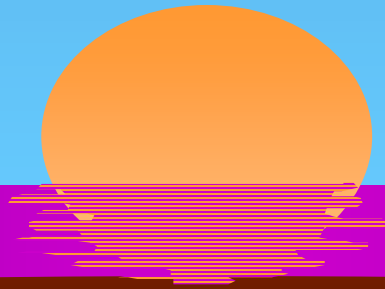


# Sustainability of Ecotourism and Traditional Agricultural Practices in Chiapas, Mexico

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# General Objective

Determine sustainability of ecotourism and traditional agricultural practices by using emergy and financial indicators

# Specific Objectives:

- 1) Analyze land use and distribution at the regional level and by groups
- 2) Value household productive activities using energy and financial indicators

# Methods

- Energy analysis
  - investment ratio
  - environmental loading ratio
- Financial analysis
  - revenue cost ratio
- Combined analyses
  - total energy to financial benefit ratio
  - labor energy to revenue ratio

# A System Diagram Example

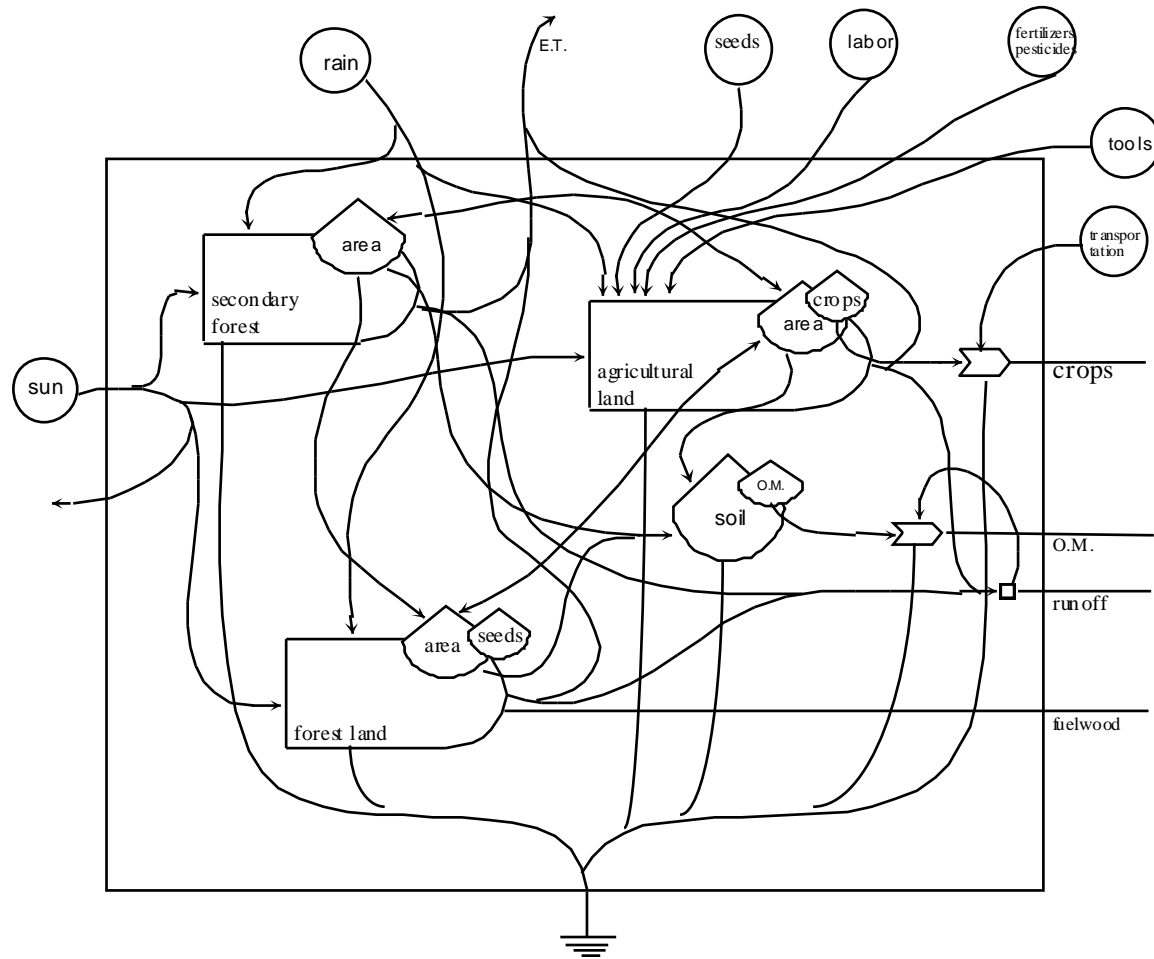


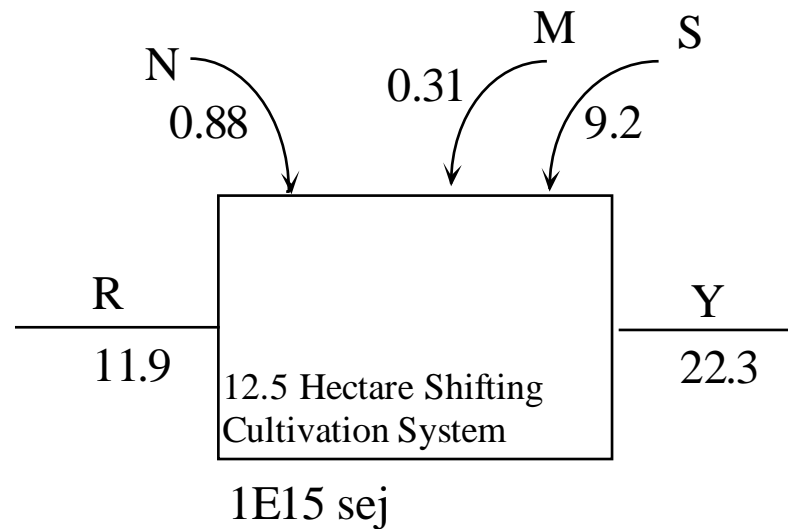
Figure 3-35. Shifting Cultivation System Diagram.

# An Emergy Evaluation Table

Table 1. Emergy Evaluation of Shifting Cultivation System.

Note	Item	Raw Units (units/yr)	Trans- formity (sej/unit)	Solar Emergy 1E+15 (sej/yr)	Emdollar Value (US\$/yr)*
RENEWABLE RESOURCES:					
	1 Sunlight	1.97E+15 J	1E+00	1.97	1,045
	2 Rain, chemical	1.85E+12 J	2E+04	28.57	15,183
NONRENEWABLE RESOURCES:					
	3 Soil erosion	1.90E+10 J	7.37E+04	1.40	744
INPUTS:					
	4 Seeds	1.04E+09 J	3.57E+05	0.37	197
	5 ...				
YIELDS:					
	9 Crops	1.28E+11 J	3.57E+05	45.68	24,272

# Emergy Ratios to Evaluate Resource Use



Investment Ratio

$$IR = (M + S) / (R + N)$$

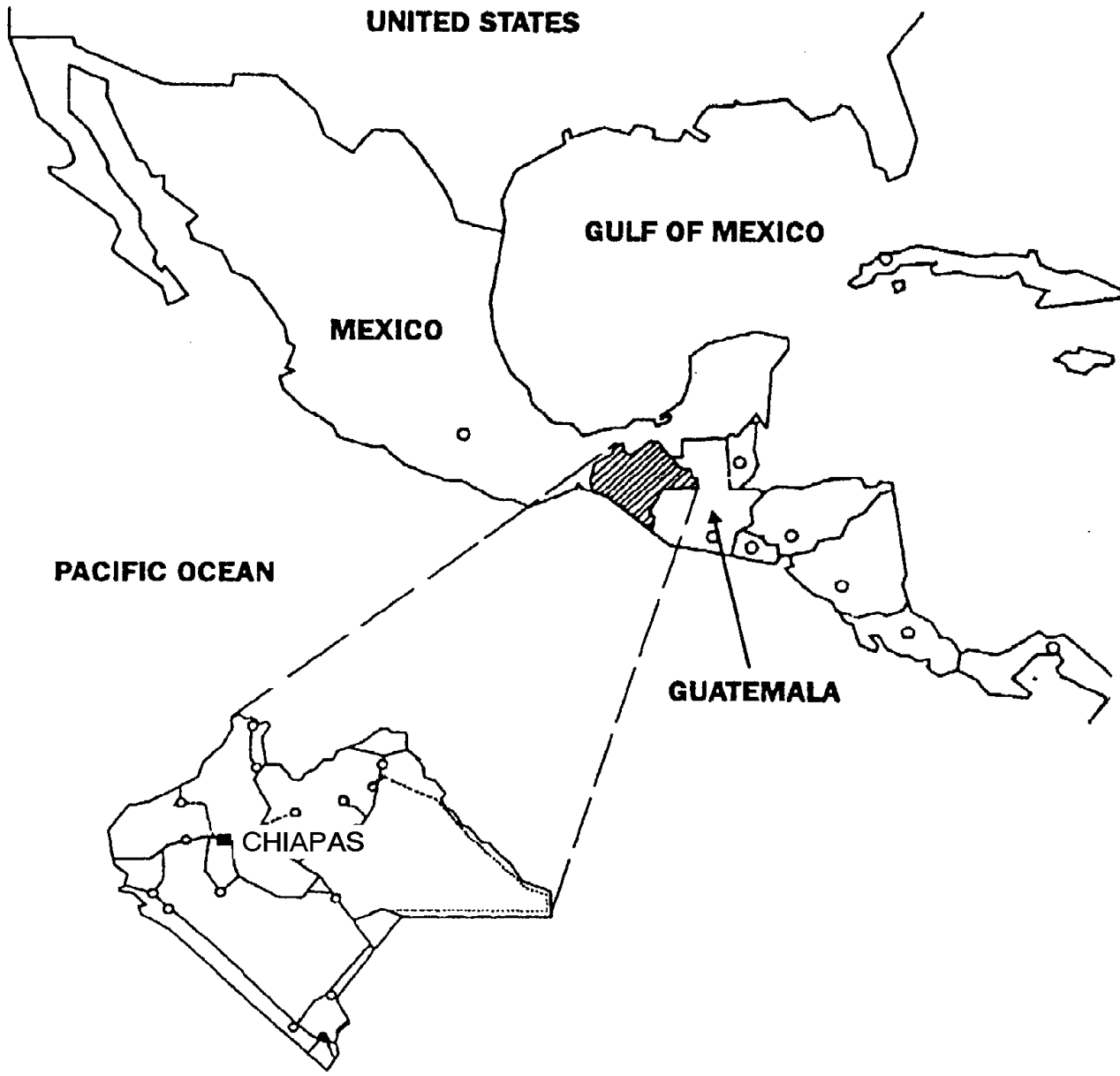
Environmental Loading Ratio

$$ELR = (N + M + S) / R$$

# Financial Analysis

- B (benefits) = Total financial benefits
- C (costs) = Total financial costs
- R (revenue) = B - C
- REVENUE / COST RATIO  
$$R/C = (\text{revenue}) / (\text{costs})$$
- Government subsidies and loans





