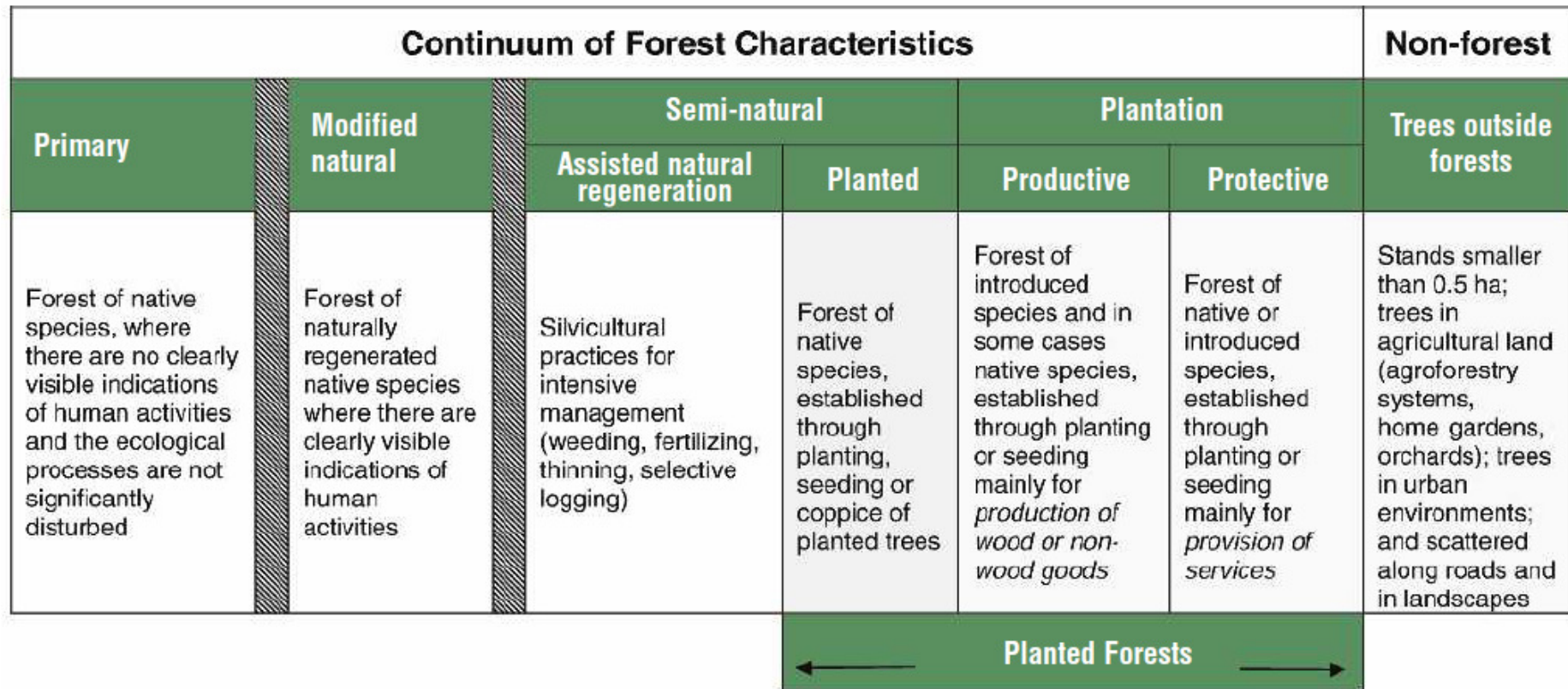
Forest Situation in 2010



- Slight drifts from **primary forests** towards **modified natural forests** and towards **plantations**
- Forest composition varies between **climate zones**
- Forest composition is depending on **management scenarios**,
unmanaged – continue cover management – clear cut management

