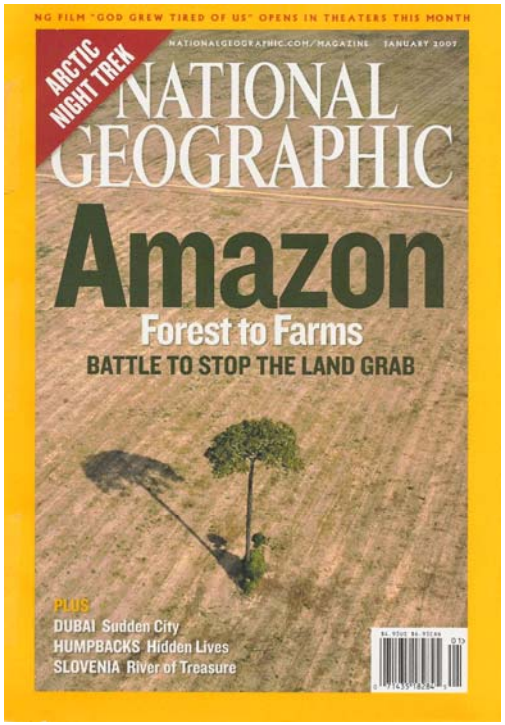
Degradation of Forest Ecosystems

NREM 612

Dr. Bruland



I. Definitions: >250, forester, geographer, legal, etc.

A. What constitutes a forest?

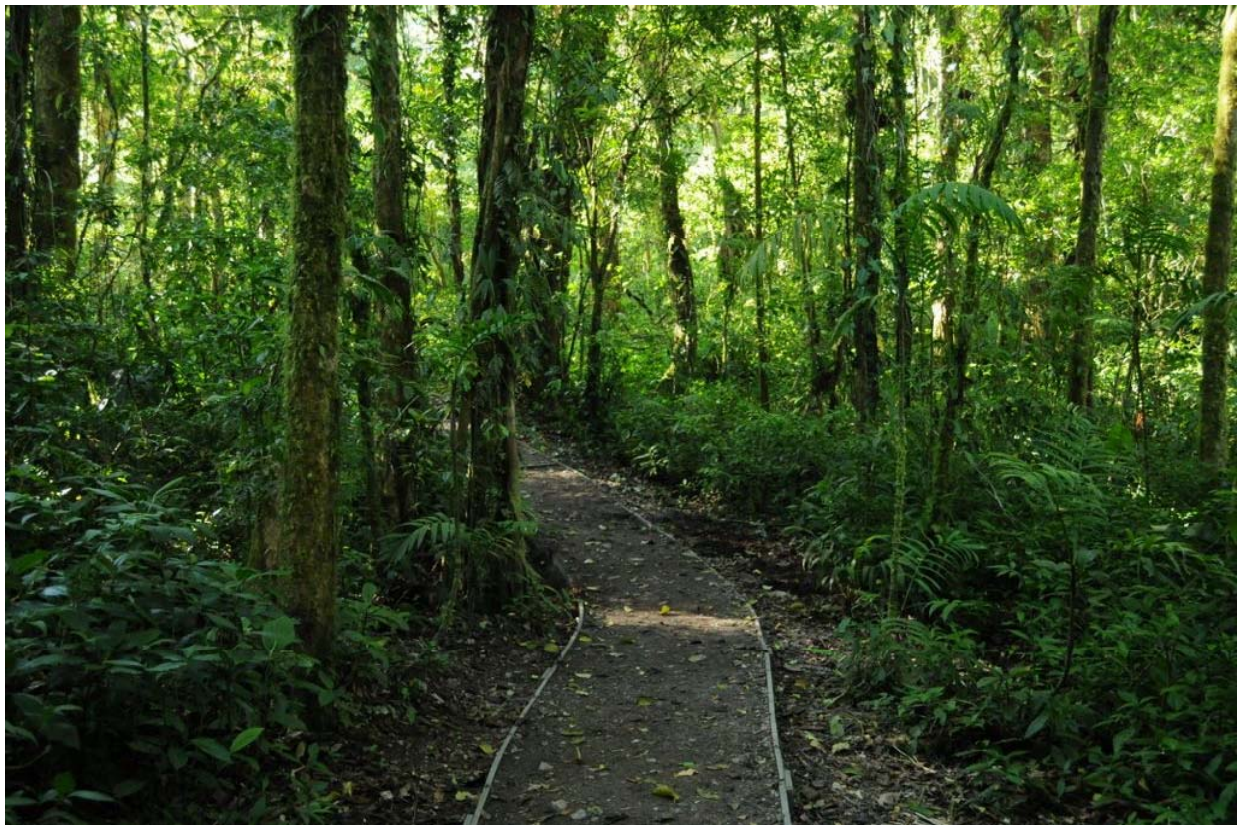
1. Sometimes clear boundaries bet. forest & non-forest, otherwise gradual transitions

2. **Convention on Biodiv. 2001 Def:** Ecosys in which **<u>trees</u>** are **predominate** life forms

3. **FAO 2000 Def:** Ecosystems dominated by **<u>trees</u>** (perennial woody plants > 5 m @ maturity) where crown cover >10%, area >0.5 ha

B. Forest Types

1. **<u>Conservation/Reserve</u>**: Forest w/ minimal modification, harvesting, utilization



Monteverde Cloud Forest Reserve, Costa Rica

2. **Agroforestry**: Deliberate assoc. of forests w/ crops, livestock, or other types of products (i.e. honey) to result in more diversified prod. system

Agroforestry system (alder + avocado w/ corn & beans) in Caserio Los Frutales, Guatemala

3. **Silvopasture**: combines trees w/ forage & livestock prod. Trees managed for timber & provide shade, shelter for livestock

Silvopastoral system with cows, slash pine, & bahia grass in SE US

4. **Slash-&-Burn** (shifting ag, swidden): Patches of primary forest logged, burned, converted to ag or pasture, left fallow to regenerate

Slash-&-burn in Central & South America

5. **<u>Plantation</u>:** System managed intensively for maximum productivity/$ w/ techniques such as clear cut, selective logging

C. **<u>Deforestation</u>**: imprecise term associated w/ varying degrees of degr.

1. conversion of forest to another LU, or long-term reduction in canopy cover below 10% (MEA 2005)

   a. current rate: 13 mi ha yr^{-1} (FAO 2005)

II. Historical Losses & Current Status of Forests

A. 8,000 years ago global forest area = 6.2 bi ha (47% cover) (Billington et al. 1996)

1. Currently ~ 3.9 bi ha of forest (30% cover) (FAO 2005)

a. 40% ↓ since dawn of ag, most losses since IR (MEA 2005)

