

Biodiversity Loss in Tropical Ecosystems

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- In a statement by Tilman (2000), “the earth will retain its most striking feature, its biodiversity, only if humans have the prescience to do so.

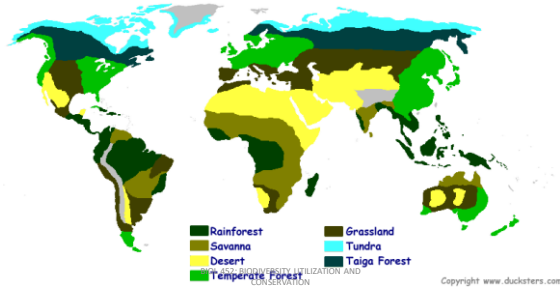
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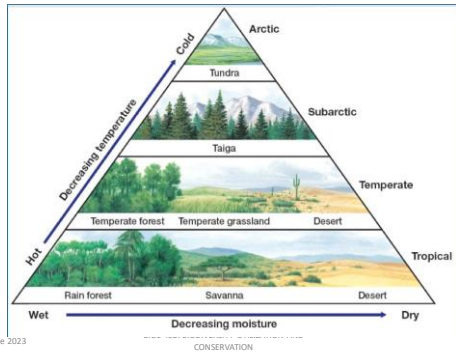
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Biomes of the World

- Large-scale patterns in vegetative structure and dominance.
- About 18 biomes throughout the world.



Biomes are a function of temperature and precipitation



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Tropical Rainforest

- The term 'tropical forest' was first coined by Schimper in 1897 in his book 'The Plant Geography.'
- Described by Humboldt as **evergreen land, hygrophilous in character, at least 30m high, but usually much taller, rich in thick-stem lianas and in woody as well as herbaceous epiphytes.**



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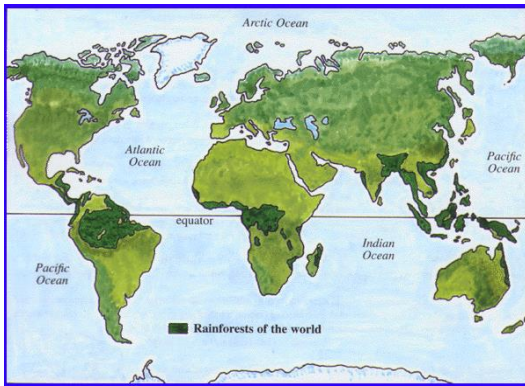
Where are the tropical rainforest found?

- Along the equator in Southern America, Asia, Africa and Australia.
 - $\pm 10^\circ$ from the equator.

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Distribution of TRFs

- Largest expanses in the Amazon Basin of South America, Indo-Malaysian region, Congo and West Africa.
- Africa has about 20% of the world's tropical forest
 - 10% of which is found in the south coast of West African (the Upper Guinean Forest).

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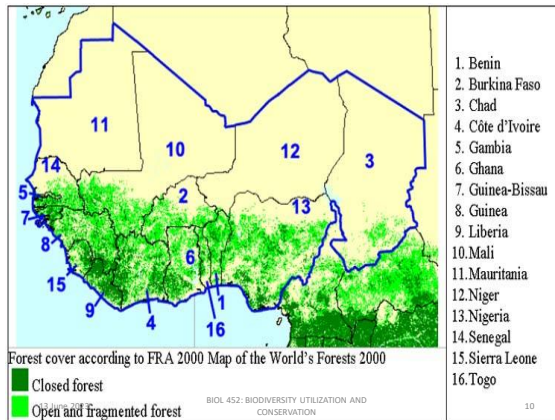
The Upper Guinean Forest

