

# Land Use Change and Human Systems Dynamics

Cotacachi Ecuador  
1963-2000

Robert E. Rhoades

University of Georgia

2004

# Objectives

- Analyze land-use change over 40 years in Cotacachi, Ecuador
- Link land-use change to human system dynamics
- Discuss implications for sustainability





# SANREM - ANDES

SUSTAINABLE AGRICULTURE AND NATURAL  
RESOURCES MANAGEMENT

Innovative research for people and ecosystems

Cotacachi Ecuador  
1998-2004



USAID

English version

Versión en español



SANREM

Quit

MAIN MENU

Scaling up



Actions

Scaling back

Authors

Style  
Template-english

Quit

Home

SANREM Los Andes. Cotacachi - Ecuador

# Sustainable Mountain Futures

SANREM-Andes goal:

"Improving mountain livelihoods and habits by linking sustainability science with community values and knowledge"



Quit

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Sustainable Mountain Futures

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## Sub Menu

### Sustainable Mountain Futures



Why?



Objectives  
Key Issues

Andes / South  
America  
Ecuador  
Cotacachi Parish  
Project Area



Where?



How?



Landscape / Lifescape  
Participatory  
Interdisciplinary  
Multi-Stakeholder  
Multi-Scale

Thematic Teams  
Local Collaborators  
Project management / Donors



Who?

Click these thumbnails  
and menus for details

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## Study Team

Thematic  
research teams

Cotacachi  
collaborators

Management /  
Donors

- USAID / SANREM  
Directorate
- SANREM-ANDES  
Coordination



Mr. Robert Hedlund  
USAID



Mr. Carlos Perez  
SANREM Director

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Sub-menu





# Lifescape



## History

- Prehispanic period
- Conquest
- Colonial period
- Independence
- Republican period

Rural and urban population  
Age distribution  
Population dynamics



## Demographics



## Socio-economics indicators

- Households
- Population



## Communities



## Food, culture and biodiversity

- Food and Identity
- Local diet
- Cuisine

Introduction  
Peasant communities  
Results  
Conclusions



## Migration



## Ethnoecology

- Ethnicity
- Gender roles
- Cognitive mapping
- Myths and legends
- Receipts and sayings
- Sacred landscapes

Click these thumbnails  
and menus for details

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Lifescape

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# Biophysical elements



Geology

Aerial photos  
Satellite image  
Contour lines  
Aspect  
Slope  
Triangular irregular network TIN  
Digital elevation model DEM



Topography



Climate / Weather



Introduction  
Metereological stations  
Precipitation  
Temperature  
Evaporation  
Humidity

Watersheds  
River systems  
Soil characteristics  
Soils and agriculture



Water and Soils



Biodiversity



Methodology  
Results

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and menus for details

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Landscape

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# Interactions



Farming systems



Introducción y descripción  
Zonas agroecológicas  
Calendarios agrícolas  
Cambios en los sistemas de producción

Objectives  
Methodology  
Results  
Maps  
Conclusions



Cambio en el  
uso del suelo



Agrobiodiversity



Change of crops and varieties  
Memory banking  
Women and homegardens

Objectives  
Methodology  
Sample selection  
Results  
Discussion



Economics of  
water allocation



Human - water interactions  
in the Pichavi's watershed

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and menus for details

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Interactions and Consequences

Menu



# Actions

Click these thumbnails  
and menus for details



Water quality monitoring



Introduction  
Objectives  
Water monitoring  
Results  
Comments



Water resources monitoring



Soils and LU management  
/ Modelling irrigation



Water & irrigation  
Erosion & conservation



Repatriation "Finca de los  
cultivos ancestrales"

Objectives  
"La finca"  
Cultivated varieties  
Results  
Discussion



3D model "Maqueta"



Future visioning



Atlas



Background  
Objectives  
Methodology  
Contents

Advocacy coalitions  
Coalitions for managing the Ecological  
reserve Cotacachi - Cayapas  
Coalitions for using and controlling water  
Coalitions around mining