2. Loss rates vary by continent?

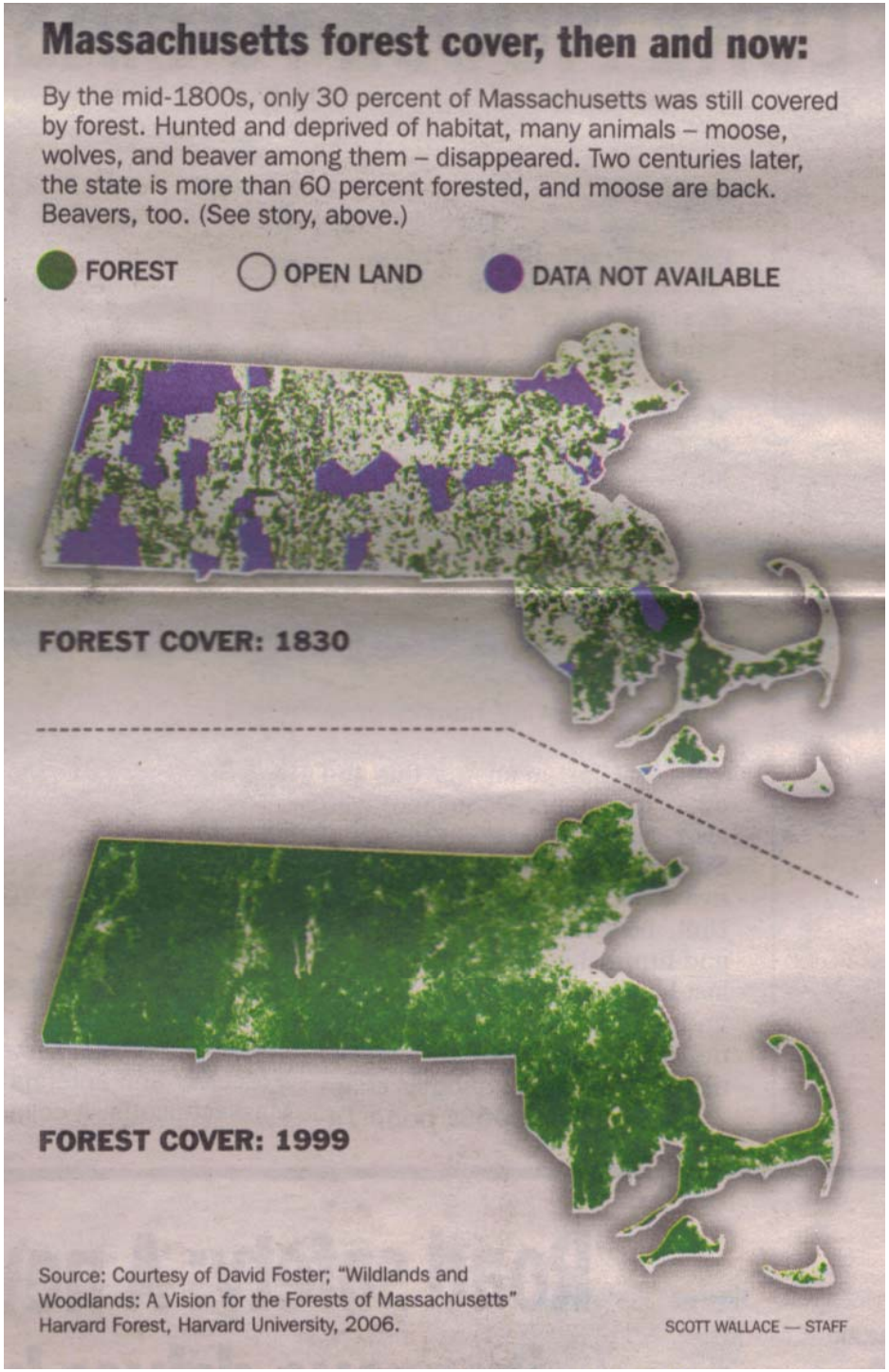
Continent/ Country	**Overall % Loss** (Lomborg 2001, Pimentel 2001)	**Current Cover** (FAO 2001)
Europe	50-70	37%
USA	30-**50?**	26% (N & Cent Am)
South America	20-?	51%
Asia	50	28%
Africa	24-?	22%

3. Loss rates vary by forest type

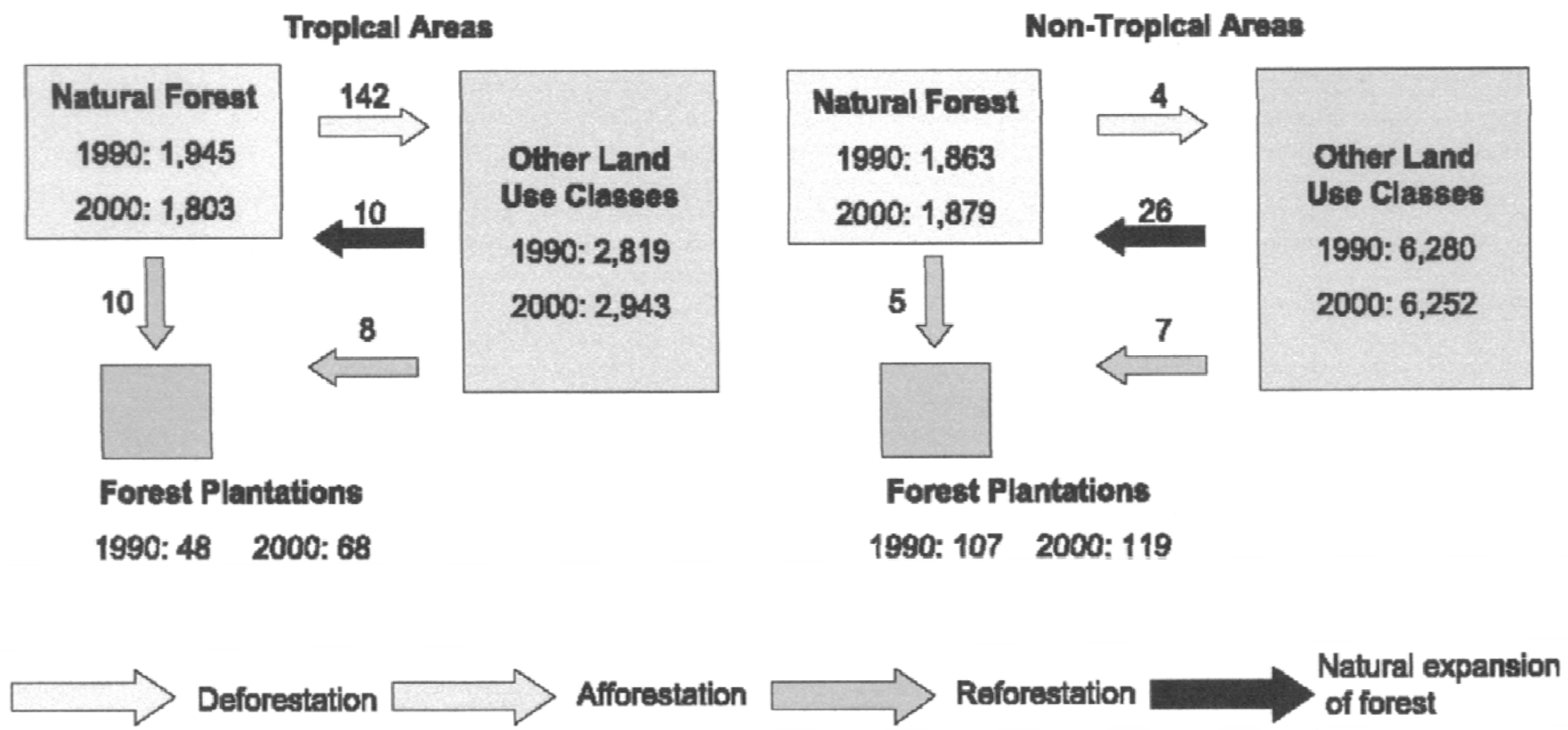
    a. Temperate/Boreal forests ↑ in last 40 yrs