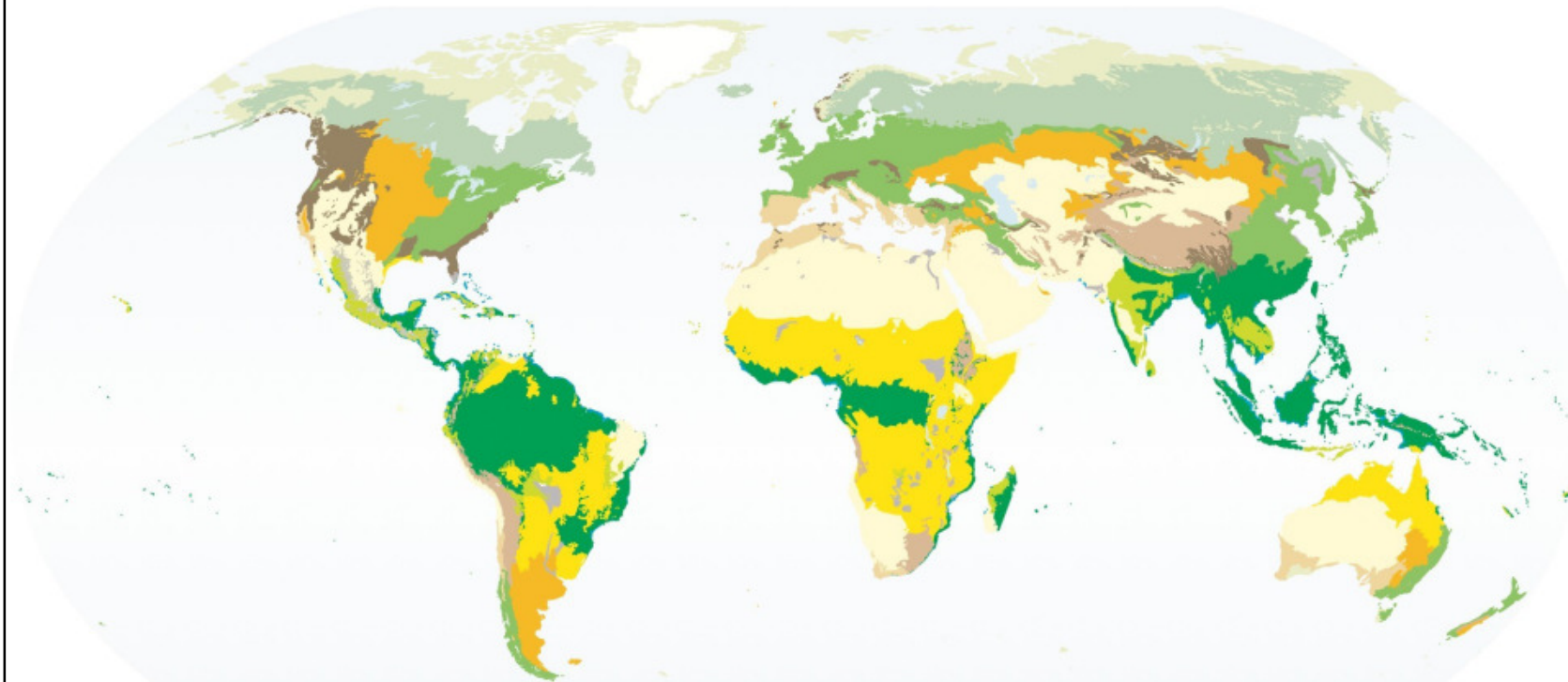
Source: FAO, 2010

Scope and Concept of Planted Forests



Source: Carle (2008); FAO (2006)

Distribution of World Forest Types



Biomes

- Tropical and sub-tropical moist broadleaf forest
- Tropical and sub-tropical dry broadleaf forest
- Tropical and sub-tropical coniferous forest
- Temperate broadleaf and mixed forest
- Temperate coniferous forest
- Boreal forest / Taiga
- Tundra
- Mediterranean forest, woodland, and scrub

Source: MA 2005. Map designed by Emmanuelle Bournay, Paris.

- Tropical and sub-tropical grassland, savanna, and shrubland
- Temperate grassland, savanna, and shrubland
- Montane grassland and shrubland
- Flooded grassland and savanna
- Mangrove
- Desert and xeric shrubland
- Rock and ice

source: UNEP, 2012

Natural Tropical Forests

Characteristics in a nutshell

- Uneven in tree height and age distribution
- Many mixed species
- Permanent cover
- Natural regeneration (enrichment planting)

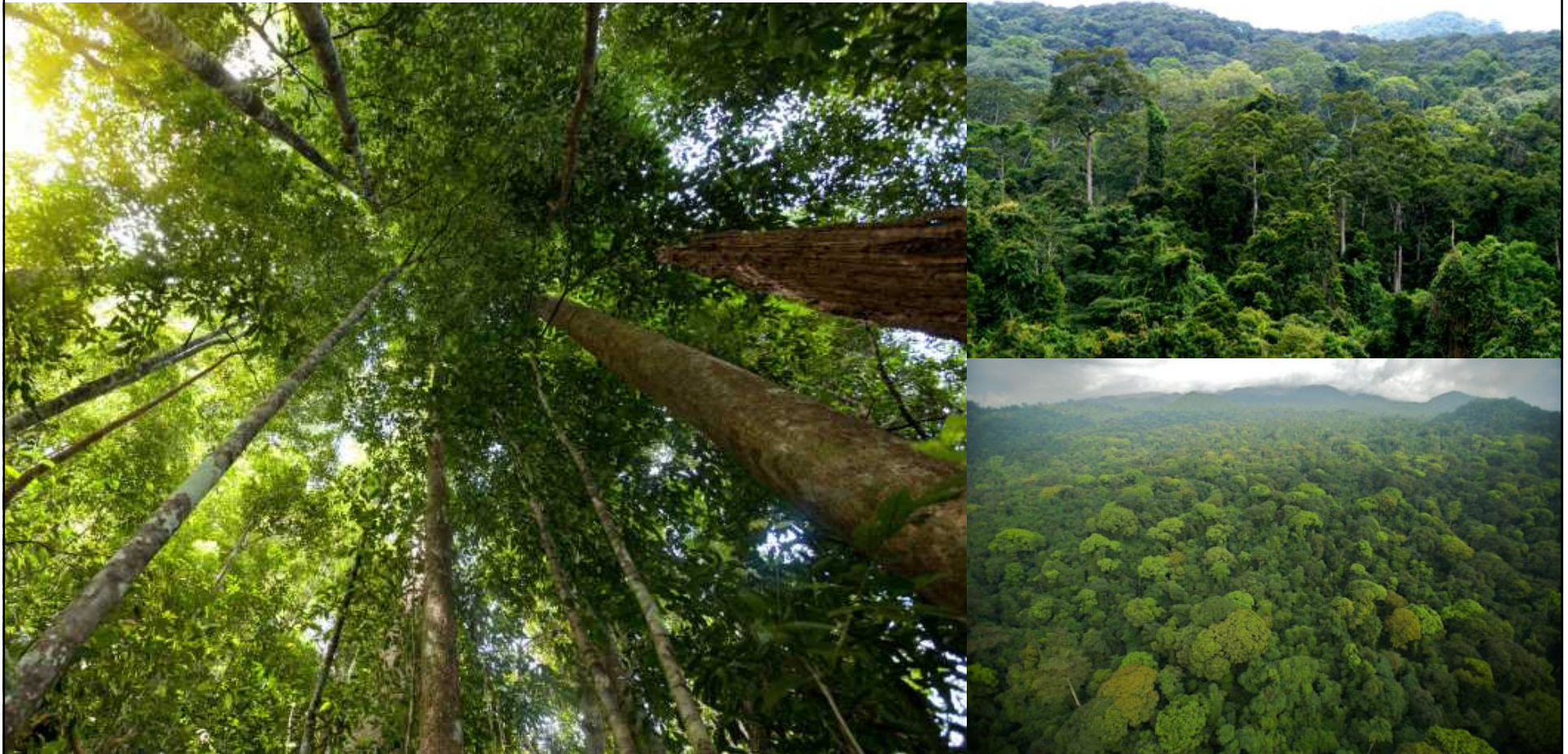
Harvesting methods

- Selective cuts of only mature trees (poly-cyclic)
- Frequent thinning, selective cuts of all dimensions; target diameter