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January 2005

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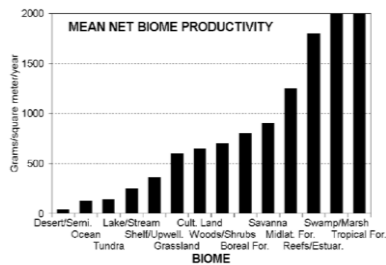
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1. Benin
2. Burkina Faso
3. Chad
4. Côte d'Ivoire
5. Gambia
6. Ghana
7. Guinea-Bissau
8. Guinea
9. Liberia
10. Mali
11. Mauritania
12. Niger
13. Nigeria
14. Senegal
15. Sierra Leone
16. Togo

Tropical Rainforest

- > 250 cm of rainfall each year.
- Most productive biome on earth
- 10% of land, but 30% of **net primary productivity**



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Tropical Rainforest

- Most biologically diverse terrestrial ecosystems.
 - Contains ca. 50 – 90% of all species in the world.
 - two-thirds of the estimated 250,000 plant species.
 - 90% of insects, etc.

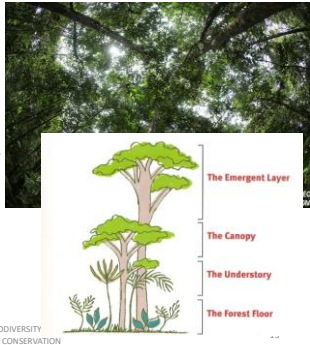
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Characteristics of the Tropical Rainforest

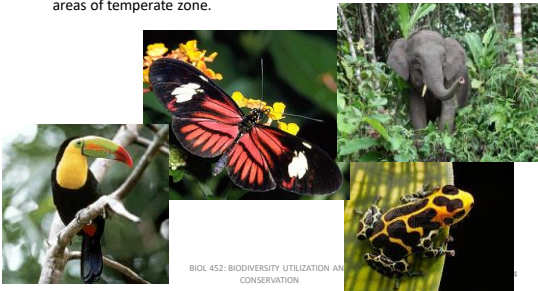
- Dominated by woody plants, which form a **continuous layered canopy cover**.
- This continuity distinguishes forest vegetation from savanna, and its also the reason for the **paucity of grasses**.
- Many lianas (vines) and epiphytes.
 - Strategies of non-trees to reach light.



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- Animal life equally abundant and diverse:
 - ✓ invertebrates and insect exceedingly numerous.
 - ✓ relatively small number of large and conspicuous mammals, but many more species of other vertebrates especially birds than in comparative areas of temperate zone.

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Tropical Rainforest

- Most soils are infertile
 - Nutrients are in living biomass and litter layer.
 - Growth limited mostly by phosphorus.
- Decomposition drives nutrient availability.



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Status of Exploitation of the TRF

- Each year, an estimated 13 million hectares of TRF is cleared, representing 1% of the remaining 40% of original forest areas in the world (FAO, 2005).
- In Ghana, for instance, almost 90% of the original forest cover has been lost since 1940:
 - 22,000 hectares deforested each year.

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- Forest decline is the result of action of a number of **agents** who exploit the forest in unsustainable ways in search of profit and means of subsistence:
 - ✓ slash-and-burn farmers
 - ✓ commercial farmers
 - ✓ cattle ranchers,
 - ✓ loggers
 - ✓ mining and petroleum industrialist
 - ✓ land settlement planners,
 - ✓ infrastructural developers, etc.

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Forest Exploitation in Ghana



- Slash-and-burn agriculture
 - Taungya farming, for example
 - Used to be sustainable but no longer considered as such due to increasing population

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Forest Exploitation in Ghana

- Logging



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Forest Exploitation in Ghana

- Mining



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To Exploit or Not to Exploit

The dilemma of African countries

- Exploitation of forest resources exerts many devastating impacts on the forest ecosystem, despite emphasis on sustainable harvesting and regenerative capacity.

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Negative impacts of logging

- Forest road network destroys 5-6% of tree cover.
- Felling destroys about 5% of surrounding trees.
- Living and processing areas can destroy 0.5-0.6% of forest area.
- Generally, logging destroys more than 6-9% of the forest canopy if extraction is restricted to 10-15 m/ha.
- Ecologists tend to blame only timber exporters for these impacts.