**UNITED STATES**

**GULF OF MEXICO**

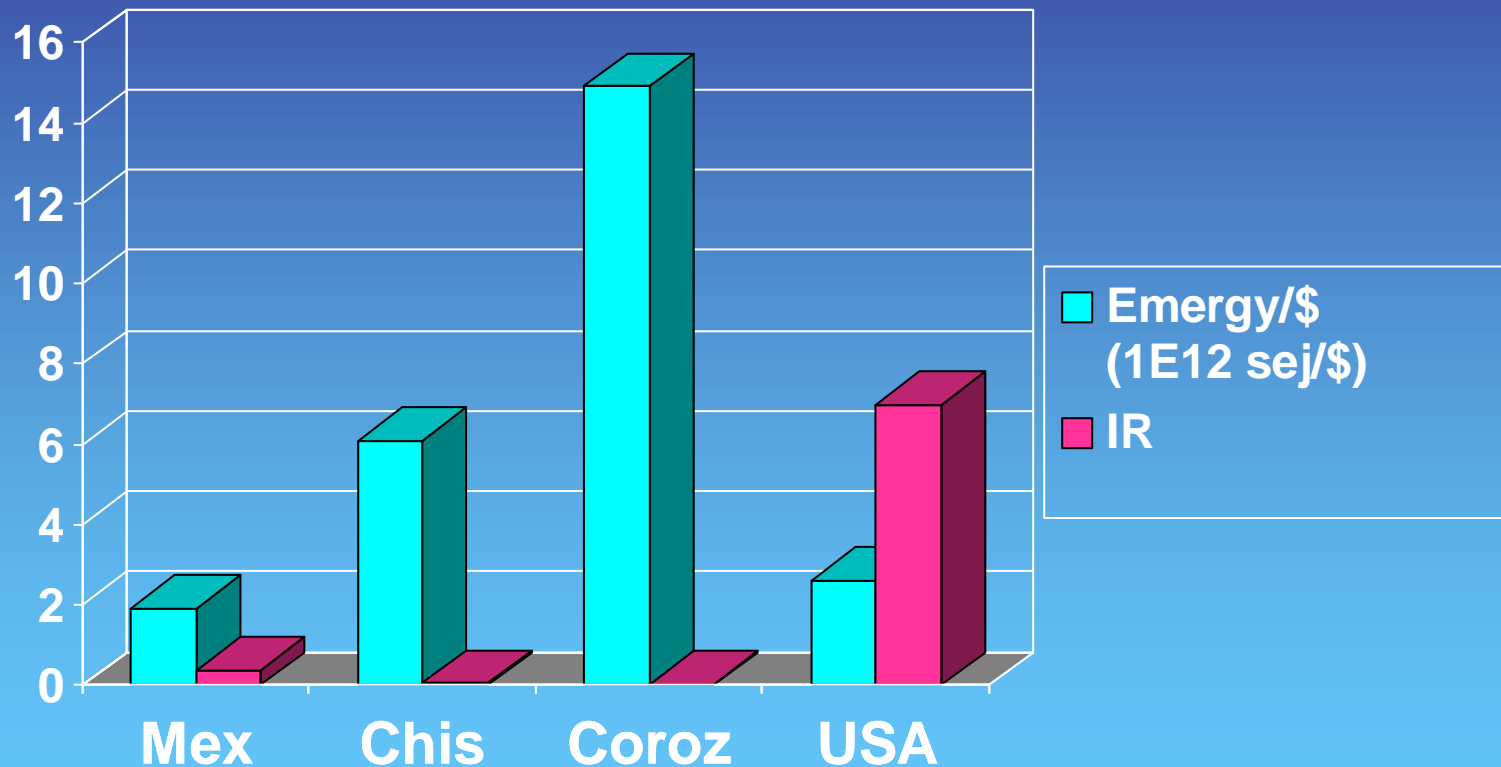
**MEXICO**

**PACIFIC OCEAN**

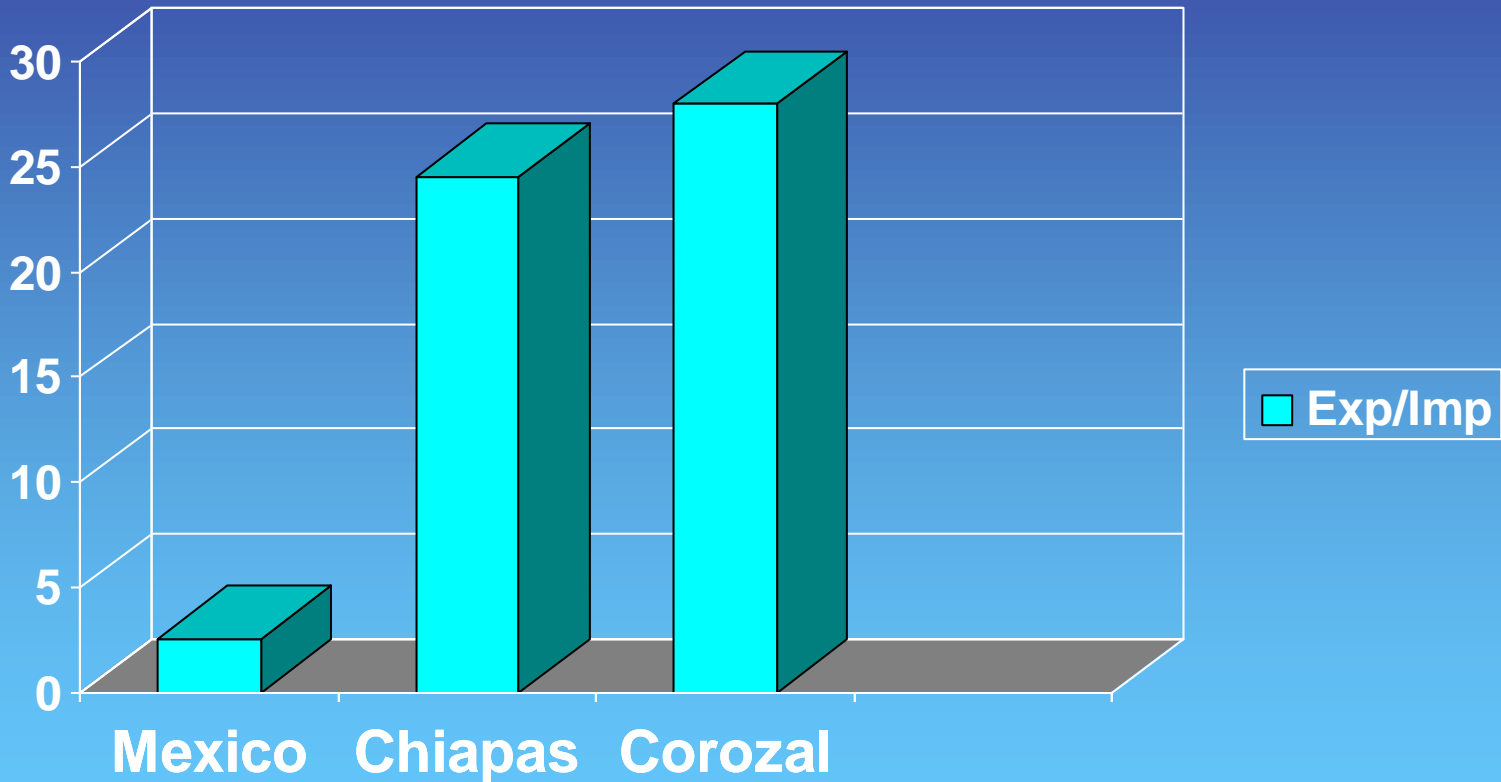
**GUATEMALA**

**CHIAPAS**

# Emergy/\$ and IR for Mexico, Chiapas and Corozal



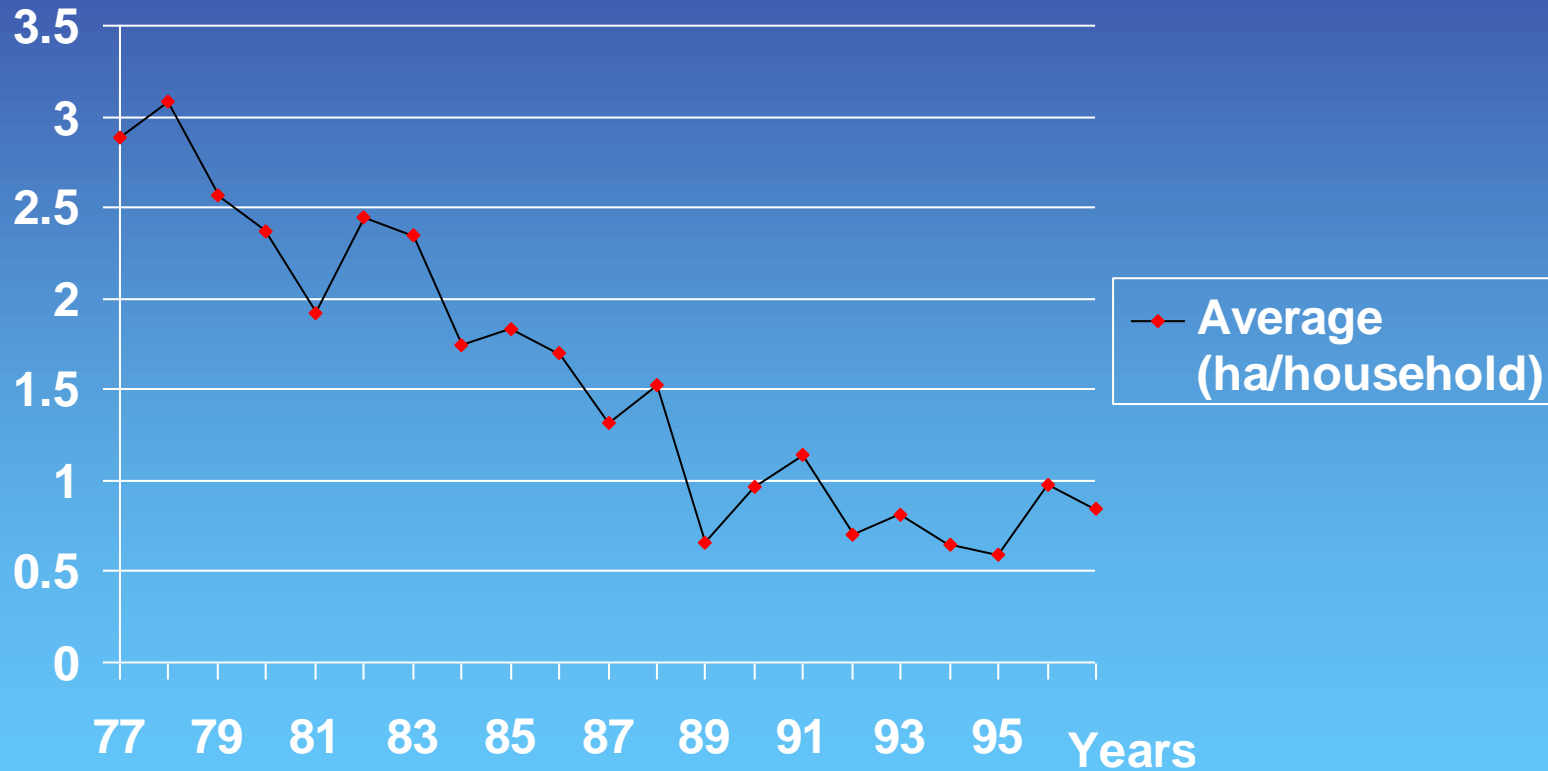
# Export to Import Ratio for Mexico, Chiapas and Corozal