Natural resources  
management coalitions

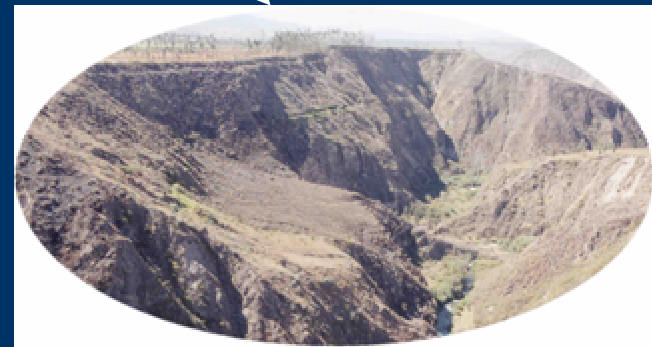
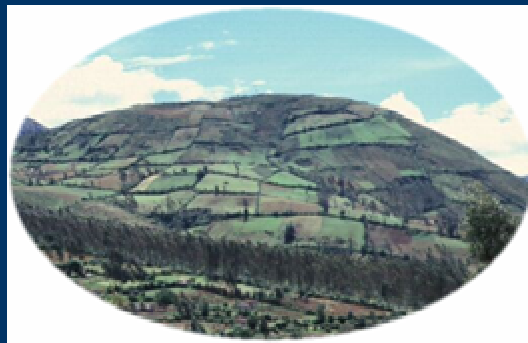
Quit

Home

Action

Menu



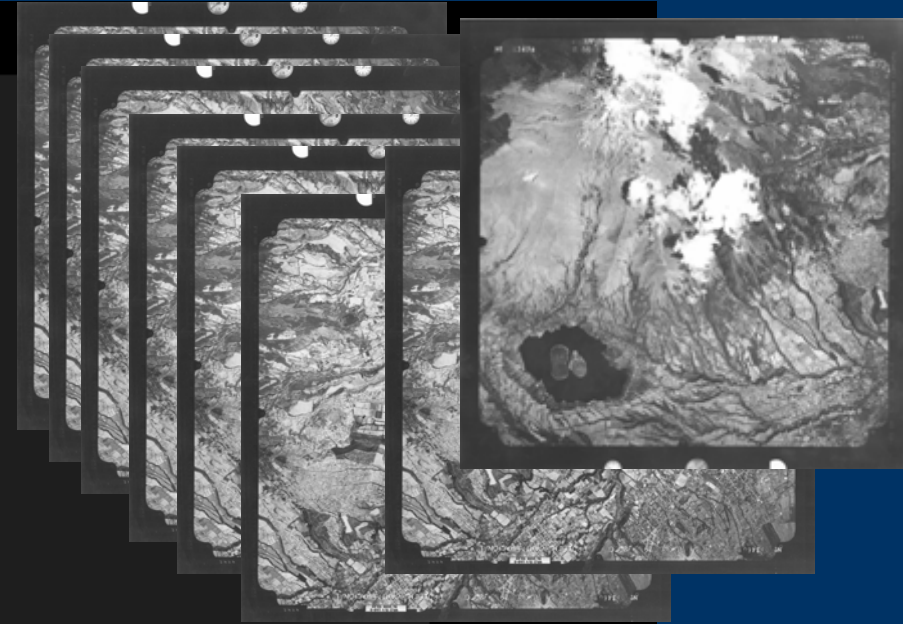
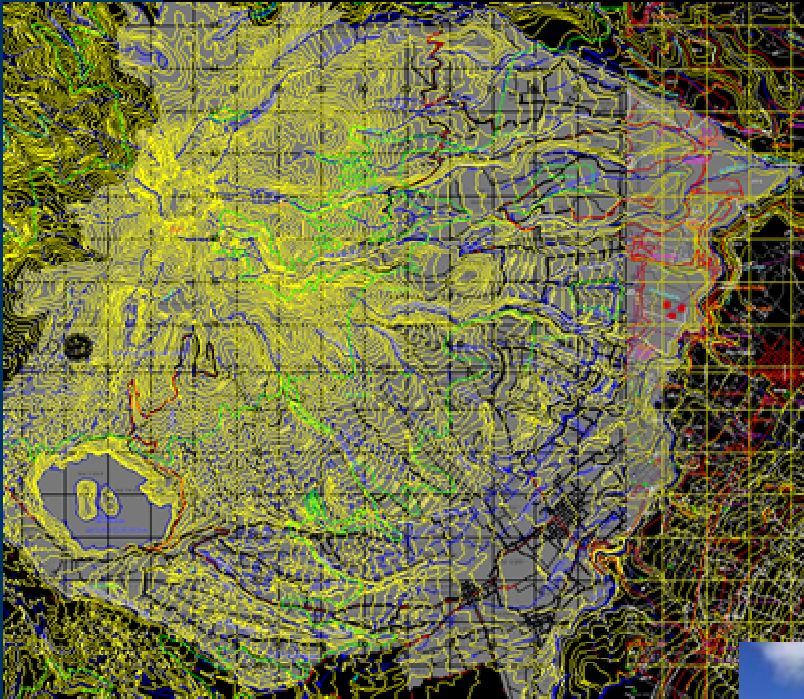


