**Tropical Agro-Ecosystems**

From Rain Forests to Deserts

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**Wet to Dry Tropical Vegetation**

- Acid soils
- Alkaline soils

- 3000+ - 1000 mm
  - 12 - 10 months

- 2000 - 500 mm
  - 9 - 4 months

- 500 - 0 mm
  - 4 - 0 months

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**Vegetation Distribution in the Tropics**

- Desert
- Semi-desert
- Shrubland steppe
- Dry savanna
- Wet savanna
- Swamp Formations
- Tropical forests (seasonal and rainforest)
- Tropical highlands

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**Tropical Climate-Vegetation Zones**

- Desert
- Semi-desert
- Shrubland steppe
- Dry savanna
- Wet savanna
- Swamp Formations
- Tropical forests (seasonal and rainforest)
- Tropical highlands

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**Vegetation**

- **Wet months**
- **Rain Distribution of rain**
- **Percent land area**

<table>
<thead>
<tr>
<th>Vegetation</th>
<th>Wet months</th>
<th>Rain</th>
<th>Distribution of rain</th>
<th>Percent land area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deserts</td>
<td>0</td>
<td>&lt;250</td>
<td></td>
<td>20%</td>
</tr>
<tr>
<td>Semi-deserts</td>
<td>1</td>
<td>&lt;250</td>
<td>1 short wet season</td>
<td>20%</td>
</tr>
<tr>
<td>Shrubland steppe</td>
<td>2-4</td>
<td>250-500</td>
<td>1 or 2 wet seasons</td>
<td>10%</td>
</tr>
<tr>
<td>Dry savannas</td>
<td>4-6</td>
<td>500-1500</td>
<td>2 wet seasons</td>
<td>20%</td>
</tr>
<tr>
<td>Wet savannas</td>
<td>7-9</td>
<td>800-2000</td>
<td>Rivers run all year</td>
<td>20%</td>
</tr>
<tr>
<td>Forests</td>
<td>10-12</td>
<td>1000-3000</td>
<td>Seasonal, evergreen,</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>and rain forests</td>
<td></td>
</tr>
</tbody>
</table>
Hot Dry Deserts and Semi Deserts
(Less than 250 mm rain)

- Location
- Soils = Aridisols
  - May have problems with salt accumulation
  - Generally alkaline in nature
  - Can be fertile if irrigated
- Little agriculture practiced

Semi-arid Shrubland Steppe
Grassland/Shrubland Savanna
(250-500 mm, 2-4 months wet season)

- Location
- Soils = Aridisols
  - May have problems with salt accumulation
  - Generally alkaline in nature
  - Can be fertile if irrigated
- Some irrigated agriculture, ranching

Semi-arid Shrubland Steppe
Grassland/Shrubland Savanna
(250-500 mm, 2-4 months wet season)

- Crops
  - Drought resistant cereals
    - Sorghum
    - Millet
  - Various pulses
- High potential if water is available

Savanna (47%)
(500-2000 mm, 4-9 months)

- Dry Savanna (29%)
  - Short wet season
  - Two wet seasons
  - Monsoon, long wet season
- Wet Savanna (18%)
  - Two wet seasons

Dry Savanna
Bushland Savanna
(500-1500 mm, 4-6 months)

- 4-6 humid months, 500-1000 mm
  - Short rainy followed by long dry season
- Rainfed and irrigated agriculture
  - Grazing
  - Annual crops: sorghum, sweet potatoes, beans, cowpeas
  - Perennial crops with irrigation

Dry Savanna
Bushland Savanna

- Two wet seasons, low rainfall
  - 600-1500 mm
- Crops
  - Perennial crops - marginal, need irrigation
  - Cassava, pulses, maize, sorghum, millet
  - Drier parts used for grazing
**Dry Savanna**

*Bushland Savanna*

- Monsoon, one long rainy season
  - 750-1500 mm
  - Extensive areas of Asia and Africa
  - Highly variable climate and production

- Crops
  - Perennial
    - Only drought tolerant - sisal, cashew
    - In wetter areas, tea important
  - Groundnuts, cotton, sorghum, millet, maize
  - Rice when irrigated
  - Rangelands limited by dry season

- Rainfed and irrigated agriculture

**Sub Humid Wet Savanna**

*Woodland Savanna*

- Location
  - Thailand
  - Ghana
  - Northern Brazil

- 7-9 humid months, 800 - 2000 mm
  - Rivers have water all year round

- Discontinuous canopy with continuous grass or woody shrub ground cover

**Sub Humid Wet Savanna**

*Woodland Savanna*

- Two wet seasons with high rainfall
  - 1000-2000 mm

- Major agricultural land
  - Easy to clear, mechanization possible
  - Where soils permit, highly productive
  - Much converted into savanna of grasslands
  - Fires
  - Continuous cultivation