4. Tropical forest ↓ in last 40 yrs

    a. 350 million ha deforested, 500 million ha degraded (Lamb et al. 2005)



Major Change Processes & Rates of Change in Tropical & Non-Tropical Forest Area from 1990-2000



(FAO 2001, MEA 2005)

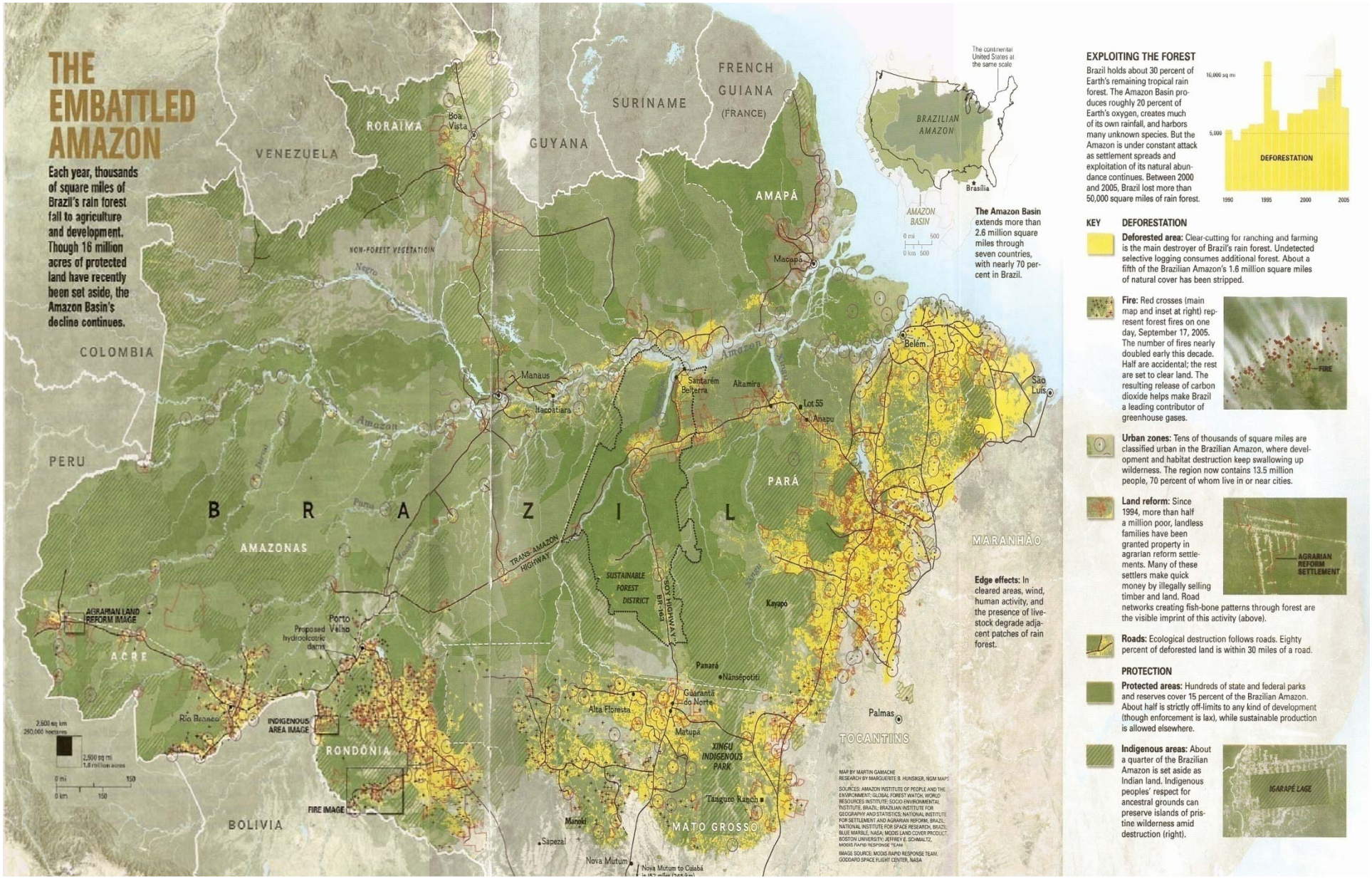
B. > 50% (2.1 billion ha) of world's forests are located in 5 countries

Which countries are they?

1.