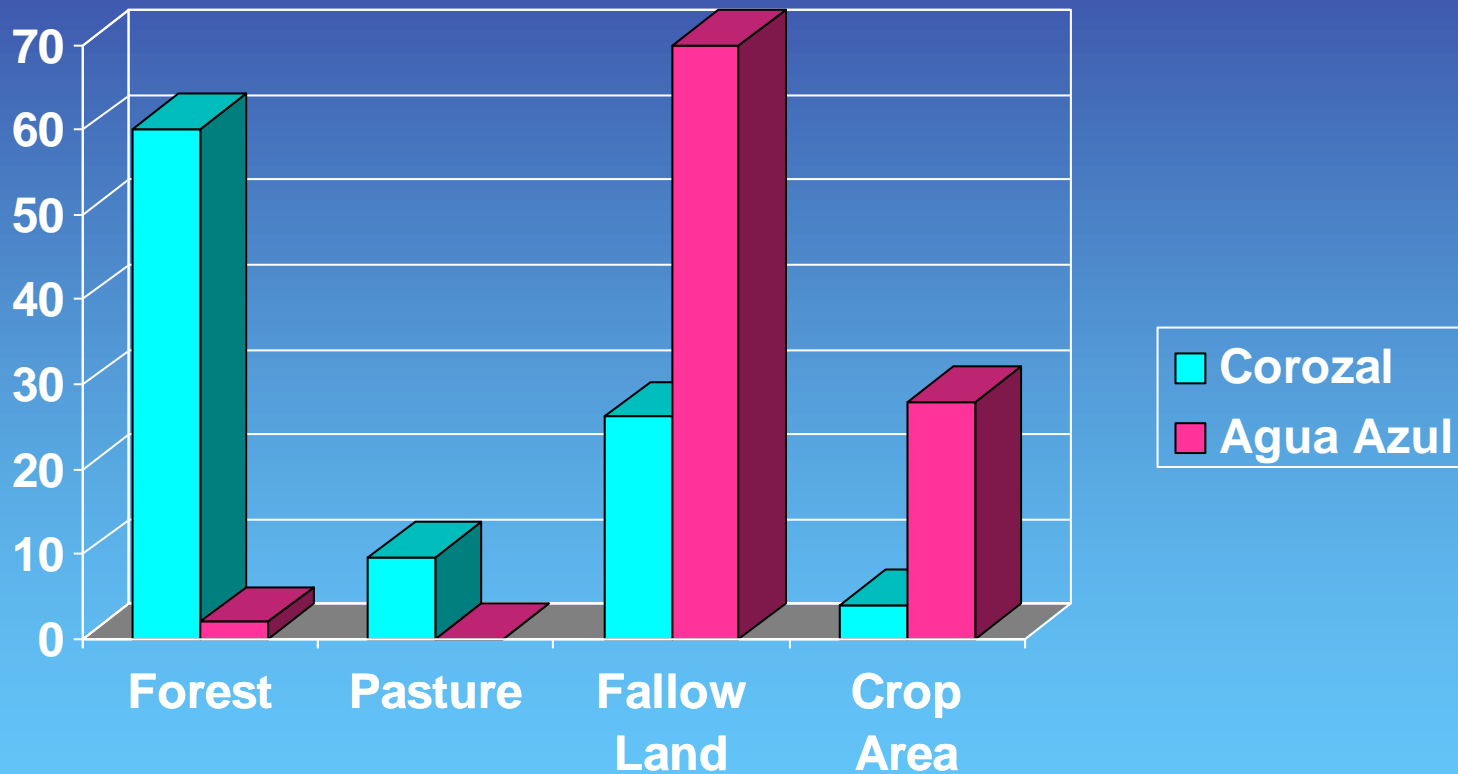
The background of the slide features a stylized tropical sunset. The sky is a gradient from light blue at the top to a darker blue at the bottom. A large, bright orange sun is positioned in the center, just above a dark blue horizontal line representing the horizon. Below the horizon, the sun's reflection is depicted as a series of horizontal, wavy lines in shades of orange and yellow. On either side of the sun, there are several palm trees with green fronds and brown trunks, rendered in a simple, graphic style.

# Land Use and Distribution Analyses at the Regional Level and by Group

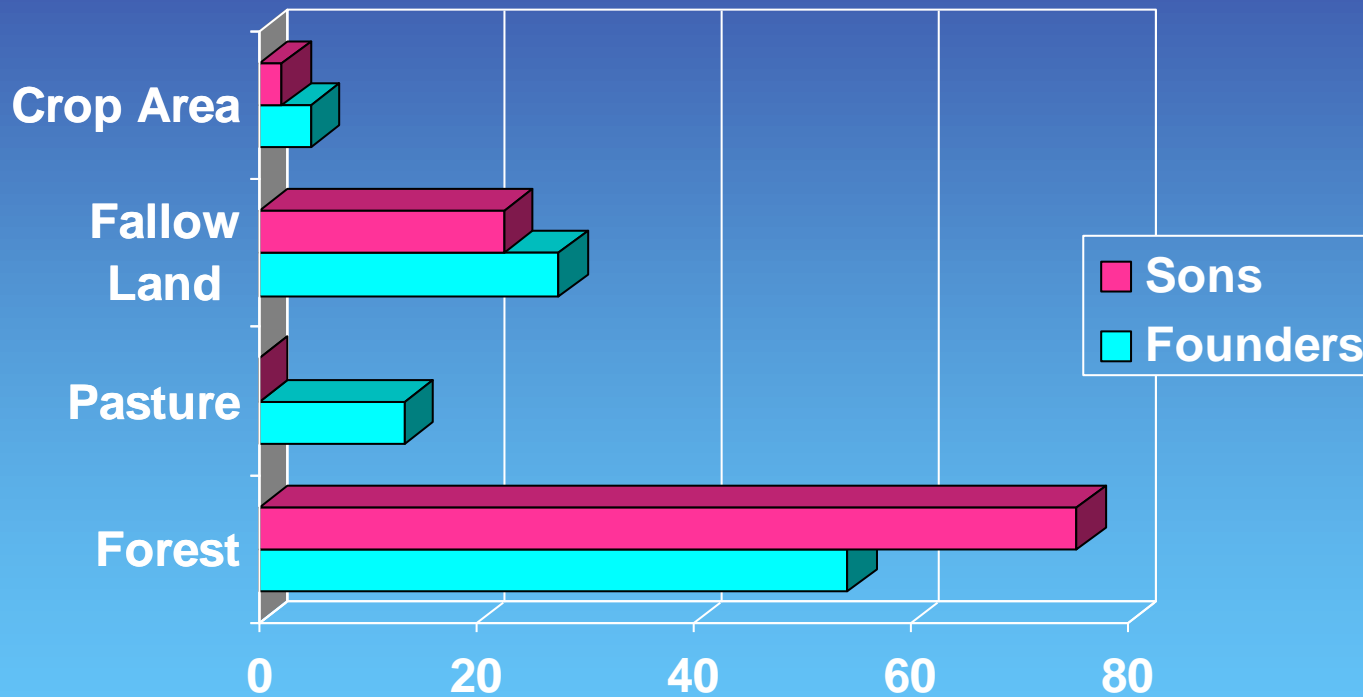
# Deforestation Rates from 1977 to 1996 in Corozal



# Land Distribution (%) in Corozal and Agua Azul in 1996

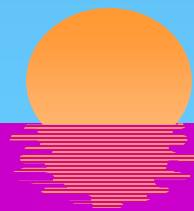


# Land Distribution (%) in Corozal per Group in 1996



# Trends of Founders' Households and Sons' Households

- ✓ Deforestation rates in both groups had been decreasing since 1976
- ✓ From 1983 to 1996, sons' households were not involved in cattle activities
- ✓ Sons' households started agricultural activities in 1983

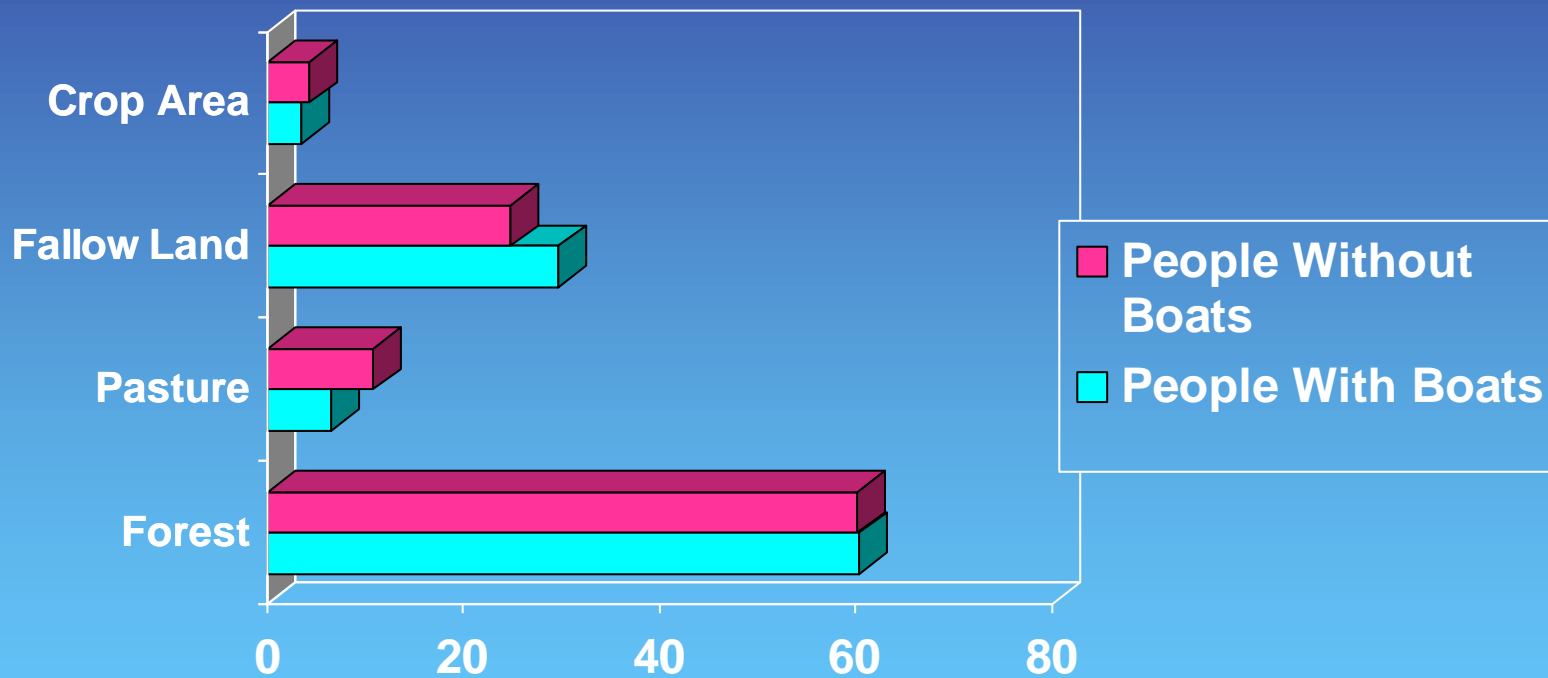




# Trends of Founders' Households and Sons' Households in 1996

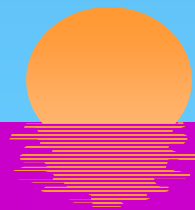
- ✓ Founders' households had more land in agriculture than sons' households
- ✓ Sons' households had more land in forest than founders' households
- ✓ Forest to total area (F/T) ratio was higher in the sons' households
- ✓ Sons' households converted on average more forest land into agriculture than founders' households.