**LUC is the product of interaction between human and biophysical dimensions**

# METHODOLOGY:

Topographical maps IGM

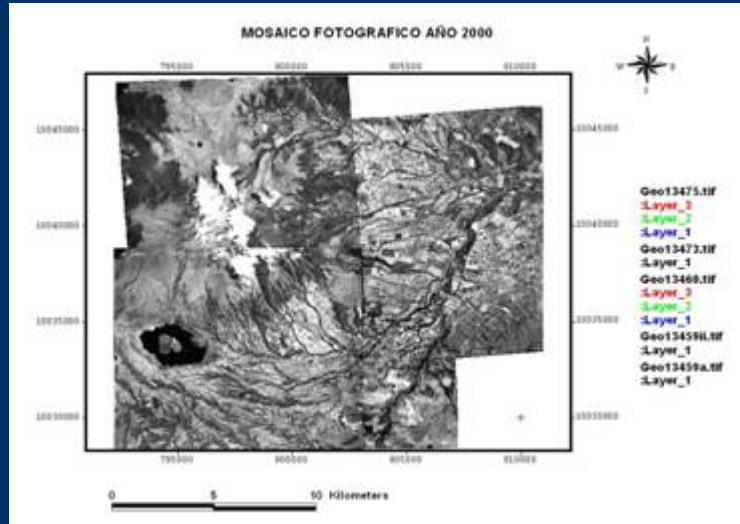
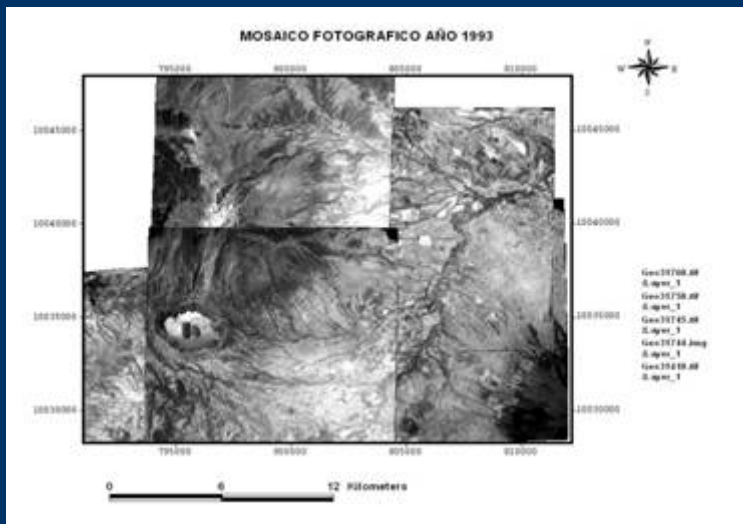
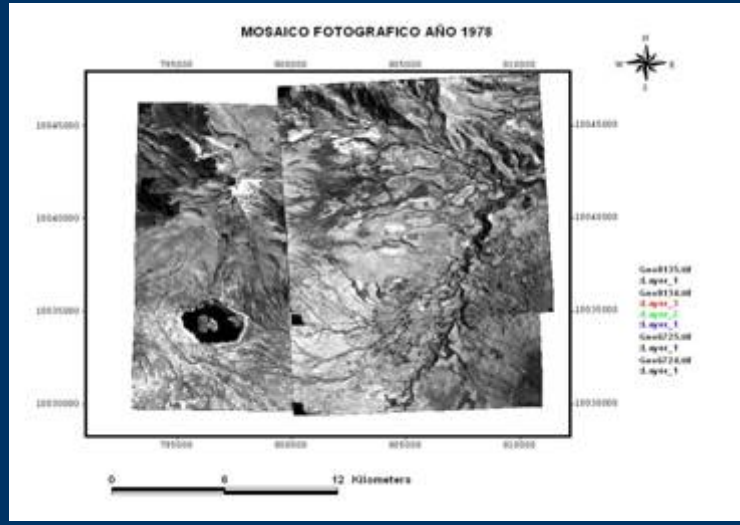
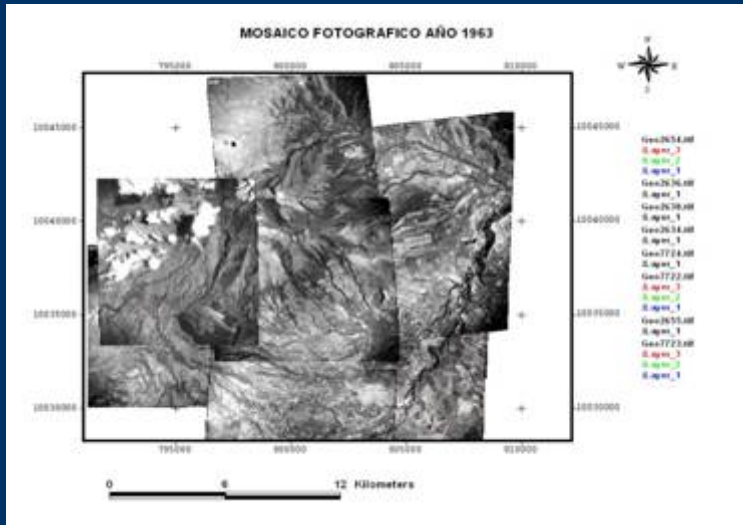
Set of aerial photos IGM