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Benefits of forest exploitation

- Forest exploitation is often one of the principal means of earning convertible currency.
- It may be the one and only silvicultural activity carried out on matured forest ([Anning's paper](#)).
- Forest utilized in this way will be better protected from agriculture than unmanaged forests, because it generates income.

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What is the Way forward?

- Development must be rationalised to protect the future of the forest and to conserve its biodiversity.
- Exploitation must be *progressive and selective*.
 - ✓ there are 300-600 tree species but only about 100 have any recognised technical value, and 30-50 are habitually exploited for profit.
 - ✓ usually an average of 0.5-3 plants is cut per ha, thus exploiting only 4-25 m³ when trees of more than 10 cm dbh are considered.

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The Way forward

- Felling should be based on carefully compiled and up-to-date forest inventories and should remain moderate.
 - annual quota fell per hectare should not exceed annual growth rate.
- Extraction methods must be improved.
 - fellers and loaders must be trained
 - road network must be developed to take into account potential rich forest areas.

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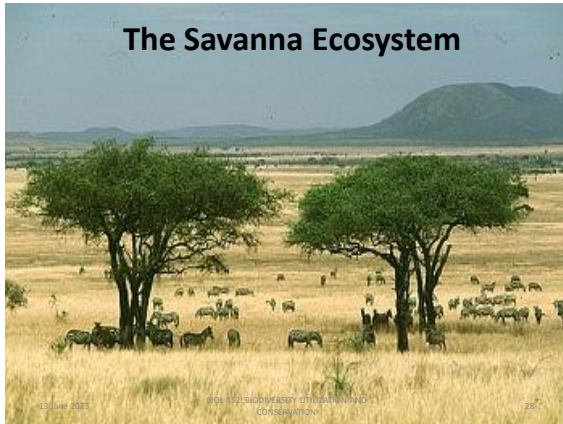
Conclusion

Conservation of the TRF, irrespective of the approach or where it is carried out must be geared toward the same result – marrying the requirements of production to those of conservation.

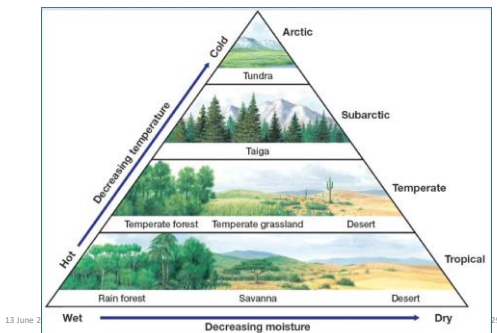
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Biomes are a function of temperature and precipitation



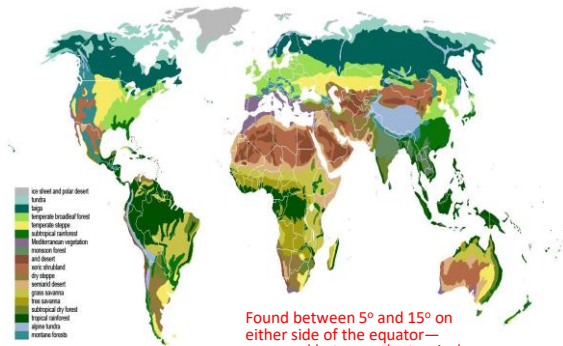
The Savanna Ecosystem

- A range of vegetation types consisting **predominantly of grasses** but also varying in the amount of forbs, shrubs and trees.
- Commonly referred to as tropical grasslands
 - found in areas where it is warm year round
 - Reduced rainfall with prolonged dry season
- Maintained by periodic fires—fire adapted.

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National Geographic

The Savanna Ecosystem

- Has large range of highly specialized plants and animals, which depend on each other to keep the environment in balance.