# Land Distribution (%) in Corozal per Group in 1996



# Similarities of Households with Boats and Households without Boats

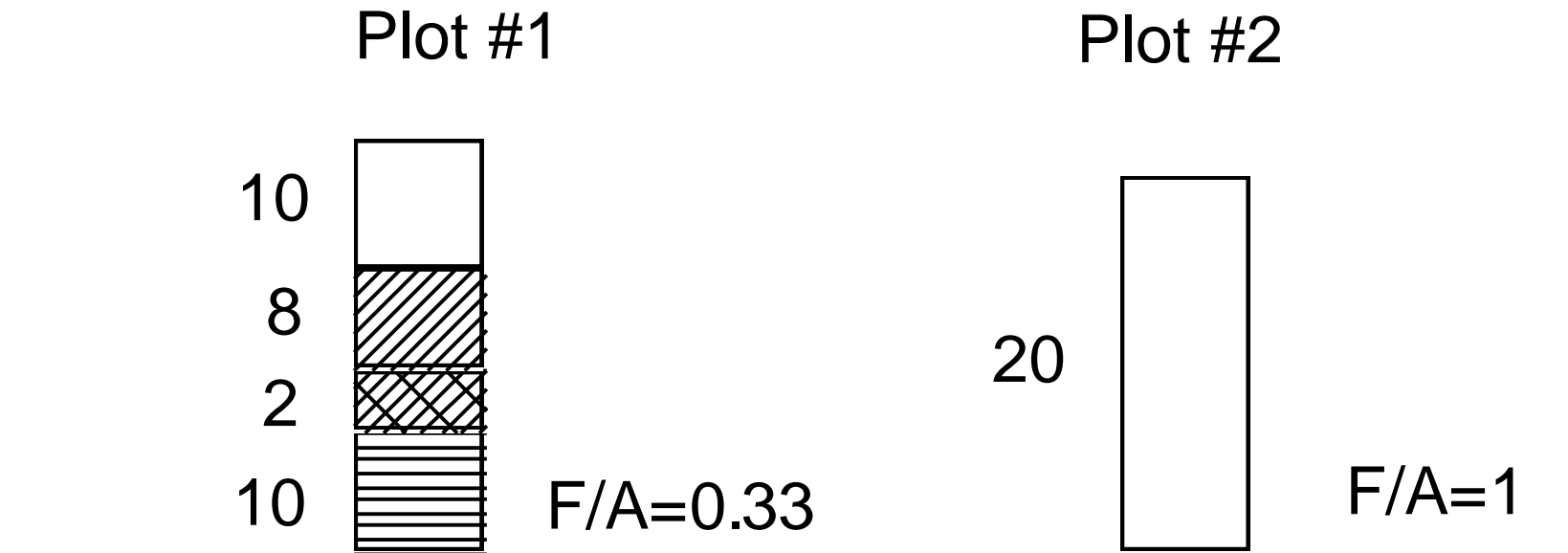
- Deforestation rates had been decreasing
- Had similar percentage of their total land in forest
- Had Fall corn cultivation
- Were involved in cattle activities



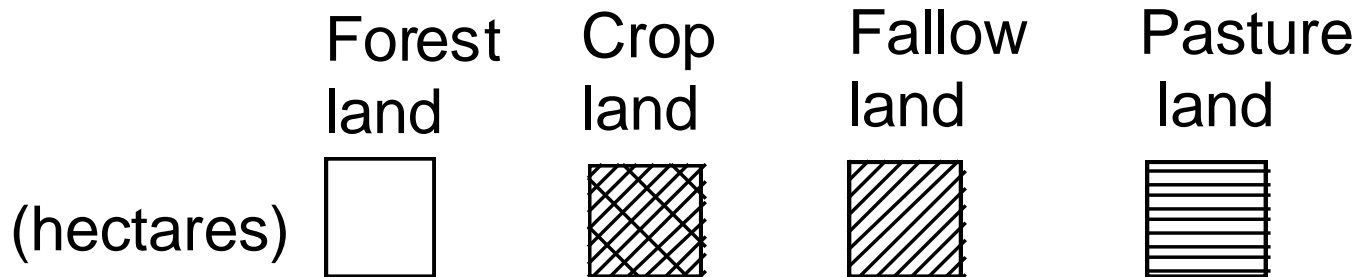
# Trends of Households with Boats and Households without Boats in 1996

- ✓ Households without boats
  - had more land in agriculture
  - had a higher percentage of their total land in pasture
- ✓ Households with boats
  - did not report Spring corn cultivation
  - converted less forest land to agriculture

