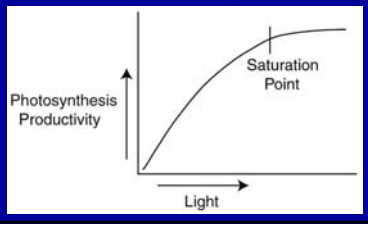
Lecture 7
Agricultural Potential of the Humid Tropics

Although the tropical forest is lush, net productivity is low.

- **This is one factor that accounts for lack of sedentary agriculture in the *Af* tropics.**
- **Only 2.5% of *Af* lands are under sedentary cultivation compared to 10% in the habitable part of the world.**
- **Jen-Hu Chang (1968) has developed *the theory of potential photosynthesis* to account for this.**

Chang, Jen-Hu. 1968. Agricultural potential of the humid tropics. Geographical Review 58:333–361

- **Photosynthesis depends on the availability of water, air, temperature, and solar radiation to plants.**
- **Without limiting factors, photosynthesis increases with sunlight up to the saturation light intensity which varies somewhat from plant to plant.**
- **However, increased light increases photosynthesis because of the effect of shading.**



- **Therefore long days, bright sunlight can be expected to increase the rate of photosynthesis.**
- **However the rate of biomass production (carbohydrate production) or yield is based on net photosynthesis which is gross photosynthesis less respiration losses.**
- **Net photosynthesis =**
  Gross photosynthesis – Respiration loss

- However, the rate of respiration is directly related proportionally to temperature between 40° and 95°F.
- Thus, the ideal climate would be bright sunny, long days and cool days and especially cool nights.
- This does not describe *Af* climates.
- Remember equatorial areas have zones of relatively low insolation due to cloud cover and short days.
- At higher latitudes, greater insolation in the summer combined with lower night temperatures increase net photosynthesis.

Net Photosynthesis as a Percent of *Af* Climate

Time	*Af*	*Aw*	*Cs* (Medit)	*Ca* (Mild temperate)	*D* (Severe winter)
Entire Year	100	105	117	91	68
8 months (March to Oct)	100	106	127	123	101
4 months (May to Aug)	100	109	136	133	152

Light Energy and Temperature in *D* and *Af* Climates during June (Northern Hemisphere)

Climate	Light energy	Avg. temp. (°C)
D	510 langleys	17
Af	357 langleys	26

Actual Yields under Optimum Conditions
International Rice Research Institute (IRRI)

Country	Yields (tonnes/ha)	
	Best conditions	Average conditions
Japan, Australia	14.3	8.9
Phillipines, Malaysia	12.3	5.0

- These differences are in accord with calculated discrepancy of net photosynthesis.
- However differences are greater under "average" conditions.
- Thus poor management carries a greater penalty in the tropics!

- Within *A* climates, *Af* poorer than drier tropical climates such as *Aw* or *As* (dry season in summer).
- This is true for sugar yields in Hawaii
  - *Af* 8.92 tons/acre
  - *As* 12.52 tons/acre
- Note: *As* climate is very rare and is due to cyclonic factors; found in Ceylon, S. India, Hawaii.

Loading sugarcane, Maui, Hawaii

Limits to High Productivity in *Af* Climates

Short days & high cloud cover
Excessive rain
Poor soils
High temperatures—especially at night
Lack of winter increases pest & disease problems