2. 3 countries have >90% forest cover

3. 64 countries have <10% forest cover



(National Geographic, Jan. 2007)

C. Forest are major pool of C

How many metric tons (mt) in a Gt? **10^9**

1. Temp. forests: net sink of 0.7 ± 0.2 Gt C yr^{-1}

2. Trop. forests: net source of 1.6 ± 0.4 Gt C yr^{-1} (Lomborg 2001)

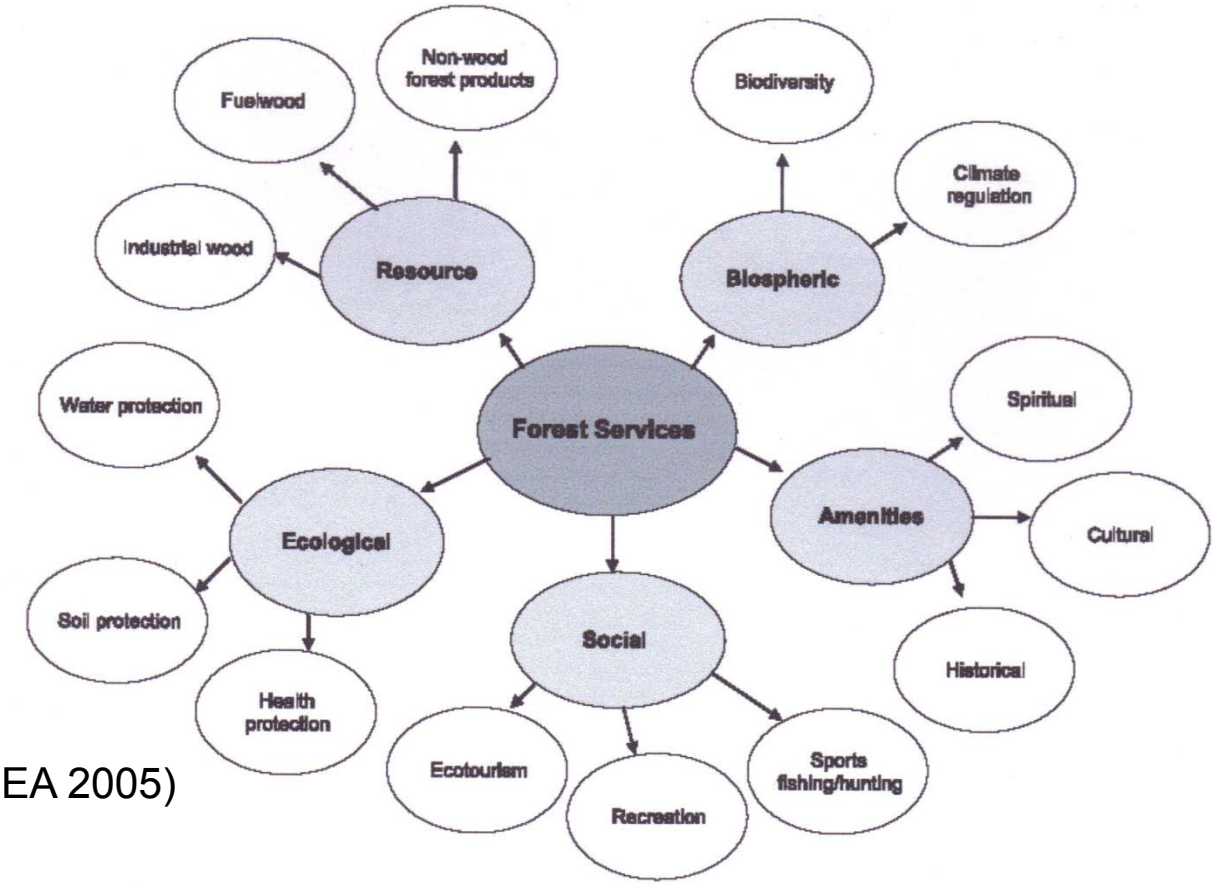
Forest Pool	N&D 1997	IPCC 2001	FAO 2005
Biomass (Gt C)	330	337	283
Soil (Gt C)	660	787 (upper 1 m)	355 (upper 0.3 m)

D. Ecosystem Services

1. Forests provide $4.7 trillion (US) yr^{-1} in eco services or

   a. ***$969 ha^{-1} yr^{-1}*** **(Costanza et al. 1997)**

   a. includes valuation of non-timber products



(MEA 2005)

III. Causes of Forest Degradation

A. Natural factors

1. Fires, hurricanes, tsunamis, volcanoes, glaciers

B. Human-Induced factors

1. **Pop pressure:** ↑ deg, conversion of forest

    a. Collection of fuelwood (FW):

        i. ¾ of world's FW burned in dvping countries (FAO 2006)

    b. People forced to travel farther from home to collect

        i. **Fuelshed**

c. Improved infrastructure:

i. New roads, railways, canals open prev. inaccessible forests

ii. power lines bring electricity

2. Often high poverty & uncertain land tenure in trop. forests

3. **Economic:** Provide 3.3 billion m^3 wood yr^{-1} (MEA 2005)

   a. Wood $\rightarrow$ valuable market commodity

      i.

   b. Forestry contributes 2% of world's GDP, > $600 bi US (Chiras 1998, Lomborg 2001)

      i. 10 million people employed in forestry, cons. (FAO 2005)