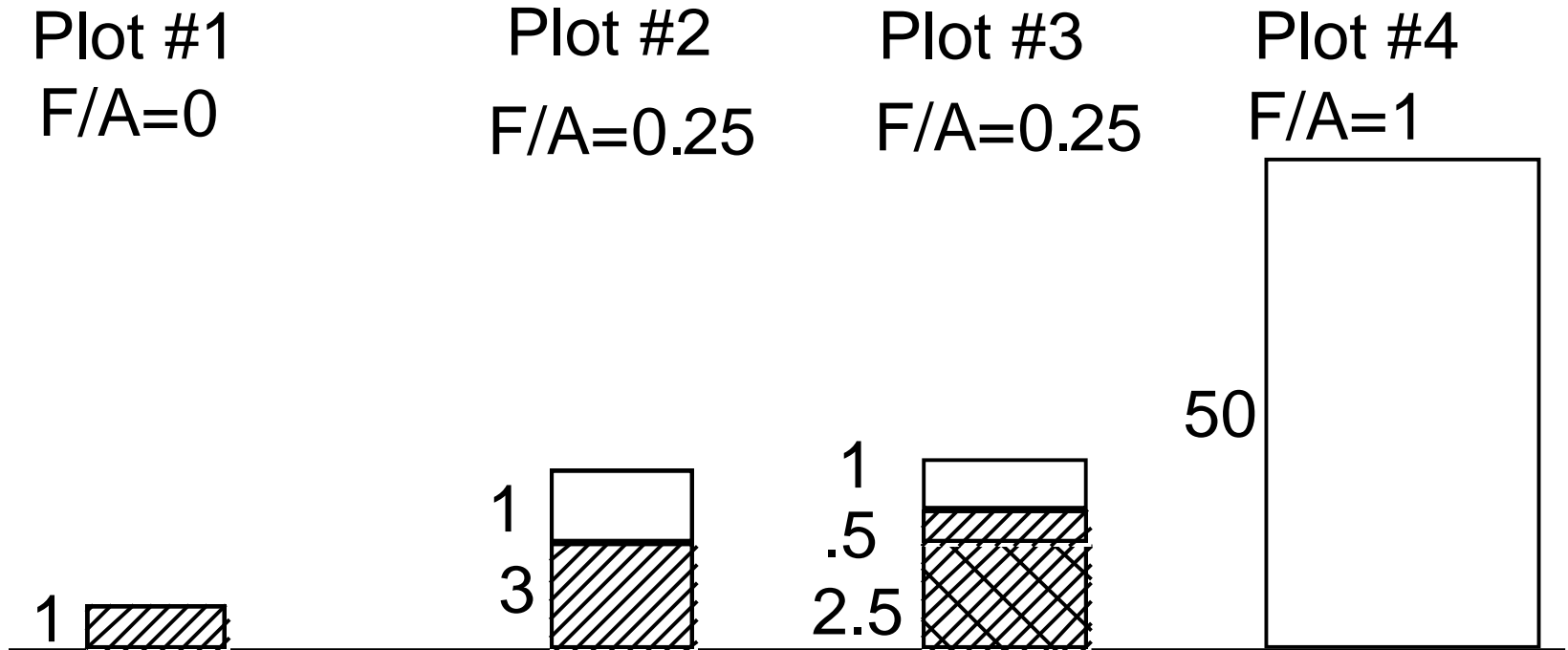
# Individual Model of Land Use



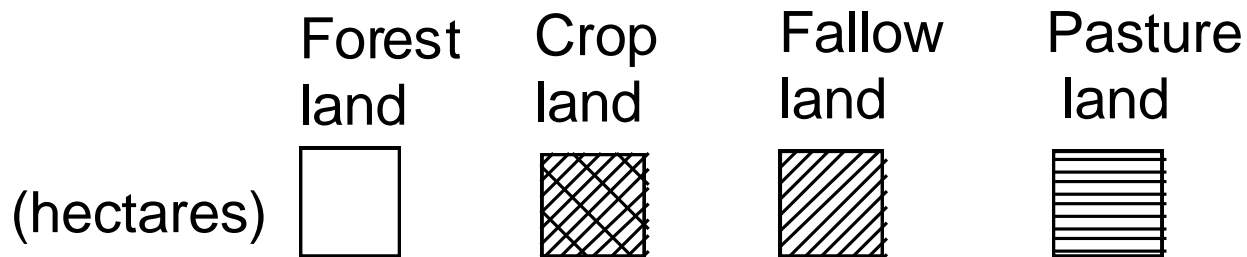
F/A=Forest/Total area

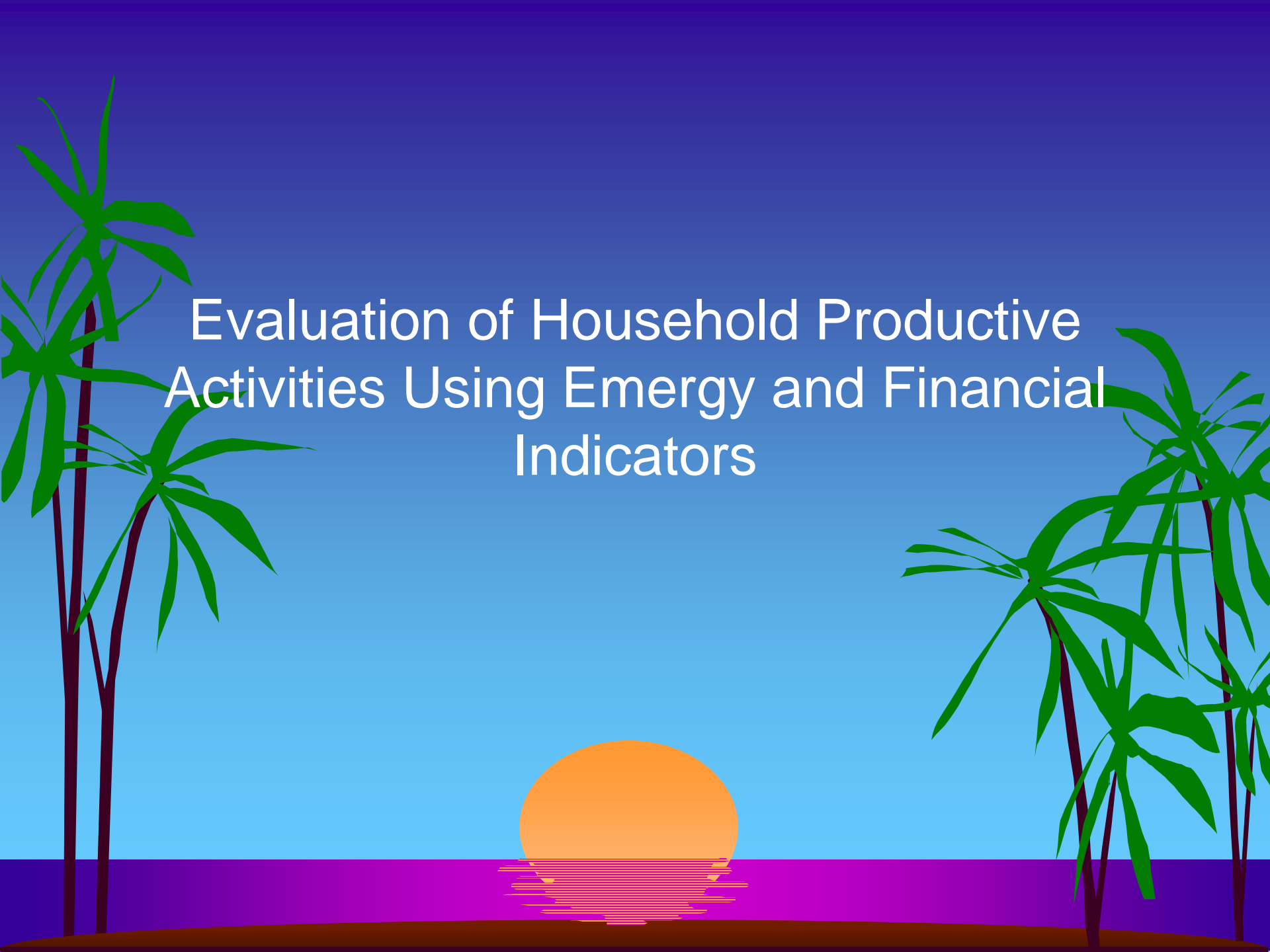


# Individual Model of Land Use



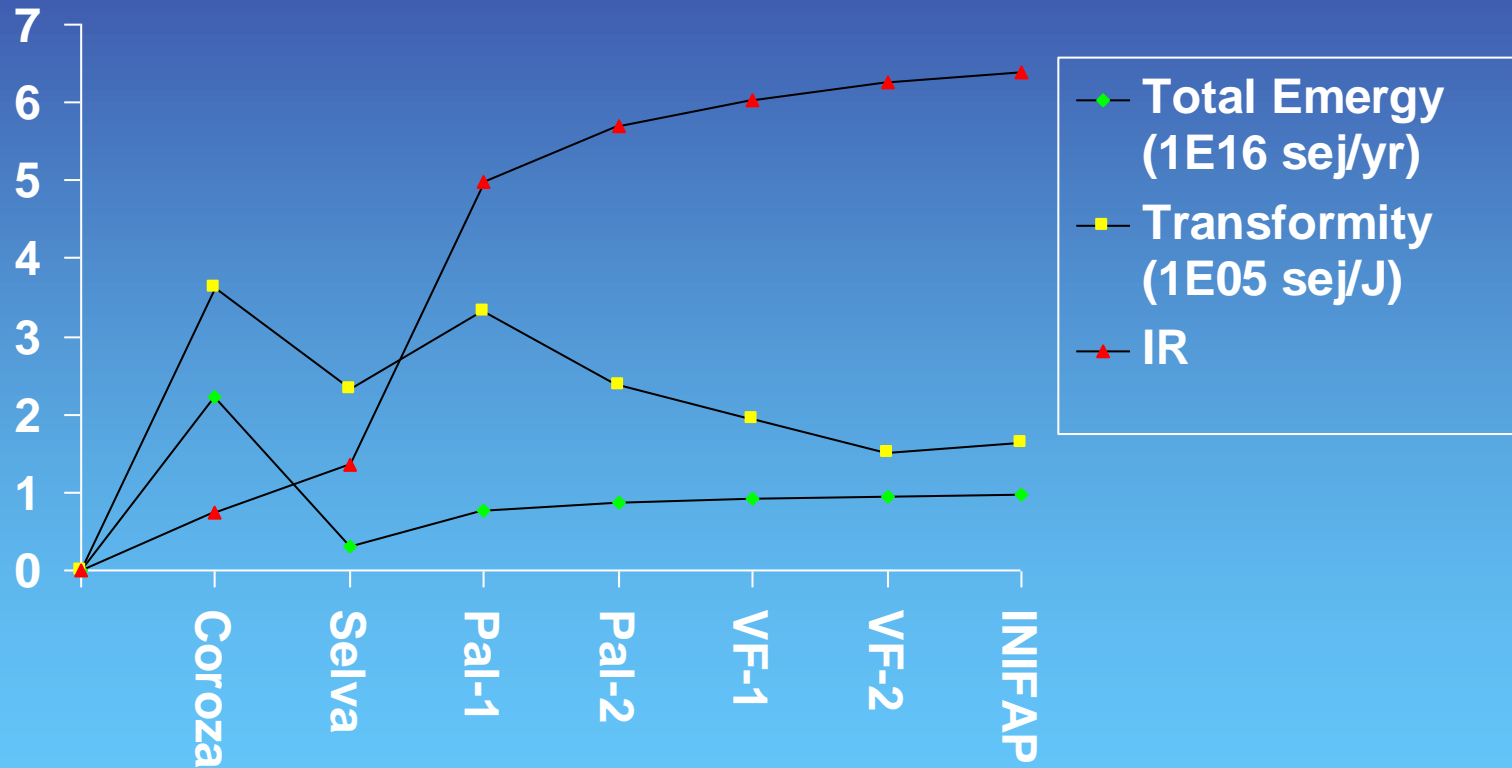
F/A=Forest/Total area



The background of the slide features a stylized tropical sunset. The sky is a gradient from light blue at the top to a darker blue at the bottom. A large, bright orange sun is positioned on the horizon, with its reflection shimmering on the dark blue water below. On either side of the sun, there are several palm trees with green fronds and brown trunks. The overall scene is peaceful and evokes a sense of a tropical environment.

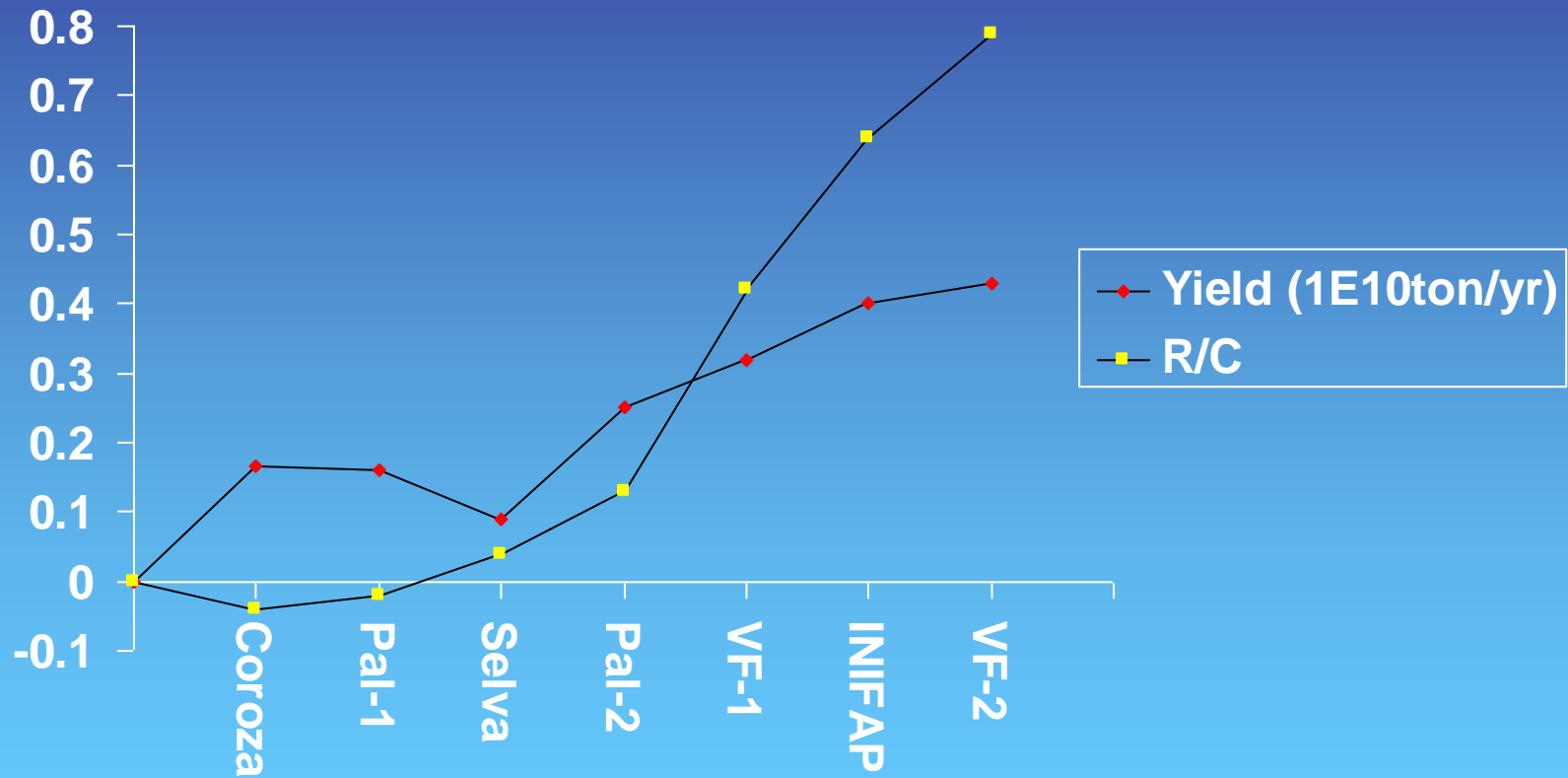
# Evaluation of Household Productive Activities Using Energy and Financial Indicators