Picture: The Earth Time 2014

Natural Tropical Forests



Picture: The Earth Time 2014; Zhu Hua 2008; Tropical Forest and Climate Coalition 2014

Conventional Logging in Natural Tropical Forests



Selective Cuts in Natural Tropical Forests

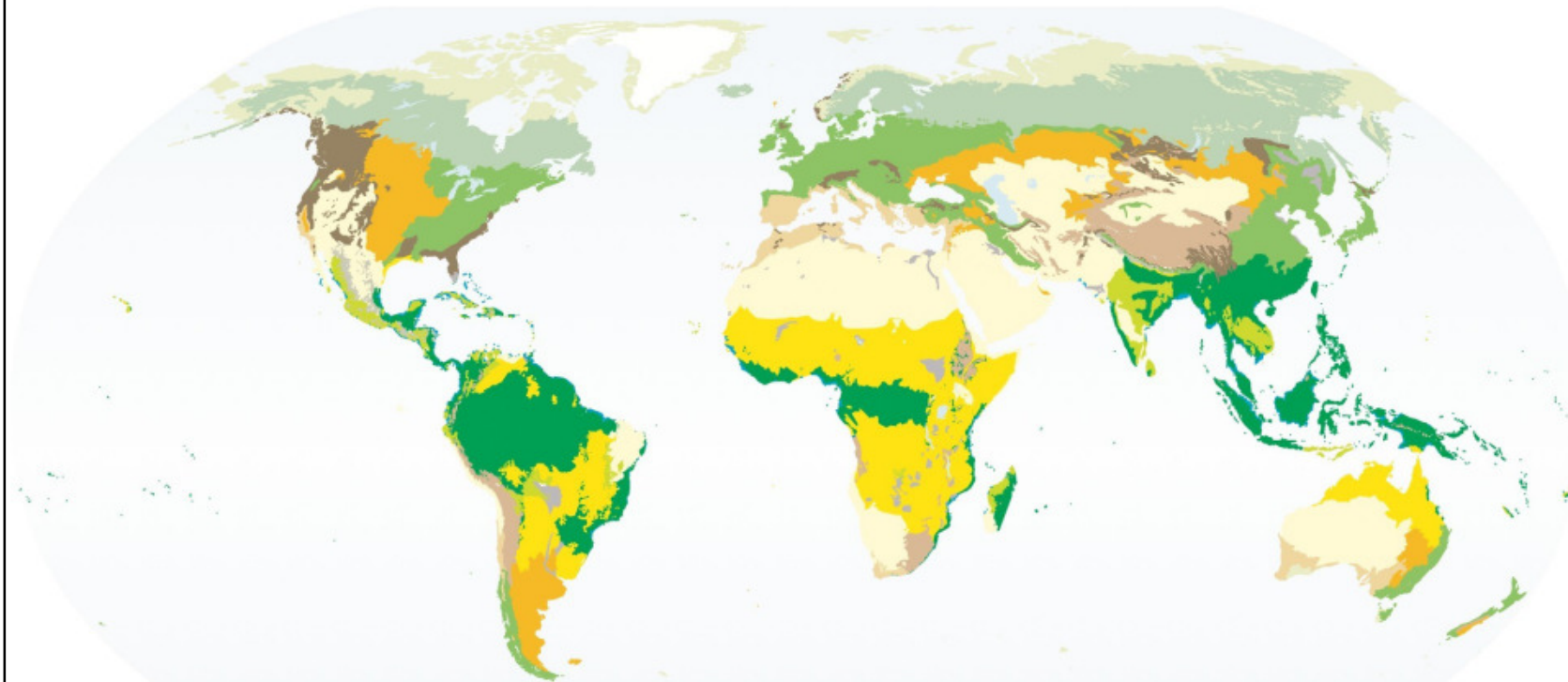


- Results in permanent forest cover, giving space (light) to next generation
- Continuous Cover Forestry (CCF)

Lit+ Mason, B., Kerr, G., Simpson, J. (1999):
What is Continuous Cover Forestry?

Picture: Hicham Daoudin, Flickr, 2012

Distribution of World Forest Types



Biomes

- Tropical and sub-tropical moist broadleaf forest
- Tropical and sub-tropical dry broadleaf forest
- Tropical and sub-tropical coniferous forest
- Temperate broadleaf and mixed forest
- Temperate coniferous forest
- Boreal forest / Taiga
- Tundra
- Mediterranean forest, woodland, and scrub

Source: MA 2005. Map designed by Emmanuelle Bournay, Paris.

- Tropical and sub-tropical grassland, savanna, and shrubland
- Temperate grassland, savanna, and shrubland
- Montane grassland and shrubland
- Flooded grassland and savanna
- Mangrove
- Desert and xeric shrubland
- Rock and ice

source: UNEP, 2012

Boreal Natural Forests

Characteristics in a nutshell

- +/- even aged, large homogeneous areas
- Non-permanent forest cover due to e.g. fire, diseases
- Natural regeneration by seeds