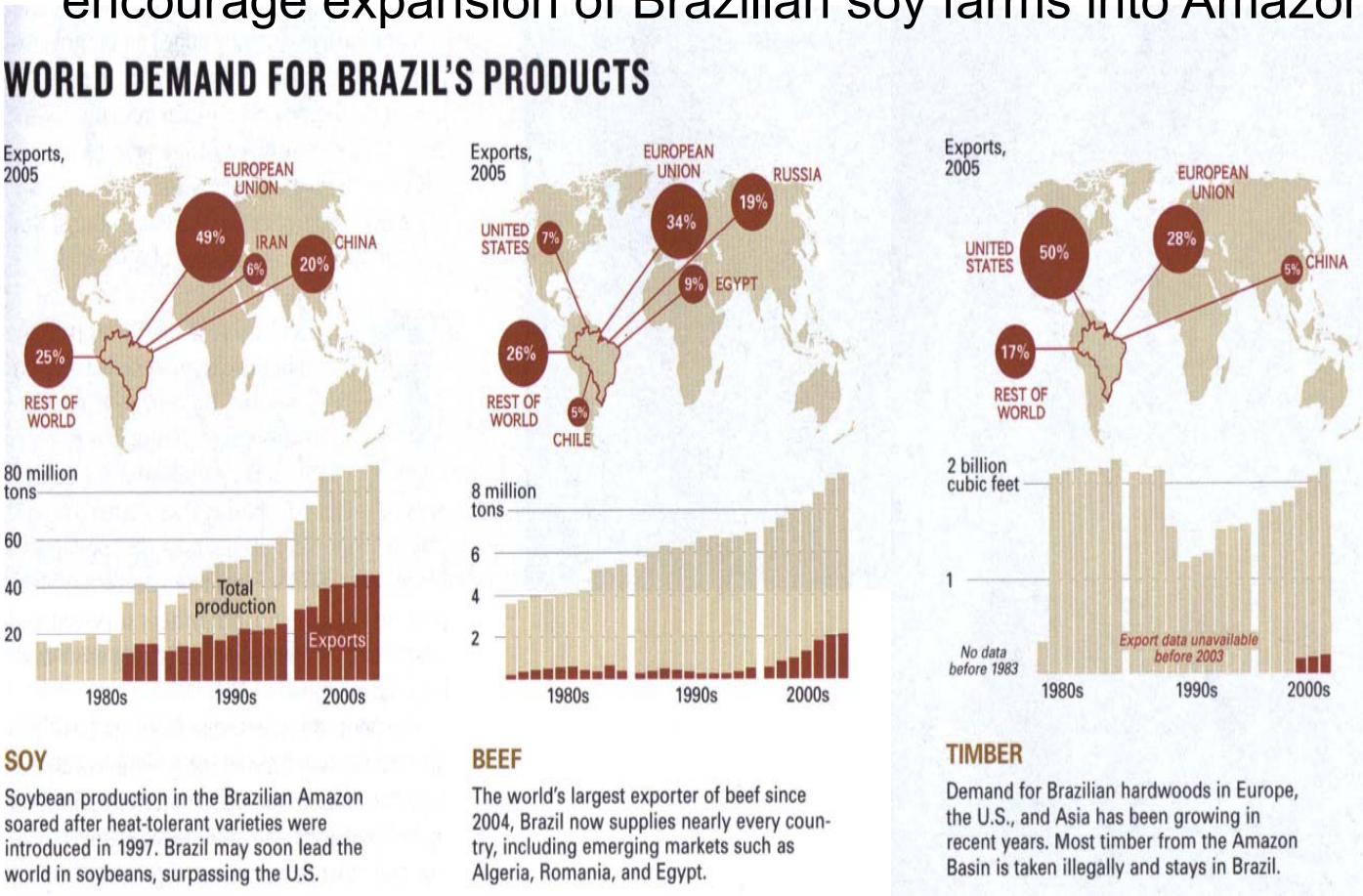
   c. Gov'ts offer subsides to timber companies **<u>OR</u>** reverse
      timber cos. pay $$$ to gov'ts $\rightarrow$ *CORRUPTION*

      i.

c. Conversion to ag/pasture

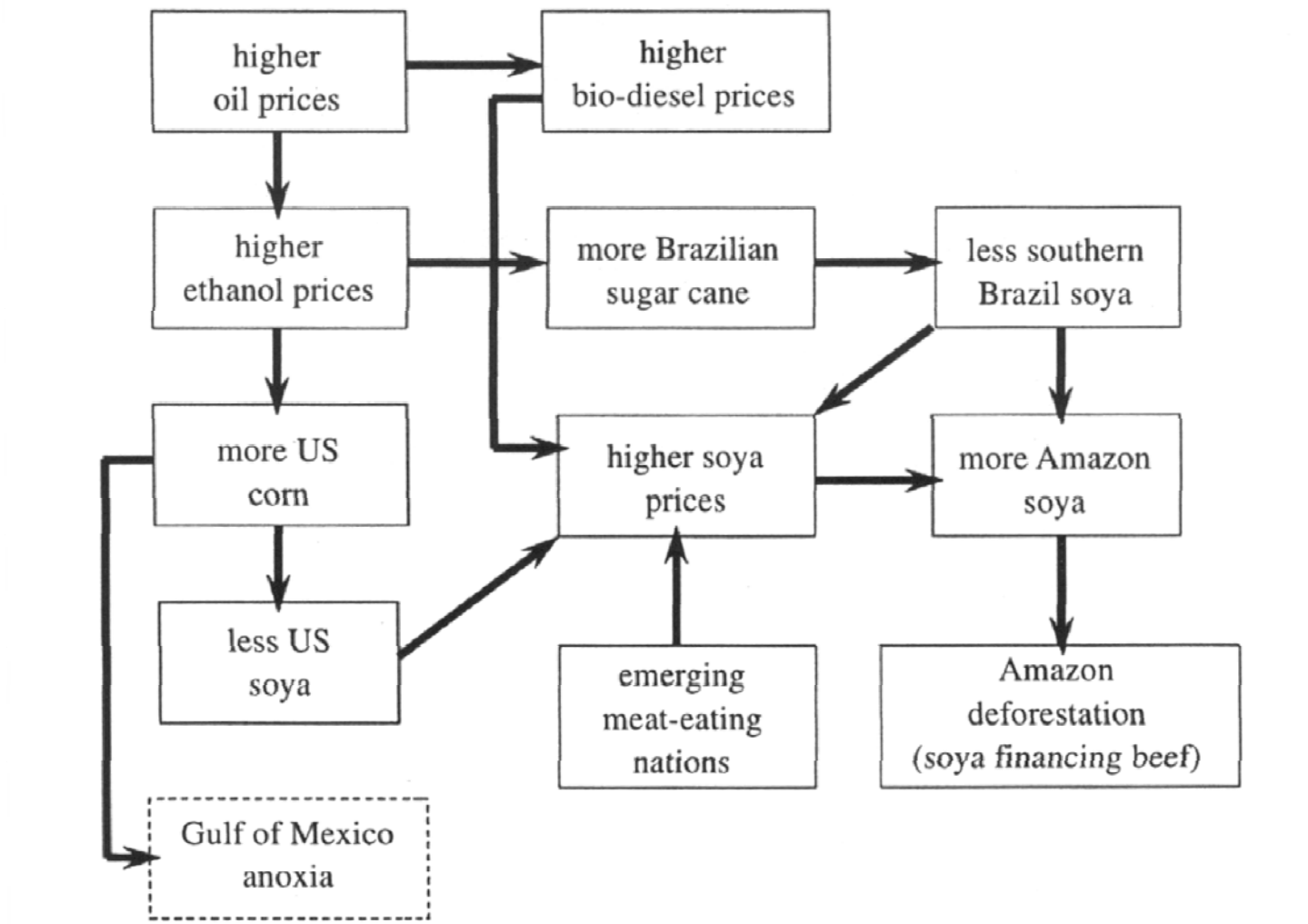
i. growing markets for beef, soybeans drive defor.

ii. US farmers switch to corn for biofuels, ↑ soy demand, encourage expansion of Brazilian soy farms into Amazon