# Total Energy, Transformity and Investment Ratios for Corn Systems

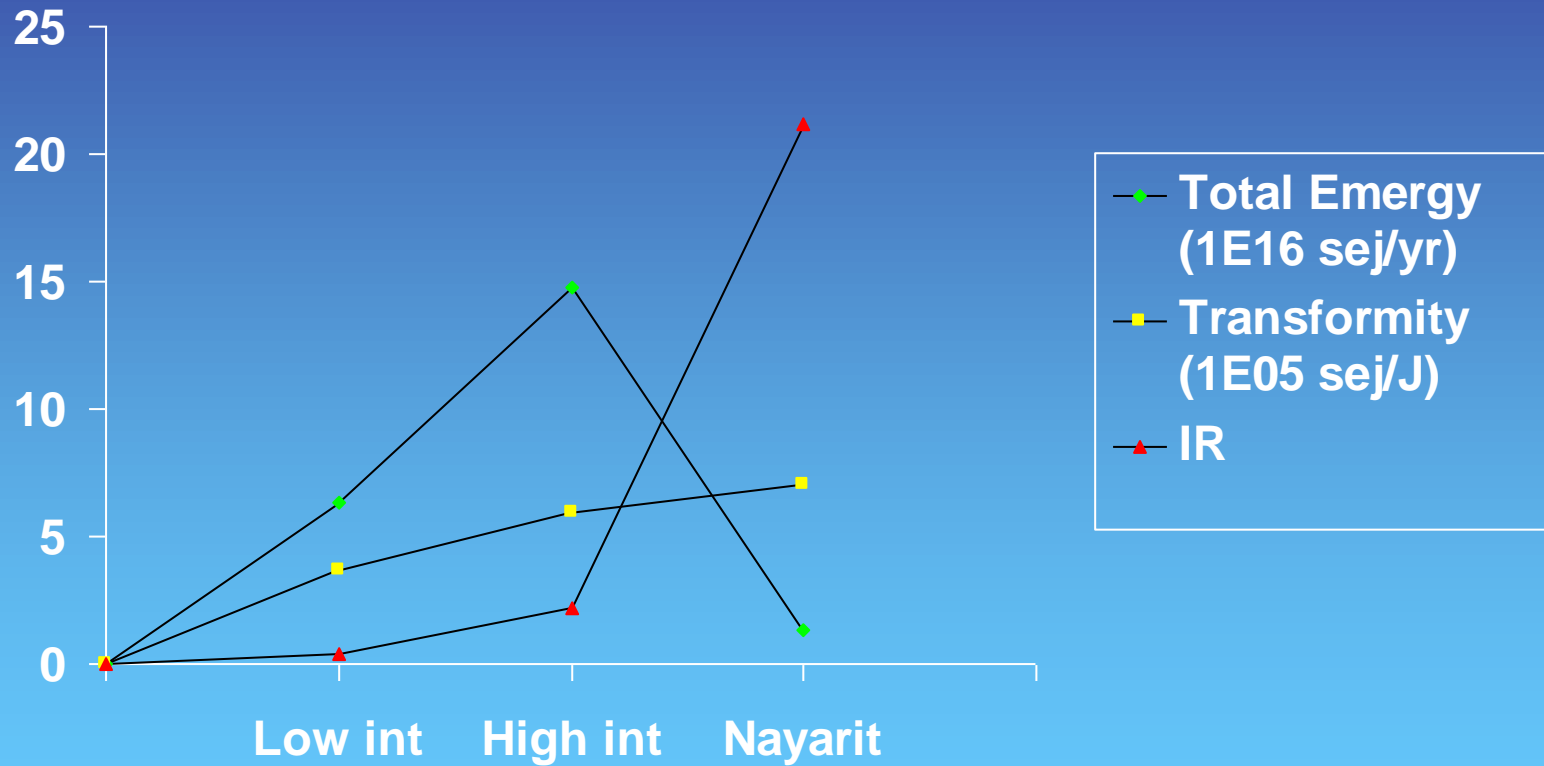




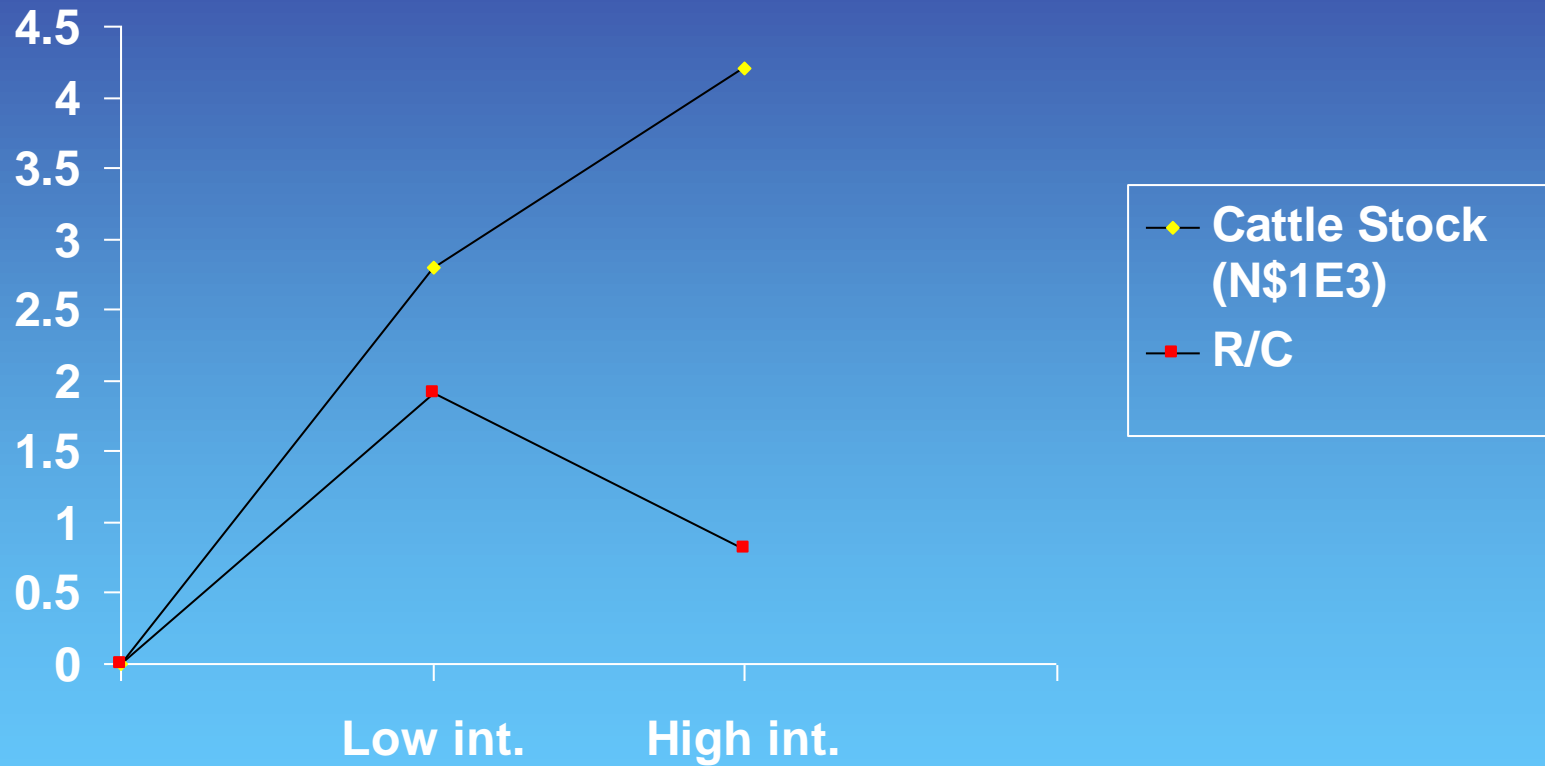
# Yield and Revenue Cost Ratios for Corn Systems



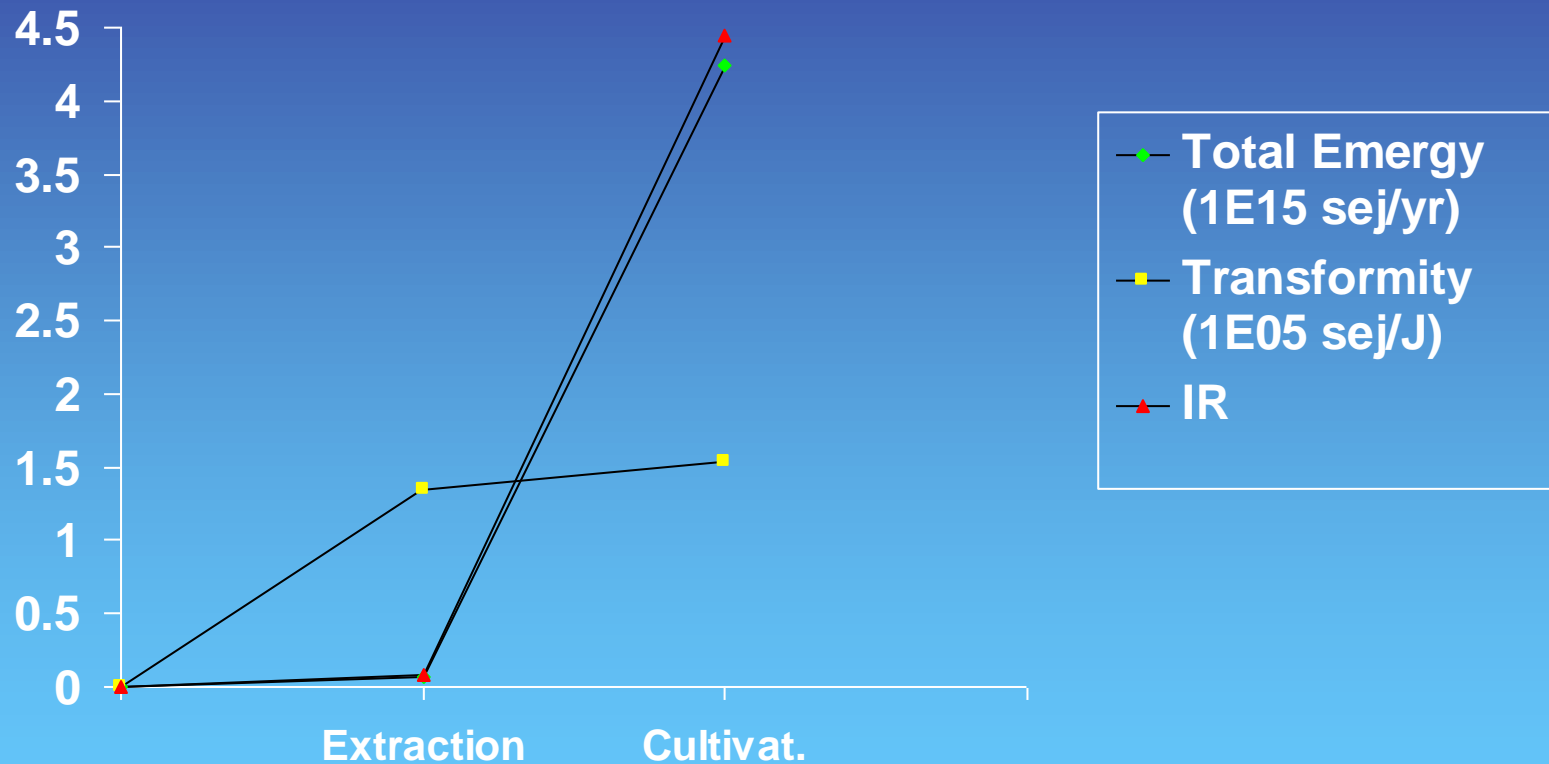
# Total Energy, Transformity and Investment Ratios for Cattle Grazing Systems