Harvesting methods

- Periodic clear cuts (or removal except seed trees) of all tree dimensions

Note+ CCF: continuous cover forestry
CNF: close to nature forestry

Lit+ FAO (2006): Global planted forests thematic study



Picture: forestfriendly500.org, 2013

Fire Dynamic in Boreal Forests



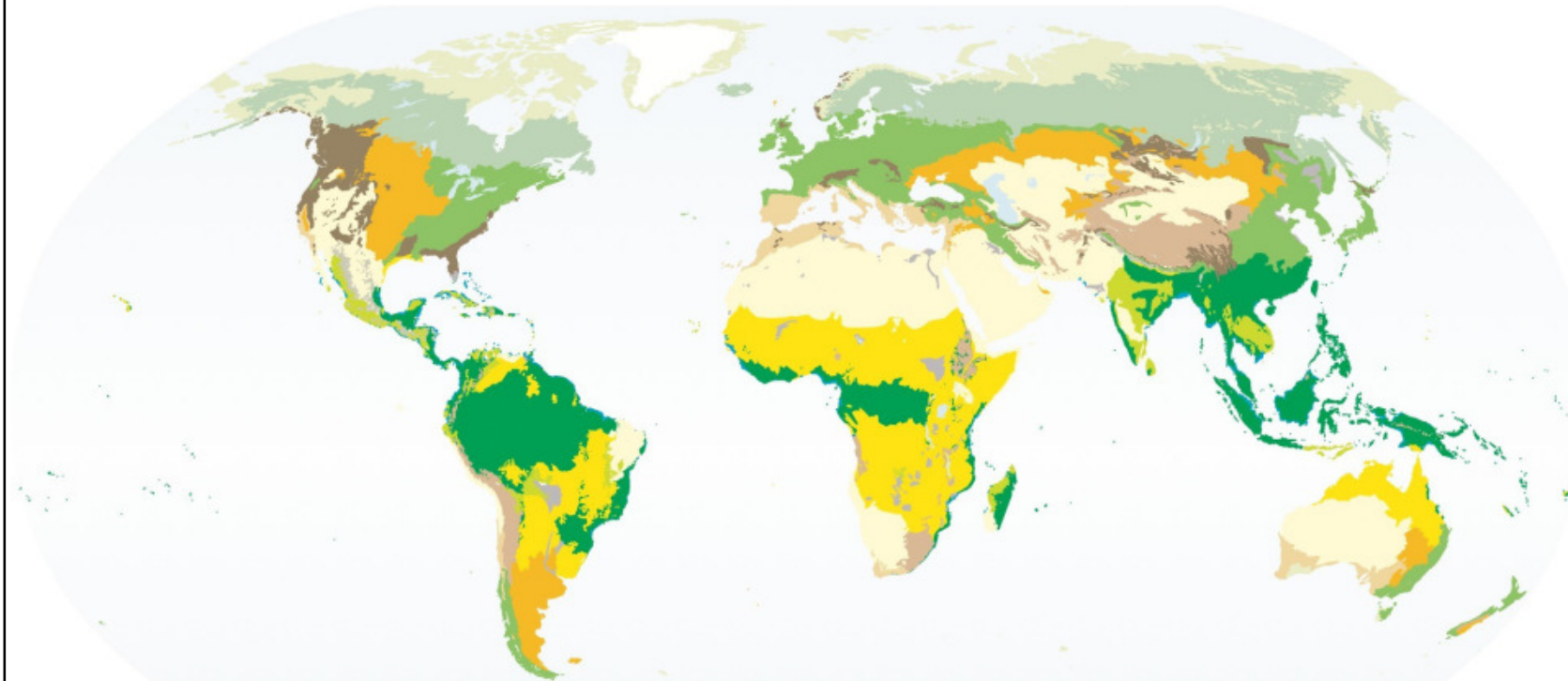
Seed Tree Cuts in Finland



- Harvesting operations ‘simulate’ natural calamity
- Seed trees for natural regeneration or planting of new trees is obligate
- Even when its named **Close to Nature Forestry**, harvesting operations are similar to Plantation Forestry

Picture right: Valmet, 2008

Distribution of World Forest Types



Biomes

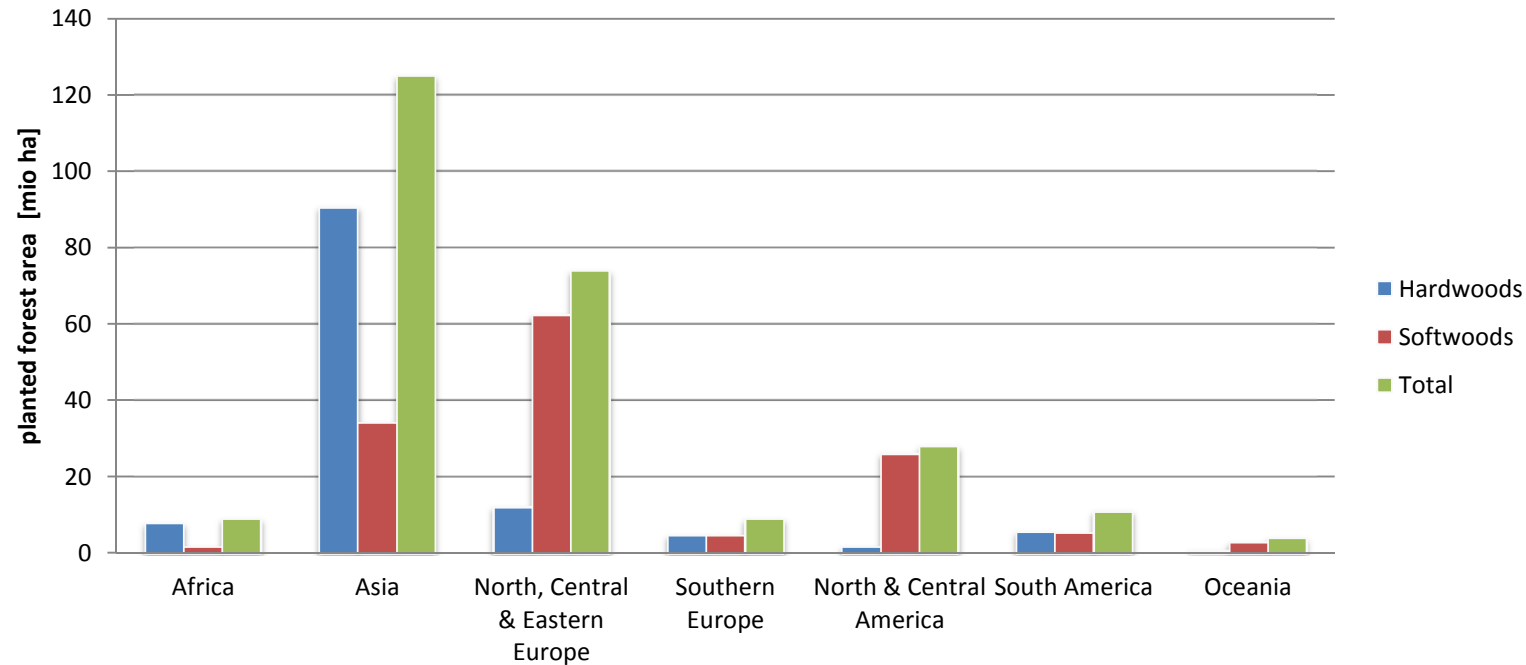
- Tropical and sub-tropical moist broadleaf forest
- Tropical and sub-tropical dry broadleaf forest
- Tropical and sub-tropical coniferous forest
- Temperate broadleaf and mixed forest
- Temperate coniferous forest
- Boreal forest / Taiga
- Tundra
- Mediterranean forest, woodland, and scrub