(National Geographic, Jan. 2007)

Economic connections among US ethanol production (corn), Brazilian ethanol production (sugar), & Amazon deforestation



(Nepstad et al. 2008)

3. Political

a. Nationalization of forests

i. **Nepal 1957**. *What happened?*

b. Land settlement schemes

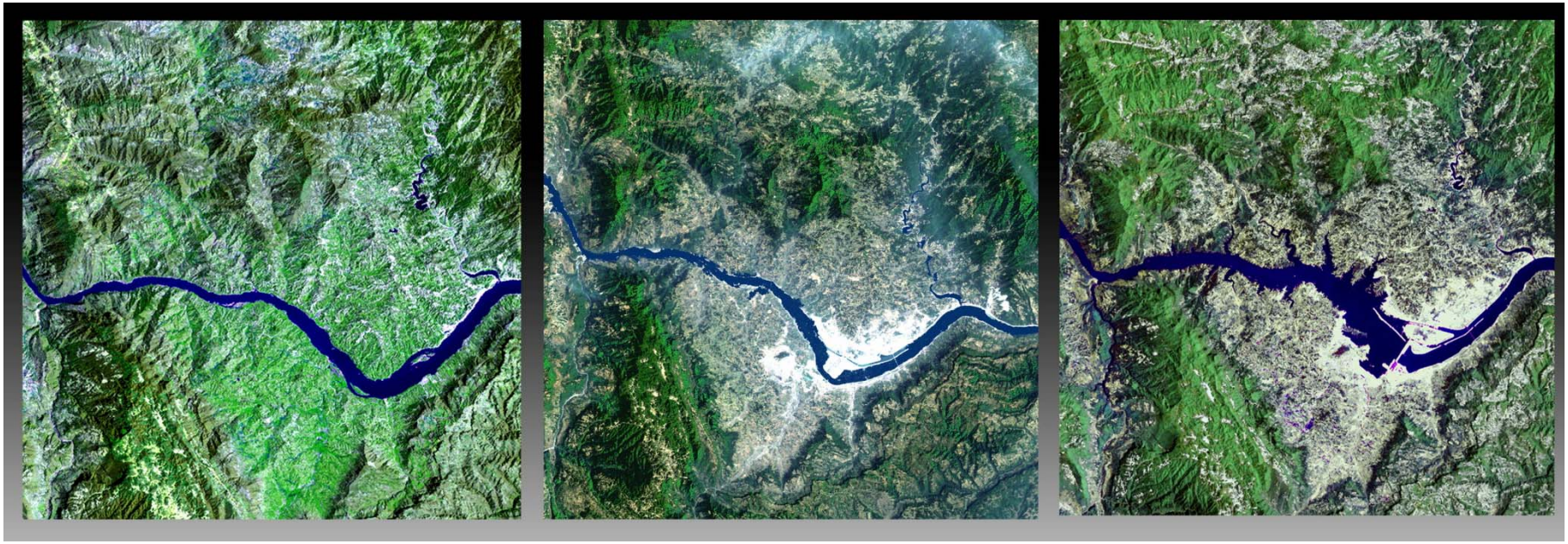
i. Defor. assoc. w/ loss of aboriginal peoples, expansion of settlers

In 1960 what country moved capital 900 km inland from coast to new location?

4. Hydroelectric dams

a. Often destroy forests w/ rich alluvial soils, high biodiversity

Where has this occurred?

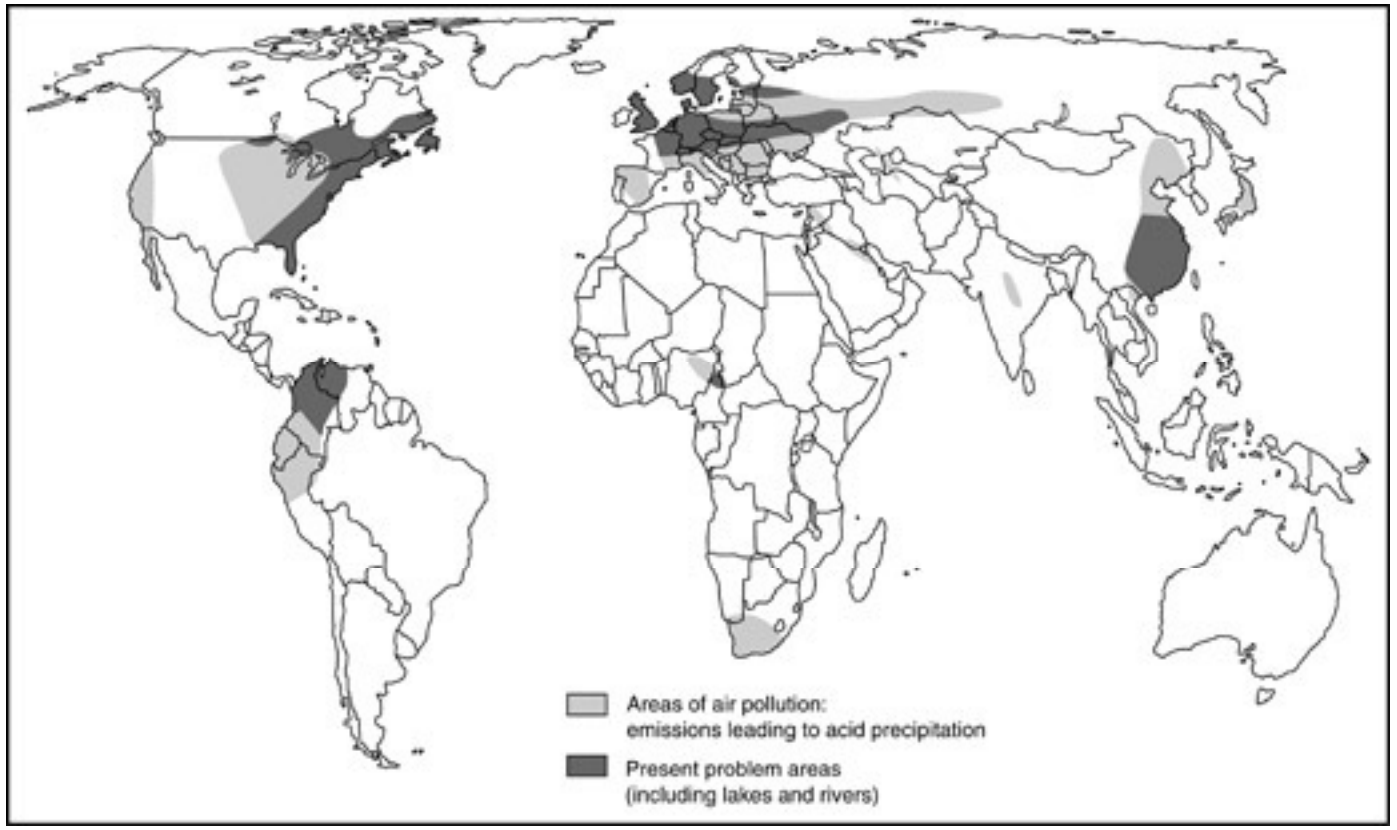


1987 2000 2004

5. Acid deposition

a: *What regions are suffering*?