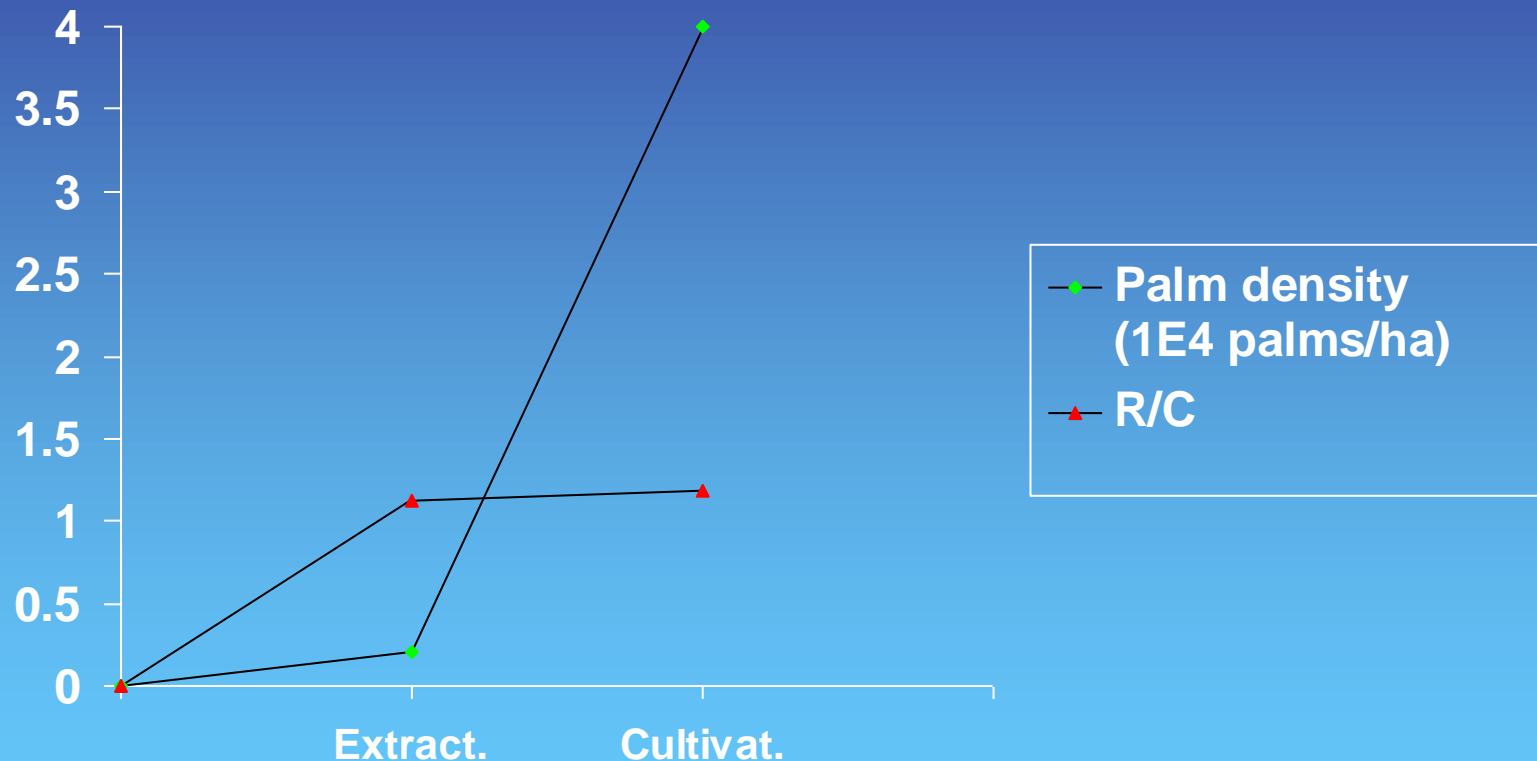
# Cattle Stock and Revenue Cost Ratios for Cattle Grazing Systems



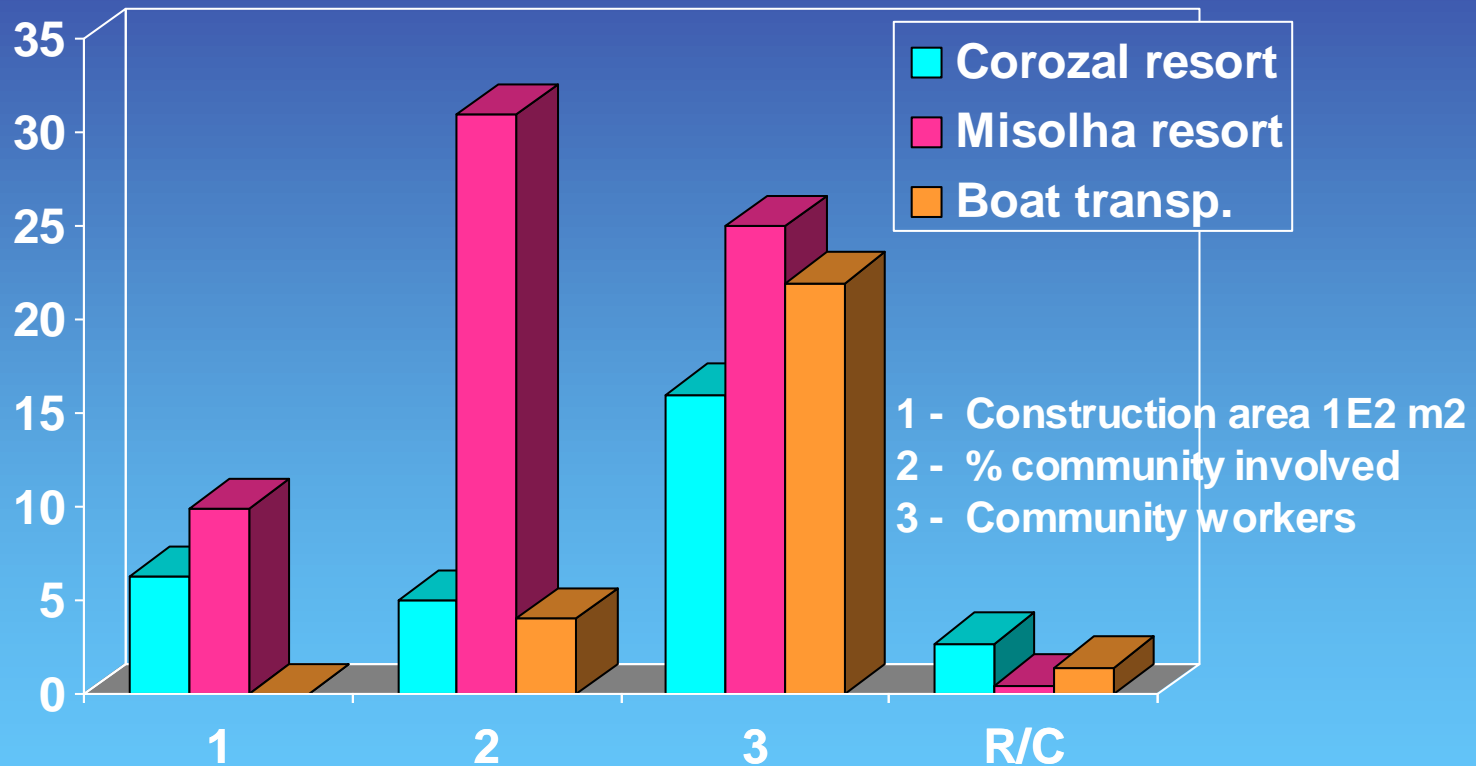
# Total Energy, Transformity and Investment Ratios for Palm Systems (1 Hectare)



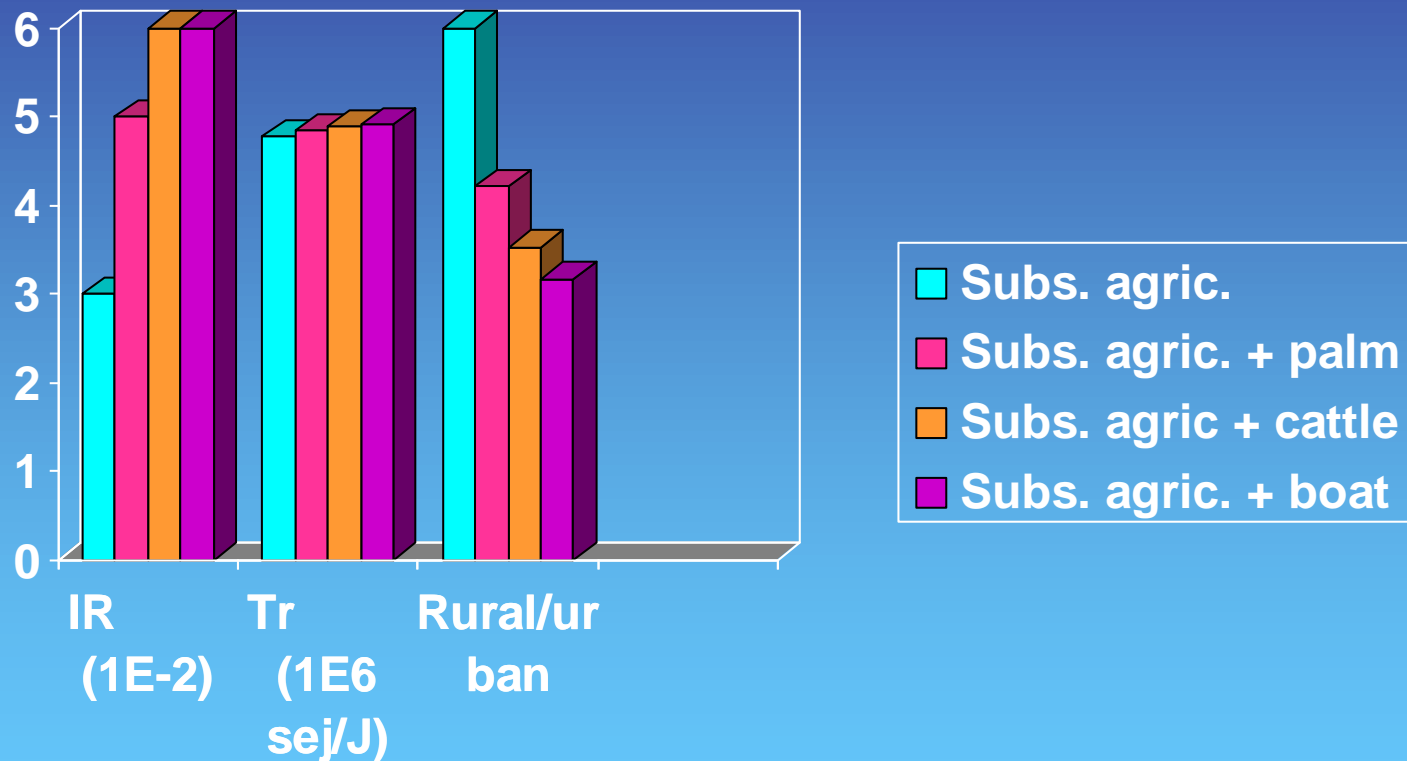
# Palm Density and Revenue Cost Ratios for Palm Systems (1 Hectare)