Source: MA 2005. Map designed by Emmanuelle Bournay, Paris.

- Tropical and sub-tropical grassland, savanna, and shrubland
- Temperate grassland, savanna, and shrubland
- Montane grassland and shrubland
- Flooded grassland and savanna
- Mangrove
- Desert and xeric shrubland
- Rock and ice

source: UNEP, 2012

Planted Forest Area by Region



- Planted forests account **261 mio ha** (total) in 2005
- Depending on scenario, area could increase up to **345 mio ha** in 2030

source: Carle, 2008

Significance of Plantation Forestry

- Plantation area was **187 mio ha** in 2000, **equ. 5 %** of global forest area *(FAO, 2000)* and **263 mio ha** in 2005 *(Carle, 2008)*
- Plantations account of **35 % of the worldwide wood supply** *(FAO, 2000)*
- Global **industrial roundwood production** in 2005 was **1.8 billion m³** in 2005 *(FAO, 2005)*
- Wood for industrial use available from plantations in 2005 was **1.2 billion m³** ... potentially **66 %** *(Carle, 2008)*
- In 2020 plantation could supply 44 % of worldwide wood demand *(FAO, 2000)*
- Scenario of 80 % industrial roundwood supply *(Carle, 2008)*



Plantations in Tropical Regions



Characteristics in a nutshell

- Monocultures
- Rotation length 7 – 20 years
- Reforestation of degraded land
- Focusing of machine accessible sites
- Steep terrain: secondary natural forests
- **Strong cooperation with local people**, e.g. planting of crop trees

Harvesting methods

- Clear cuts

Picture: Stora Enso, 2007

Plantation Management: Pulp & Paper

- Short rotation periods, 5 – 10 years
- Wood quality is less of importance
- Minimized silviculture management within growth period
- Use for: Pulp and paper; plywood; particle board; new for energy (direct combustion or pellet production)



Picture: timber-online.net, 2014; Nutto, 2009

Plantation Management: Quality Wood

- Medium rotation periods, 10 – 25 years
- Wood quality is of high importance
- Silviculture management, e.g. **pruning and thinning**, to **increase wood quality**
- Use for: Sawmilling industry (sawlogs; furniture)



Picture: TEAK HOLZ INTERNATIONAL AG, 2014

Plantation Management: Special Purposes

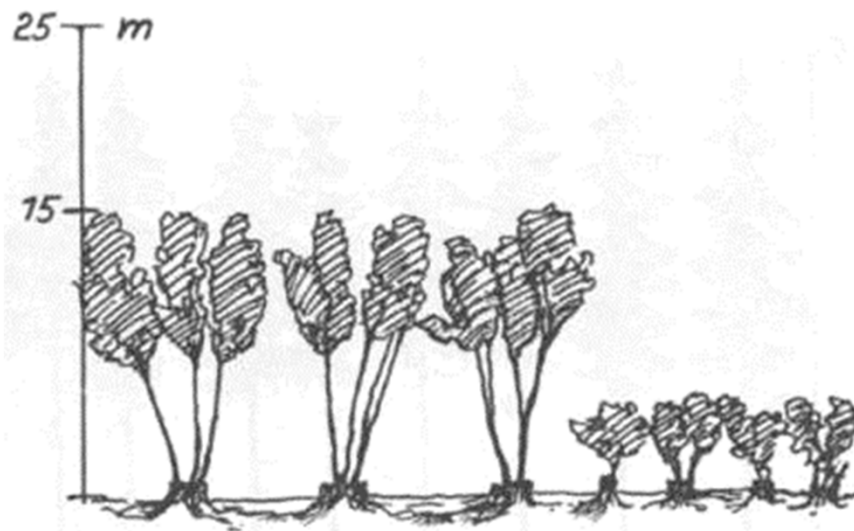
- Different rotation periods
- Multiple use of trees, therefore **wood quality might be of less of importance**
- Use for: e.g. Resin and (poor quality) sawlogs



Picture: Nutto, 2009

Coppice Forests

- 1 - 2 species
- Short rotation
- Natural regeneration by shoots after cutting
- Clear cut of medium size areas



Influence on Forest Management and Harvesting Methods

Natural Conditions

- Site (soil, climate)
- Terrain and accessibility
- Species composition
- Age, rotation period
- Tree dimension
- Wood quality

Socio-Economic Conditions

- Land owner objectives
- Laws and regulations
- Market demands
 - Local
 - Regional
 - National
 - International
- Available capacities/ resources
 - Land
 - Capital
 - Labor
 - Infrastructure