i. Sierra Nevada, Appalachians, Scandinavia, Balkans



(Kaufman & Franz 1993)

III. Effects of Forest Degr.

A. Loss of biodiversity

B. Landscape fragmentation

C. ∆s in climate, hydrology, water balance, streamflow

D. Changes in BGC, C release, C storage, nutrient flux

E. ↑ erosion, sediment export

IV. Forest Policies:

A. **Sustainable yield**: Manage in way that won't ↓ long term yield; not necessarily sustainable

B. **Multiple-use**: USFS, balance uses i.e. timber prod., recreation, & flood control

C. Current debate: How to harvest w/ least impact?

1. Intensively harvest smallest possible area

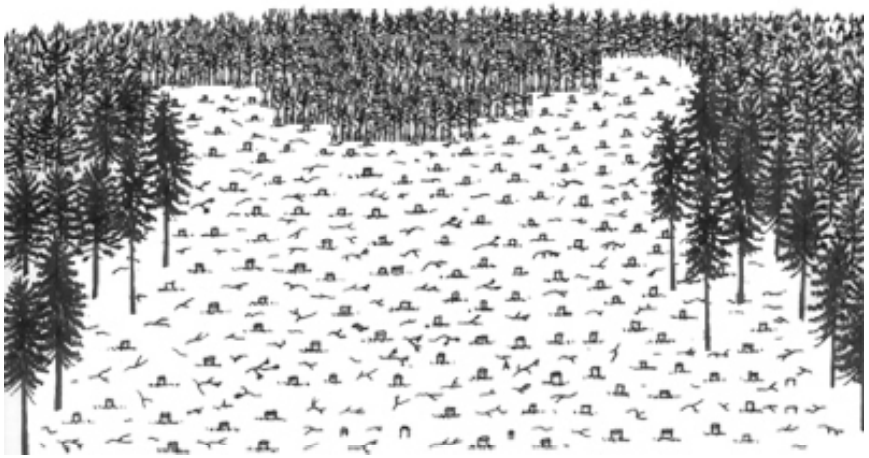
OR

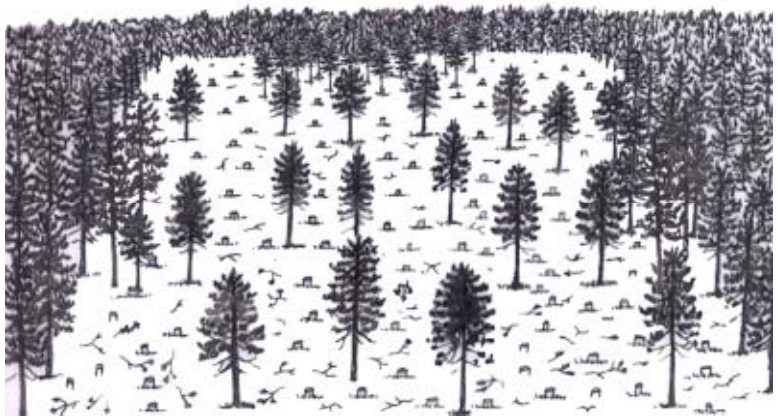
2. Less intensively harvest large area

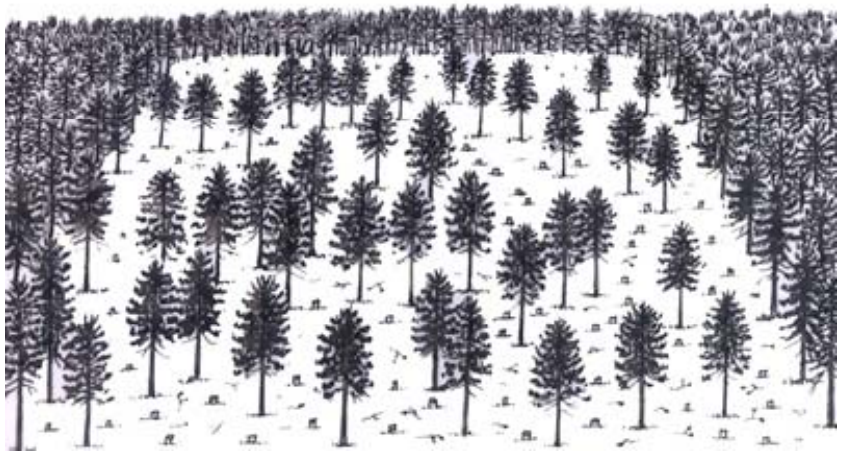
Which do N&D 1997 say is better option & why?