Field trips for observation

1963

METHODOLOGY: 1978



1993

2000

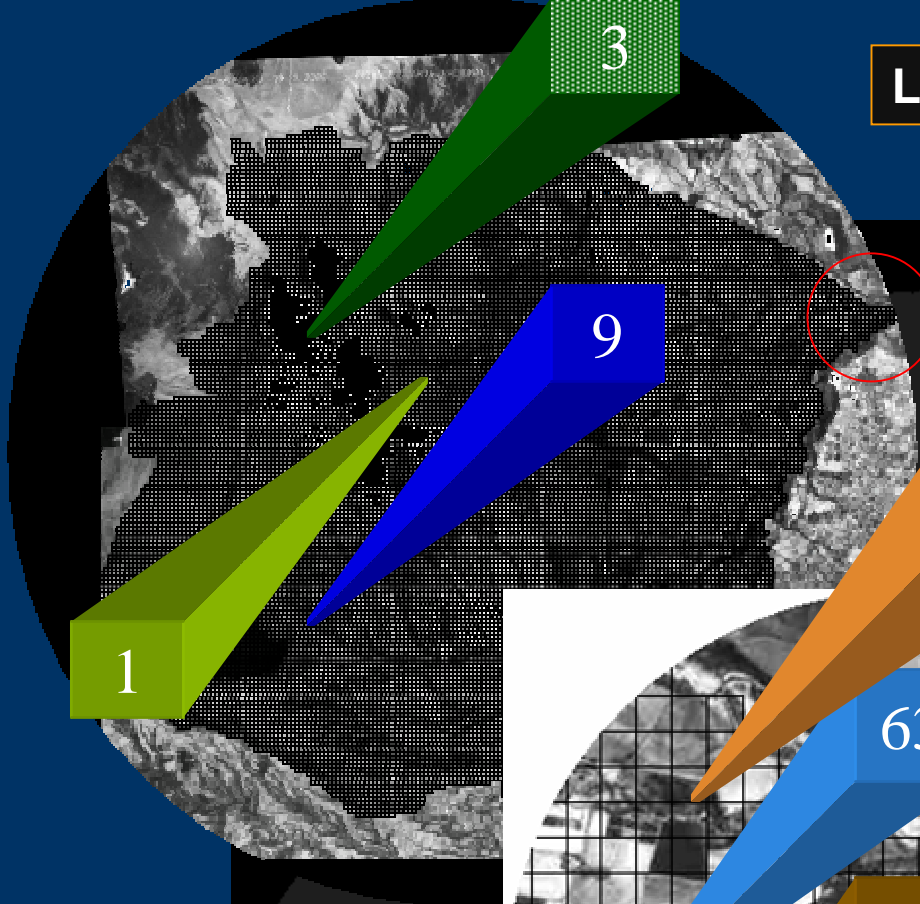
Rectified Aerial photos mosaic















# GROUND TRUTHING

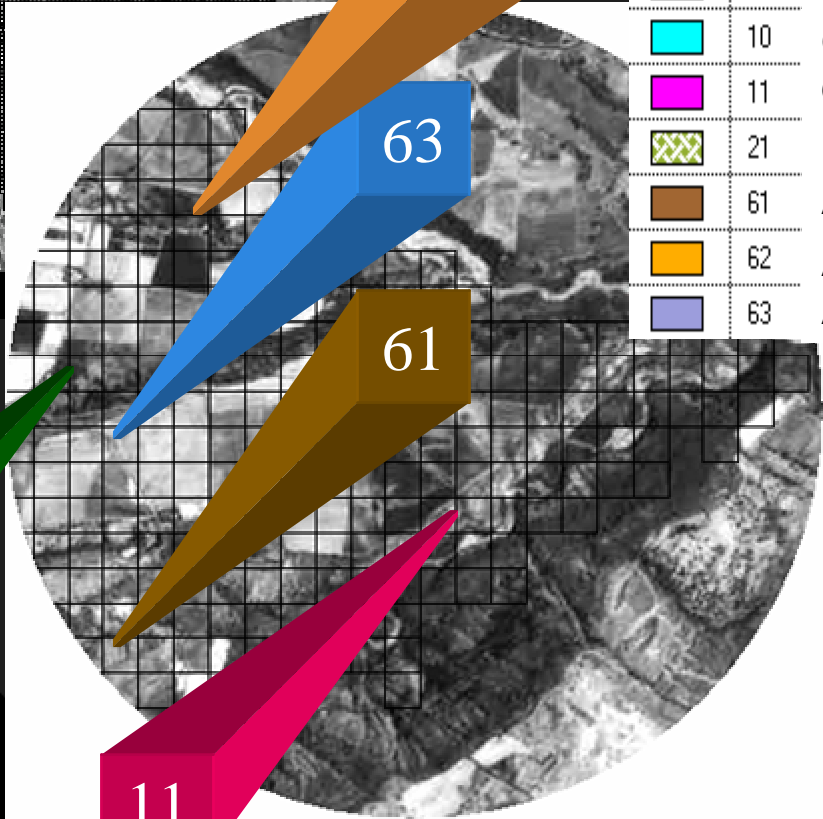




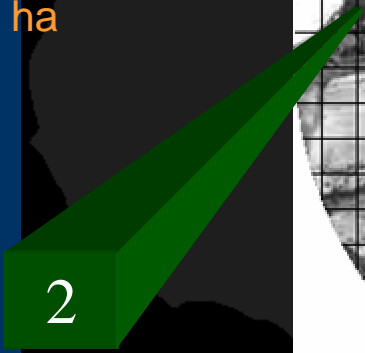
# LAND USE CATEGORIES



	1	Páramo.High andean vegetation.
	2	Brush land
	3	Primary native forest
	4	Planted forest
	5	Pasture
	7	Urban areas
	8	Glacier
	9	Lakes
	10	Greenhouses
	11	Others
	21	Páramo-Brush land mix
	61	Agricultural < 3ha
	62	Agricualtural 3-5ha
	63	Agricultural >5ha