**Sub Humid Wet Savanna**

*Woodland Savanna*

- Crops, higher rainfall regions
  - Perennial: coffee, tea, bananas, sugarcane, cacao
  - Pineapple
  - Vegetable crops, groundnuts

- Crops, driest regions
  - Sweet potatoes
  - Cassava
  - Sorghum

**Tropical Forests**

*Rain Forest and Seasonal Forest*

- Location

- Low land Forests
  - Rain forests - continuously wet
    - 2000 - 3000 mm common
  - Seasonal forest - monsoon climate
    - Short dry season, 1000 - 2000 mm common

**Tropical Forests**

*Rain Forest and Seasonal Forest*

- Location

- Temperate Forests - highlands
  - Rain forests - continuously wet
    - 2000 - 3000 mm common
  - Seasonal forest - Monsoon climate
    - Short dry season, 1000 - 2000 mm common
**Lowland Tropical Forests**
(< 900 masl)

- Complex plant community
  - 2-4 stories of trees (highest @ 30 m)
  - Bottom has herbs and shrubs if sufficient light
- Agriculture
  - Most of nutrients in plants
  - Soil has poor fertility (especially rain forest)
  - Difficult to clear land

**Tropical Forests Cropping Systems**

- Shifting agriculture, traditional
  - Shade Agriculture
    - Leave original trees to provide shade
    - Coffee or Cacao cultivation
    - Minimum of 20 years
  - Slash and Burn
    - Burn all trees to plant crops
    - Fertility decreases rapidly (3-4 years)
    - 50 years to grow back

**Intensive Agriculture**

- Remove original vegetation by machine
- Use fertilizers, pesticides, herbicides etc.
- Annual crop production, banana plantation
- Many centuries to regrow - best guess
  - May regrow grassland and not trees
- Clear cutting
  - Not known how long to regenerate

**Agriculture Potential of Forests**

**Good Potential**

- Moisture
  - Good quantity and well distributed
- Soil
  - Rain forest soils have poor fertility
  - Seasonal forests have better fertility than rain forests
  - Usually well drained
- Elevation
  - Cooler so slower growth
  - Lower yields than lowland regions
- Crops
  - Perennial: oil palm, cacao, coconut, banana, coffee
  - Annuals: cassava, yams, sweet potatoes

**Swamp formations**

- Waterlogged or inundated most of the year
- Fresh water areas
  - Location Borneo, Sumatra, Malaysia, Guyana
  - Soil = histosols
    - Drained for use, may be too acid
  - Crops
    - Deep peat, pineapple
    - Moderate peat, Oil palm, coconut, coffee, cacao

**Tropical Highlands**

- Altitudes of 1000 m to 3000 m
  - As approach equator can develop higher altitudes
- Temperature is cooler
  - 5.6°C cooler for every 1000 m
  - Crops grow slower
  - Can grow temperate tree crops at high altitude
- Wide range of moisture conditions
  - Forest to desert
**Tropical Highlands**

- Evergreen forest
  - 1250 to 2500 mm rain common
  - Shorter trees with closed canopy
  - More shrubs and herbaceous vegetation
- Good Agricultural Potential
  - Rain, reliable, moderated by clouds, mist, temp
  - Excessive rain at harvest is a problem
  - Soils: fertile with good organic matter

**Large areas**
- Cleared, cultivated, grazed, burned
- Replaced by grassland

**Crops**
- Subtropical to temperate crops
- Tea and coffee below 2100 m
- Potatoes, pyrethrum

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**Farming Systems in Tropical Climate - Vegetation Zones**

<table>
<thead>
<tr>
<th>Vegetation</th>
<th>0</th>
<th>1-4</th>
<th>4-6</th>
<th>7-9</th>
<th>10-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deserts</td>
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<td></td>
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</tr>
<tr>
<td>Semi-deserts</td>
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<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Shrubland</td>
<td>XXX</td>
<td>X</td>
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<tr>
<td>Steppes</td>
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<tr>
<td>Dry savannas</td>
<td>XXX</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet savannas</td>
<td>X</td>
<td>XXX</td>
<td>XXX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humid forests</td>
<td>XXX</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
<td>XXX</td>
</tr>
</tbody>
</table>

x = infrequent, xx = mod. frequent, xxx = widespread

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Any Questions?