V. Management Options

A. Harvest Methods: clear cut, seed tree, shelterwood, selection

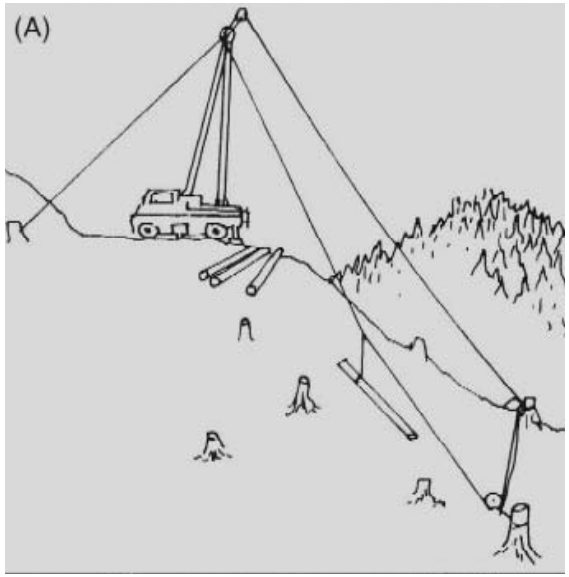


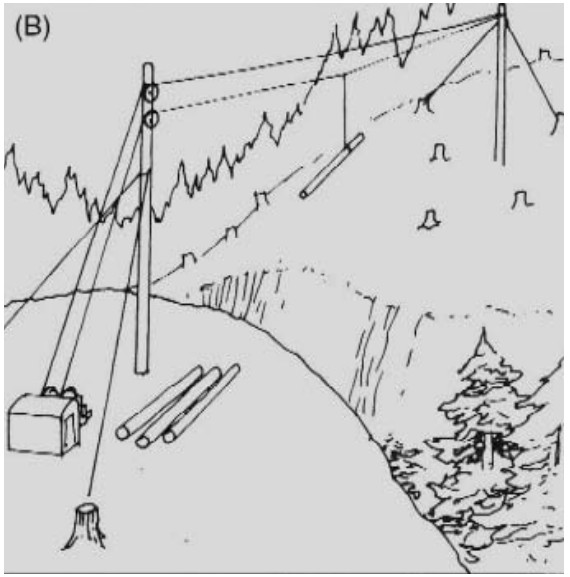


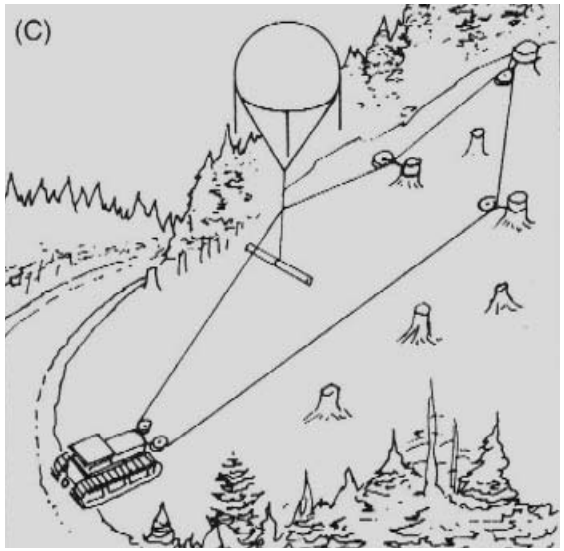


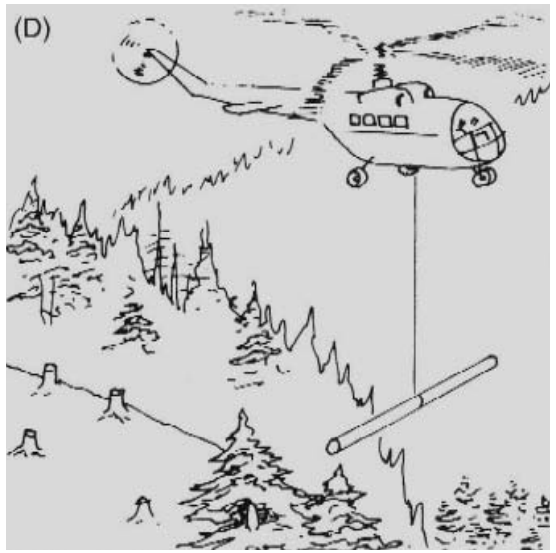
B. Harvest Equipment: animal vs mechanized, feller bunchers, tire vs track, helicopter, etc.

C. Log Transport Systems: high lead, skyline, balloon, helicopter

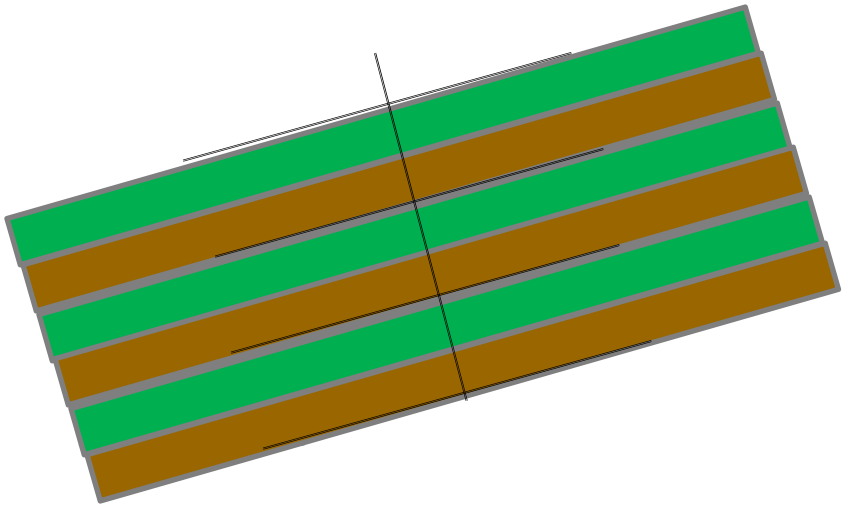


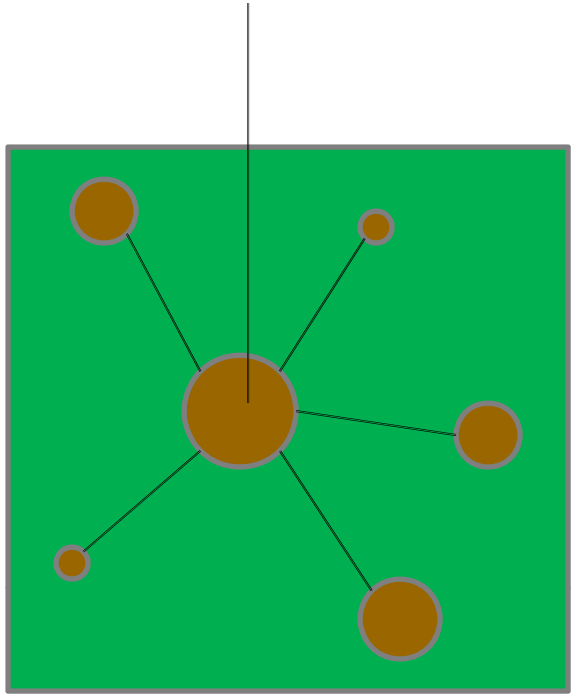






D. Patterns of harvest





E. **<u>Forest certification</u>**: recognizes sustainably-managed forests, combats illegal logging

a. 7% of world's forests currently certified, mostly in Europe & N. America

V. Forest Scenarios

A. Primary temperate forest w/ high-value timber

B. Secondary tropical forest w/ low-value timber

C. Primary tropical forest w/ high-value timber

What method of harvest would you allow if any?

What equipment, what log transport system, what harvest pattern?

What other strategies would you recommend to minimize degradation & foster restoration?