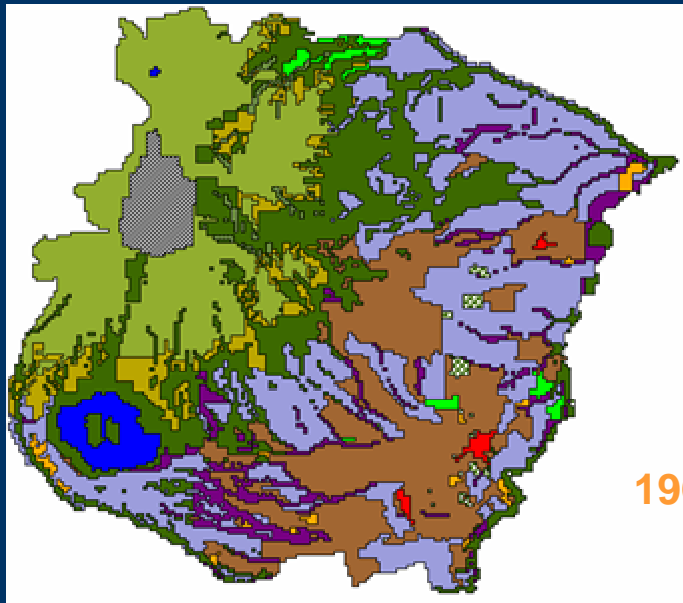


21902 ha

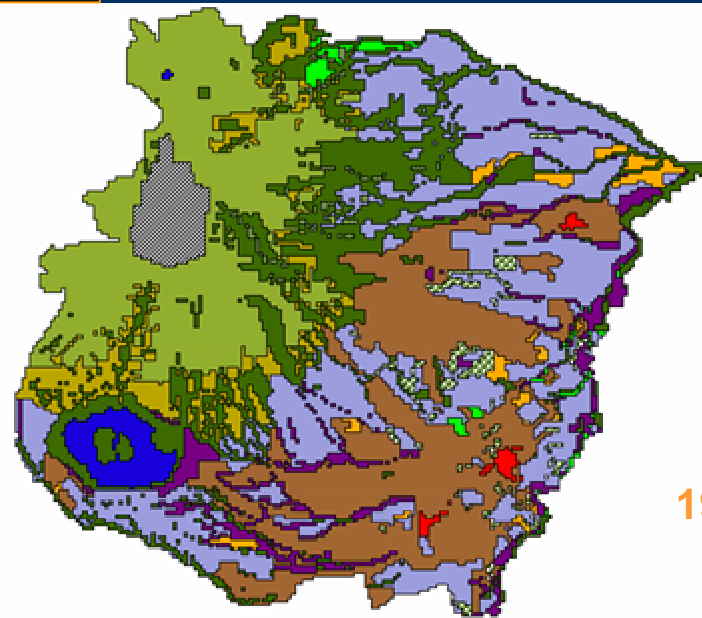


# LAND USE MAPS

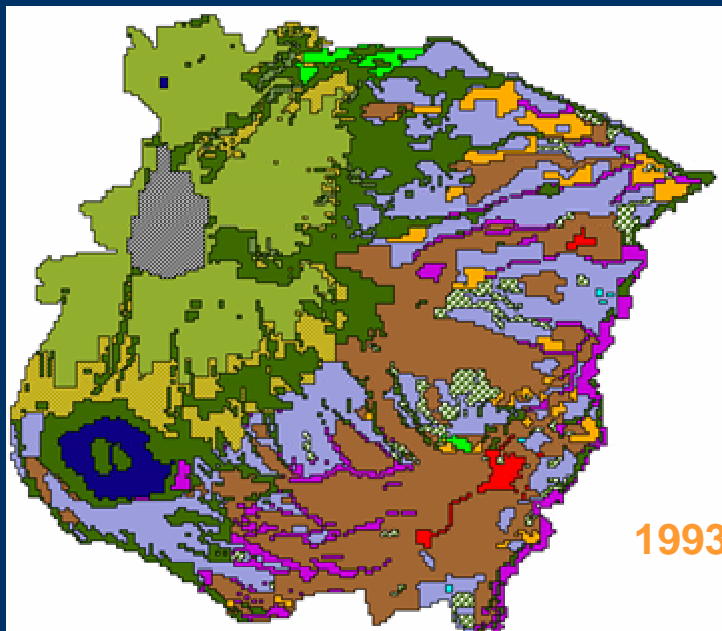
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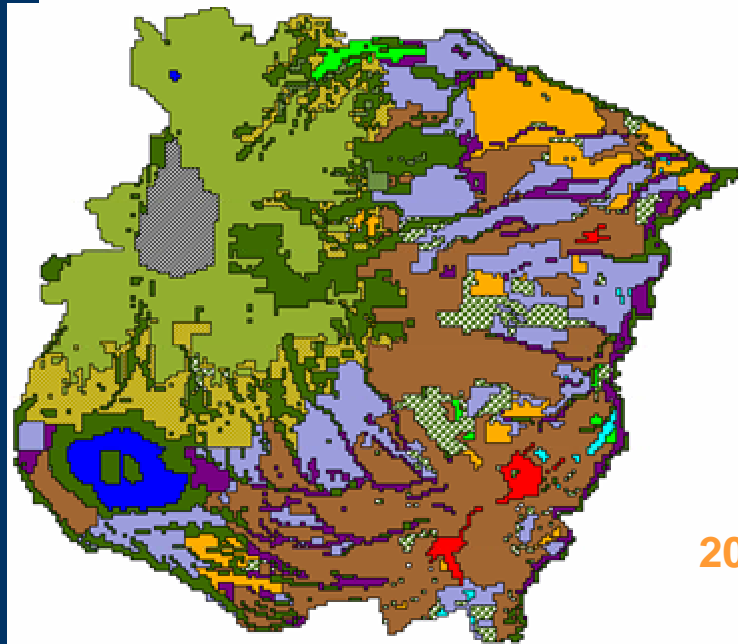
1963