Harvesting Alternatives

- Full trees
- Tree length, stem, long logs
- Short logs (standard length)
- Chips, bundles (residues)



Picture: aelf-mb.bayern.de; www.aelf-ka.bayern.de, 2010

Harvesting Systems

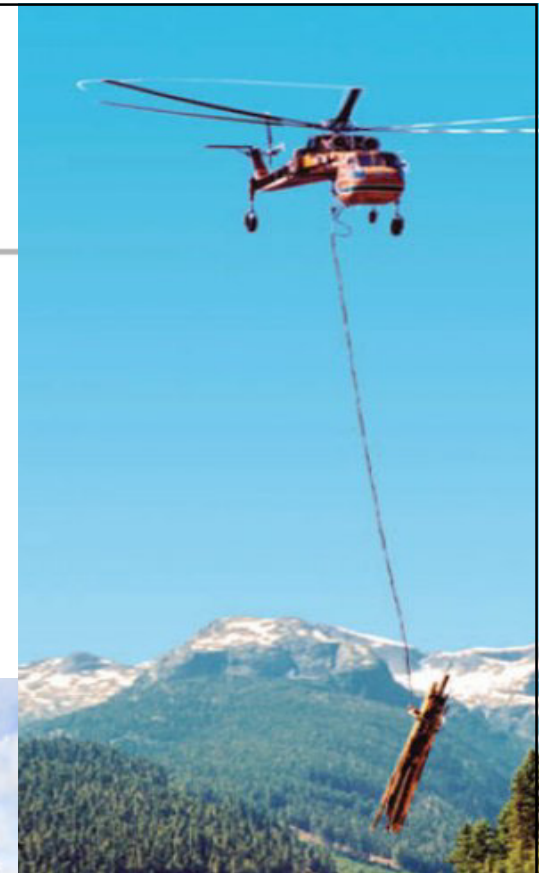
- Motor manual: chain saw; animals
- Semi-mechanized: chain saw; tractor with winch
- Full-mechanized (CTL): harvester; forwarder



Picture: Valmet 2010; Ponsse 2010; v. Tuong 2012

Harvesting Systems

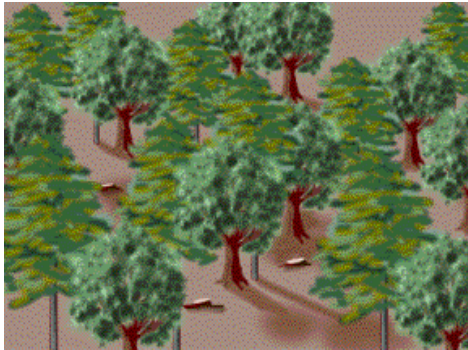
- Cable systems (mountain, soft terrain)
- Helicopter logging
- Chipping and bundling systems



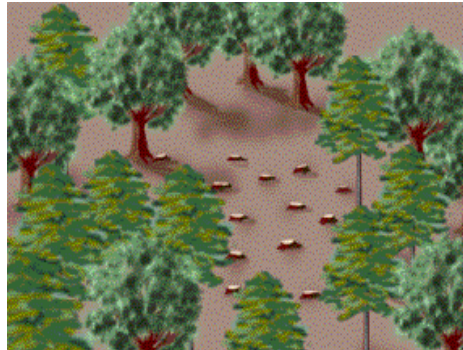
Picture: www.quiramlogging.com, 2010

Definition of Timber Harvesting

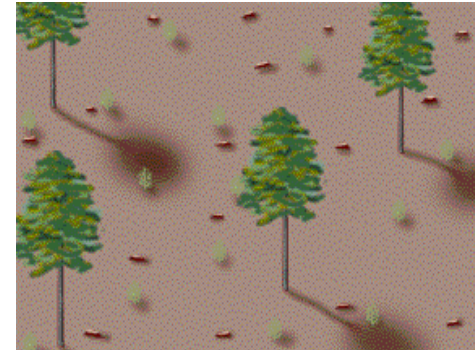
Harvesting method: describes the intensity of wood removals



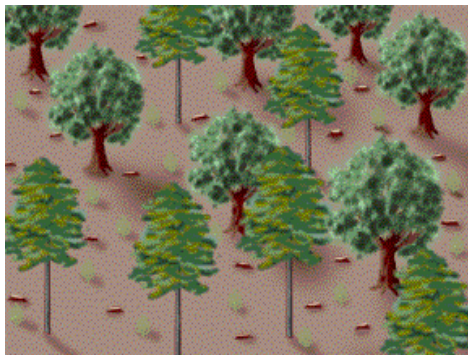
Single-tree selection



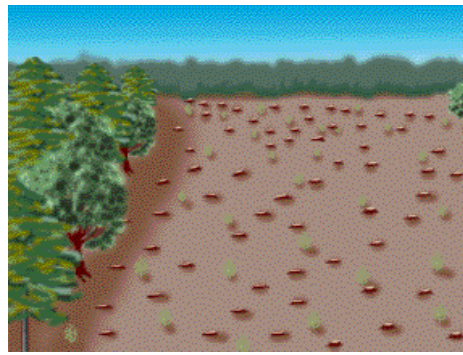
Group selection



Seed tree



Shelter wood



Clear cut

Source: <http://maineforestry.net> 2012

Definition of Timber Harvesting

Felling



Processing



Extraction



Skidding

Forwarding

Planning of Harvesting Operations: Harvesting System



Felling and processing?

- Harvesting system selection
- **Which Criteria to decide?**



Skidding?