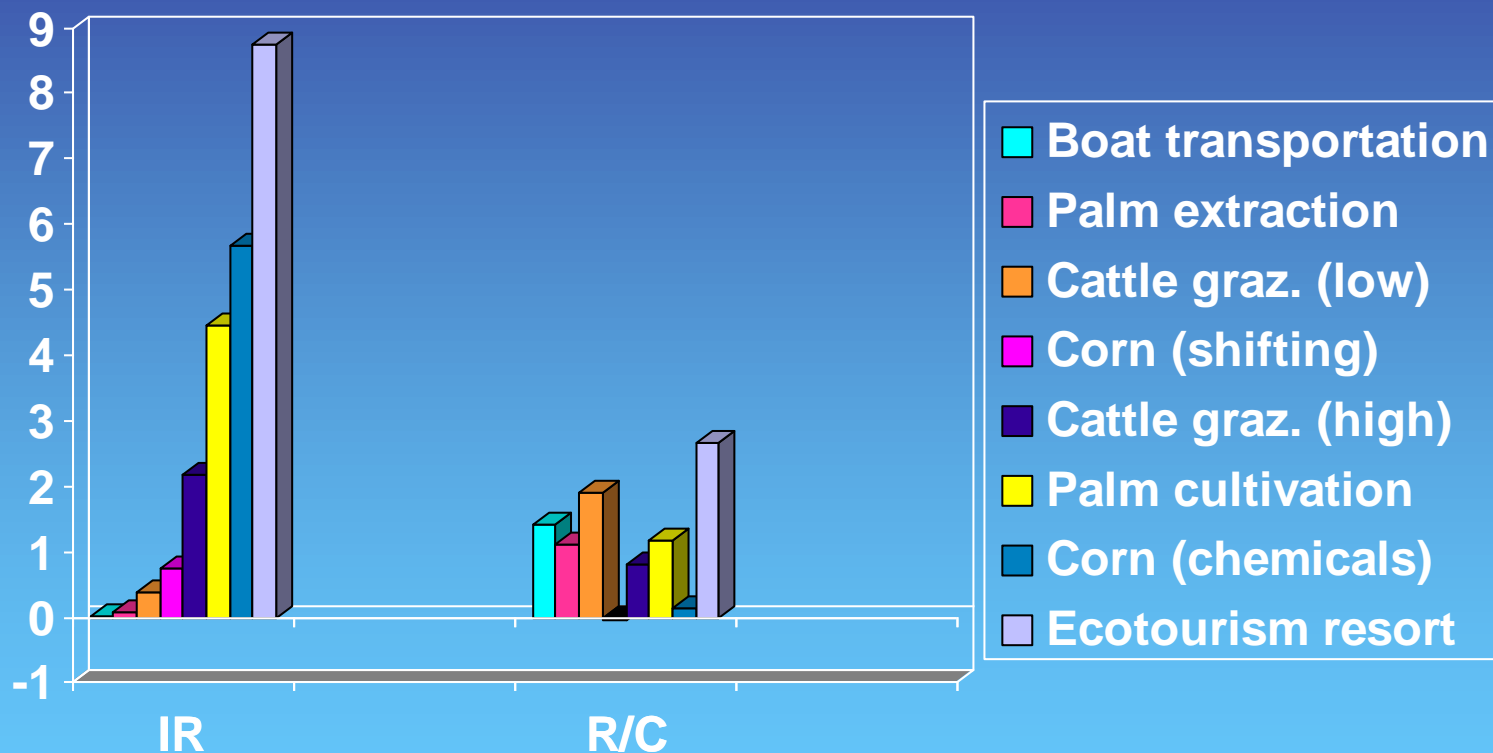
# Comparison of Ecotourism Activities in the Lacandon Forest (1997)



# Investment, Transformity and Rural to Urban Ratios for Different Households Inputs (1996)

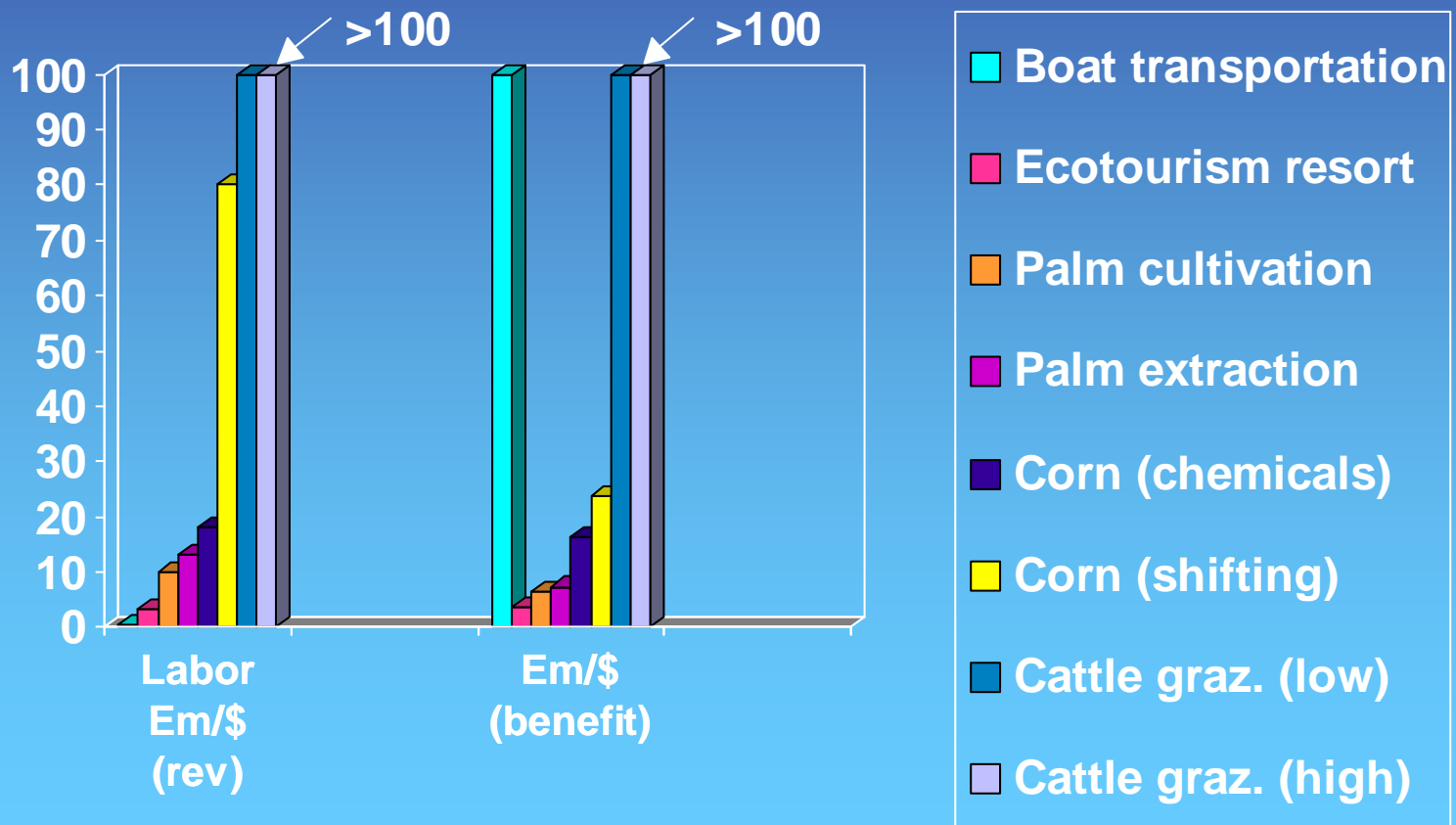


# Investment and Revenue/Cost Ratios for Household Productive Activities in Corozaal





# Labor Emergy/\$ (revenue) and Emergy/\$ (benefit) Ratios for Household Productive Activities in Corozaal



# Trends in Household Productive Activities in Corozal

- ✓ Ecotourism resort brought more money to the households with the minimum amount of energy invested (free and purchased) followed by palm systems.
- ✓ Cattle grazing systems required more energy invested to obtain financial benefits. However, low intensity cattle grazing was one of the most profitable activities measured by the financial revenue/cost ratio.

# Trends in Household Productive Activities in Corozal

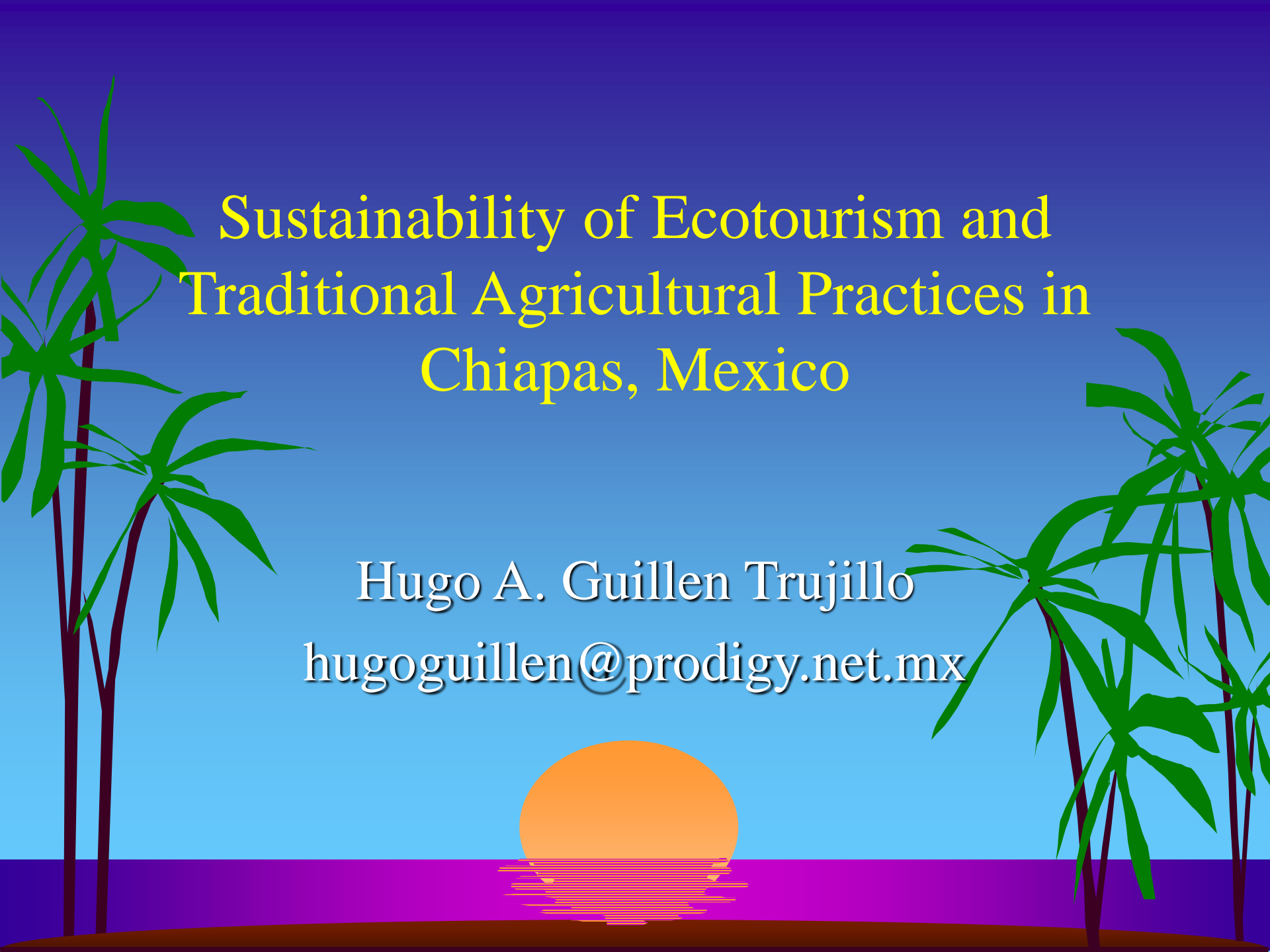
- ✓ Boat transportation had the lowest investment ratio followed by palm extraction.
- ✓ The ecotourism resort had an investment ratio similar to those ratios found in industrialized economies such as United States (7).

# Trends in Household Productive Activities in Corozal

- ✓ Ecotourism activities were the systems with the least labor energy required to obtain one dollar in revenue and with the highest financial revenue/cost ratios.
- ✓ The least sustainable activities measured either by the energy/\$ (benefit) ratio and the labor energy/\$ (revenue) ratio were the cattle grazing activities.

# Trends in Household Productive Activities in Corozal

- ✓ Government loans and subsidies which affected the financial R/C ratio influenced the householder's decision related to household productive activities.



# Sustainability of Ecotourism and Traditional Agricultural Practices in Chiapas, Mexico

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