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The Savanna Ecosystem

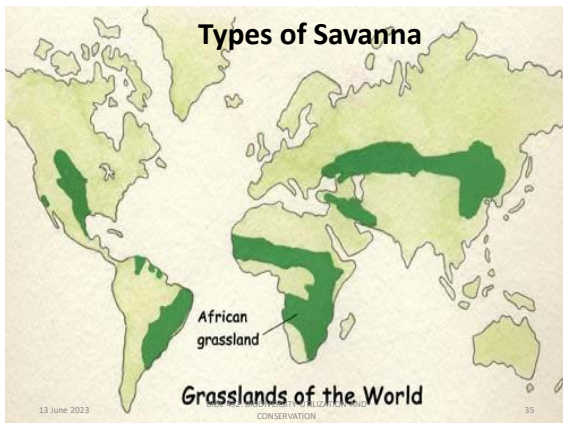


- Most of the plants shrivel up and die during the distinct dry season. Some rivers and streams dry up. Most of the animals migrate to find food.
- In the wet season, all of the plants are lush and the rivers flow freely. The animals migrate back to graze.

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Types of Savanna

- Different types of Savanna can be found around the world; in Africa, South America, Australia, etc.
- The largest and most familiar is the African Savanna, of which the Serengeti Plains of Tanzania are the most well known.
- The African savanna covers almost half of the land area of the continent (ca. 5 million square miles).

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Types of Savanna

- In broad terms, three main types of savanna can be recognised in West Africa:
 - ✓ Guinea Savanna
 - ✓ Sudan Savanna
 - ✓ Sahel Savanna
- **Derived savanna**
 - a region that was formerly high forest but in which the original large trees have now been destroyed and replaced by Guinea Savanna species.

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• Guinea Savanna

- relatively moist with rainfall between 900 and 1500 mm per year, nearly all of which falls in 7-8 months of the year.
- Trees are mostly broad-leaved species up to 12-15 m high, and forming in some places an almost closed canopy of branches.



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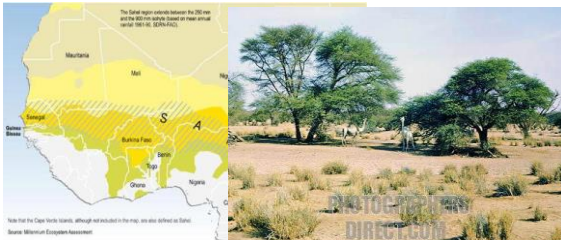
• Sudan Savanna

- Lies to the north of the Guinea savanna, and covering a greater part of Burkina Faso and Mali.
- Annual rainfall between 600-900 mm per year
- Drought is severe and lasts for approximately 7 months from October to April.



• Sahel Savanna

- Lies further north of the Guinea, with an annual rainfall of roughly 250 – 600 mm.
- Dry season is more intense than that found in the Sudan zone.
- Grasses are sparse and less than 1 m tall.



Status of Exploitation of the Savanna

- The savannas contribute immensely to world food supply by representing productivity within reach of heavy grazing animals.
- However, there are only few ecosystems that have been more badly damaged by man's activities than the savannas used as grazing lands.
- Although education, social and political factors are often implicated, an underlying cause has been the *lack of understanding of the principle of rangeland ecology*.

- Among the ecological characteristics of rangelands, **climate variability and its effect on soil and vegetation** are of prime importance.
 - Management must be based on expectation of drought.
- Special attentions should also be given to **conservation of soil and grass cover.**
- Control of **the numbers and distribution of grazing animals** particularly important.

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Influence of Grazing on Savanna Vegetation

- Most grasslands have evolved under the influence of grazing animals.
 - In the absence of grazing, different vegetation would prevail.
 - In the presence of excessive grazing the vegetation alters in its general state and composition in a less desirable direction.
- Most, if not all plants, can tolerate some degree of use.
 - However, their response vary with the intensity and timing of that use.



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Influence of Grazing on Savanna Vegetation

- Range grasses usually have three periods in each year when they are most vulnerable to grazing pressures.



Influence of Grazing on Savanna Vegetation

- 1 
 1. the start of the growing season
 - Plant dependent upon reserves of nutrients stored in the seed or nutrients from the previous year's growth.
- 2 
 2. after the main growth of the season is completed
 - Plants are maturing and developing into seed crops.
 - use at this time can prevent seeds from being set and thus, endanger reproduction.
- 3 
 3. at the end of the growing season
 - plants are storing up nutrients for the following year's growth or regeneration.