Selection of Harvesting Systems: Constraints



Constraints on harvesting systems

- Stand
- Terrain
- Forest access
- Externalities

Selection of Harvesting Systems: Constraints



Additional constraints on harvesting systems

- Natural (terrain, climate)
- Silviculture (stand)
- Company (capital, man-power)
- Economy (markets, costs, prices)
- Society
- Laws, regulations

Selection of Harvesting Systems: Constraints

Grouping of constraints/ criteria for selection of harvesting systems

- Ecology
- Economics
- Occupational health and safety, ergonomics
- Technical feasibility
- Planning and organization
- Social acceptance

Selection of Harvesting Systems: Ecology

Ecology

- Impact of harvesting system on the ecosystem, e.g.
 - Soil
 - Water
 - Air
 - Flora/ fauna
 - Noise
 - CO₂ emissions

- Eco-efficiency
- Water-footprint



Source: Fotolia 2012

2. Selection of Harvesting Systems: Tree Damages



Ecology

- Damages to residual stand

Selection of Harvesting Systems: Soil Disturbance



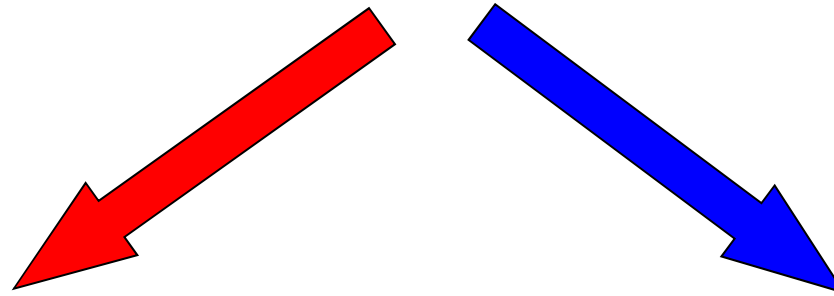
Ecology

- Soil disturbance

Source: Jaeger 2013

Harvesting Systems

Harvesting systems



felling and processing

Manual felling

partly-mechanized

e.g. cable support

fully-mechanized

e.g. CTL with single grip harvester

skidding methods

ground-based

e.g. skidder, forwarder

cable-based

e.g. cable crane, yarder, helicopter

Harvesting Systems and Machines: Mechanization

Felling and processing

Manual



Mechanization



Mechanized

Source: Jaeger 2013

Harvesting Systems and Machines



Wheel harvester

Harvester



Track harvester

Harvesting Systems and Machines



Wheel harvester

Harvesting Systems and Machines



Large-sized track
harvester
(excavator chassis)

Harvesting Systems and Machines



Excavator with
harvester head

Harvesting Systems and Machines



Wheel harvester

Harvester



Track harvester

Harvesting Systems and Machines



Track harvester
(4 tracks)

VALMET 911.1
SNAKE

Harvesting Systems and Machines



Walking-wheel-
harvester

MENZI MUCK

Harvesting Systems and Machines

Slope forwarder with cable winch FORCAR FC 200

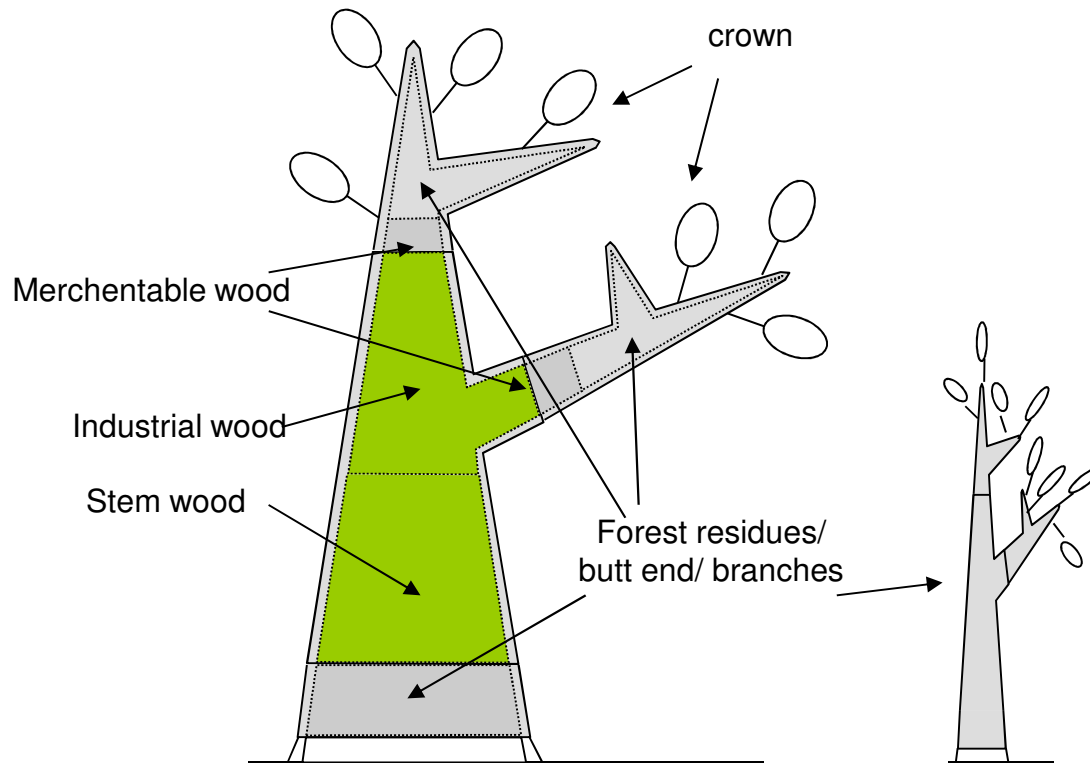


Harvesting Systems and Machines



Pre-Skidding by horses

Tree Assortments



Stem wood

Industrial wood

Forest residues

Sawmill industry, furniture industry

Particle board-, paper-, pulp industry
(bioenergy)

Bioenergy

Resources of Forest Biomass

- Ligno-cellulosic biomass from forestry – **Forest residues**, better **forest energy/ fuel wood**



Crown biomass/ from thinning

- Biomass that can't be material used
- Often with full mechanized harvesting/ cable logging
- Additional assortment for forest owner
- Usually wood chips

Split logs

- Length: 33 cm; 100 cm
- Most important assortment, esp. for hardwoods

Picture: Suchomel, 2009

Resources of Forest Biomass

- Ligno-cellulosic biomass from forestry – **Roots, stumpages**



Stumpages

- Digging off roots before replanting
- Typically full mechanized work process
- Huge ratio of dirt, sand and earth, within biomass
- Not common in Central Europe
- Common in Scandinavia and North America

Picture: Flechsel, 2012

Additional Ligno-cellulosic Biomass Resources

- Ligno-cellulosic biomass of non-forest production



Landscape conservation material

- Often of 'anyway management' – less importance of costs
- Usually low level of mechanization

Short Rotation Coppice

- Plantation type with product for energy use only
- Often on degraded land
- Basically highly mechanized work
- Less of importance in Germany

Additional Ligno-cellulosic Biomass Resources

- Ligno-cellulosic biomass from industry – **Sawmill residues**



Sawmill residues

- Untreated wood from sawmills: Solid wood and sawdust
- Usually used for pelletizing

Harvest of Short Rotation Coppice (SRC)



Lit+ Schweier, J., Becker, G. 2012, *Harvesting of short rotation coppice – Harvesting trials with a cut and storage system in Germany*. Silva Fennica 46(2): 287–299

Continuous Cover Forestry

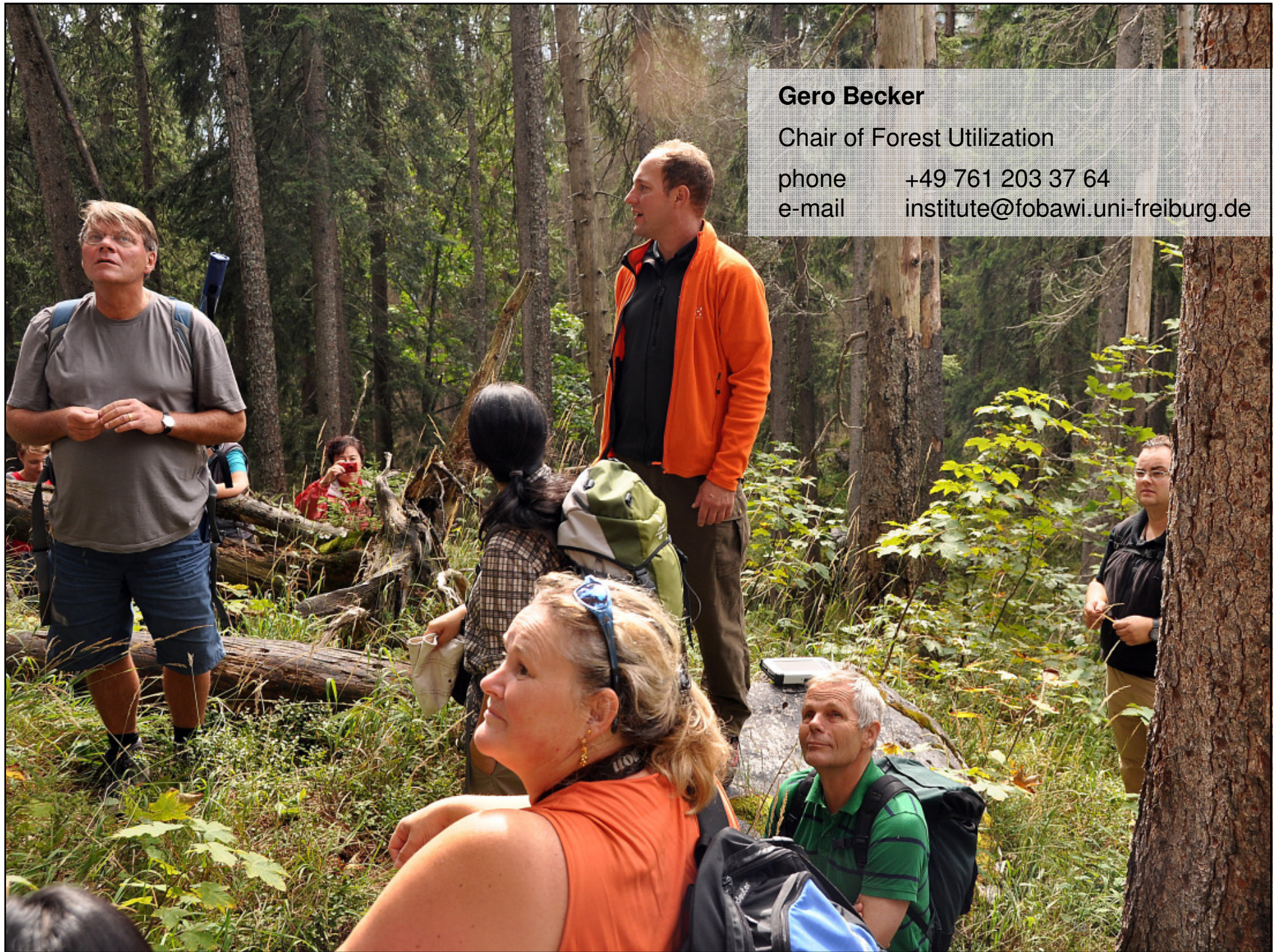
- Uneven in age and structure
- 2 – 4 species
- Permanent cover
- Natural regeneration
- Pruning (optional)
- Frequent thinning, selective cuts (all diameter, target diameter)



Lit+

Mason, B., Kerr, G., Simpson, J. (1999): What is Continuous Cover Forestry?

Picture: Cathy Fitzgerald, ecoartfilm.com



Gero Becker

Chair of Forest Utilization

phone +49 761 203 37 64

e-mail institute@fobawi.uni-freiburg.de