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Reading assignment

Read on the effect of nomadism on rangeland biodiversity.

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Vegetation Types in Ghana

- Two major biomes are represented in Ghana.
 - ✓ **Tropical High Forests** supported by the southern half of the country.
 - ✓ **Savannas or woodland** mainly supported by the northern half of the country.



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Vegetation Types in Ghana

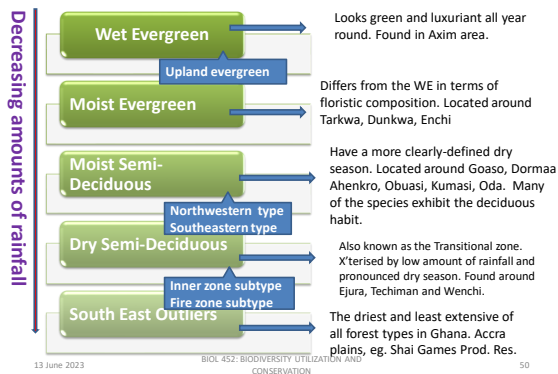
- The savanna is mainly of the Guinea type, but an area of Sudan savanna occupies the north-easternmost corner of the country – known as the **Navrongo-Bolgatanga-Bawku corridor**.
- These vegetation types are not uniform or homogenous; many variants occur in each type.
- The closed or high forest zone is made up of different types, ranging from wet evergreen (WE) rainforest to dry semi-deciduous (DSD) forest.

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Forest types in Ghana



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Wetlands

- Low-land ecosystems where the water table is at or above the level of the ground most of the year.
- Described by the **Ramsar Convention** as “areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish, including areas of marine water, the depth of which at low tide does not exceed six metres”.
- Transition zones between dry upland ecosystems and deep aquatic habitats.

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There are two broad types of wetlands:
Estuarine and Freshwater

- **Estuarine**
- An estuarine is a semi-closed body of water with variable salinity intermediate between salt and freshwater.
- Examples: lagoons, tidal creeks, river mouth.
- Roles:
 - habitat for marine organisms
 - Source of food
 - Traps useful nutrients
 - Flood prevention
 - Provides irrigation water



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Freshwater

- Freshwater ecosystems may be subdivided into swamps, marshes, bogs, etc. based on soil types and plant life.
- Swamps are generally found in sheltered arms of lakes or gentle rivers, at the edges of standing waters.



A regularly flooded swamp

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- Mangrove swamp forests -- found in sheltered muddy shores where the land is rapidly encroaching on the sea in a estuarine situations (i.e., a distinct saline woodland).
- The mangroves consist of a group of plants inhabiting tidal lands in the tropics or subtropics.
- Vegetation consists of trees and shrubs with palms, like *Raphia*, being characteristically present. Large trees less common; but show the layering characteristic of tropical forests. Lianas and epiphytes present. Ground flora dominated by the *Cyperaceae*.
- Mangroves dominate three-quarters of tropical coastlines.

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Mangrove forests

- A good example of convergent evolution, because they have a number of marked structural characteristics in common, although the plants are derived from many different families.

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Mangrove forest

Mangrove forests

- The intertidal existence represents the major limitation to the number of species that are able to thrive in this habitat
- plants must be able to tolerate broad ranges of salinity, temperature and moisture.
- plants require a number of physiological adaptations to overcome the problems of anoxia, high salinity and frequent tidal inundation.

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Economic importance of mangrove forest

- Mangrove forests are of special scientific interest by virtue of their structure and physiological adaptation.
 - use for reclamation of land from the sea
 - use as fuelwood and timber
 - constitute a source of chemical called tan bark which is used as dye
 - they support a rich and varied animal life of which many of the species are adapted to amphibious and saline habitats.
 - they are also used as excellent areas for rice cultivation.

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