1978



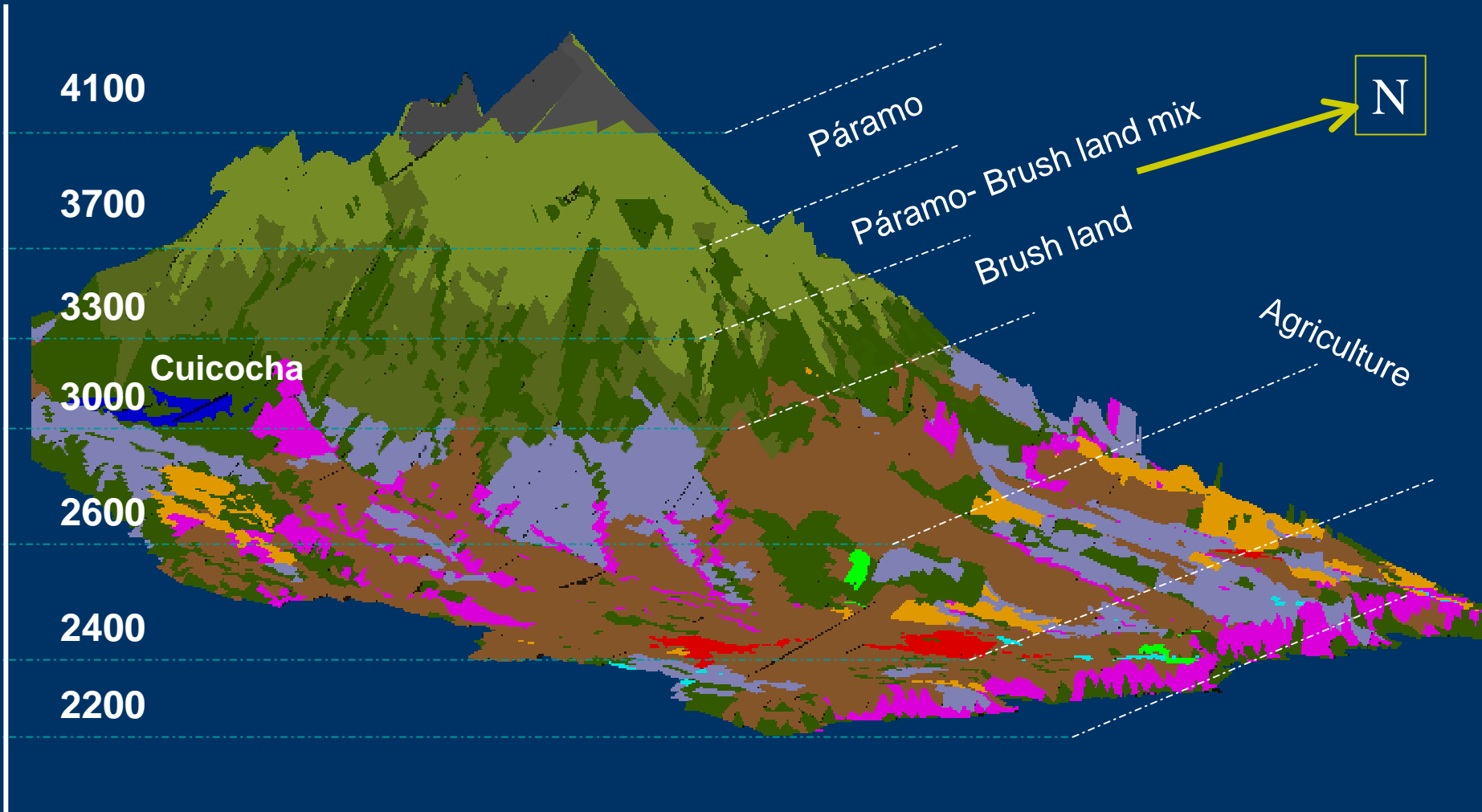
1993



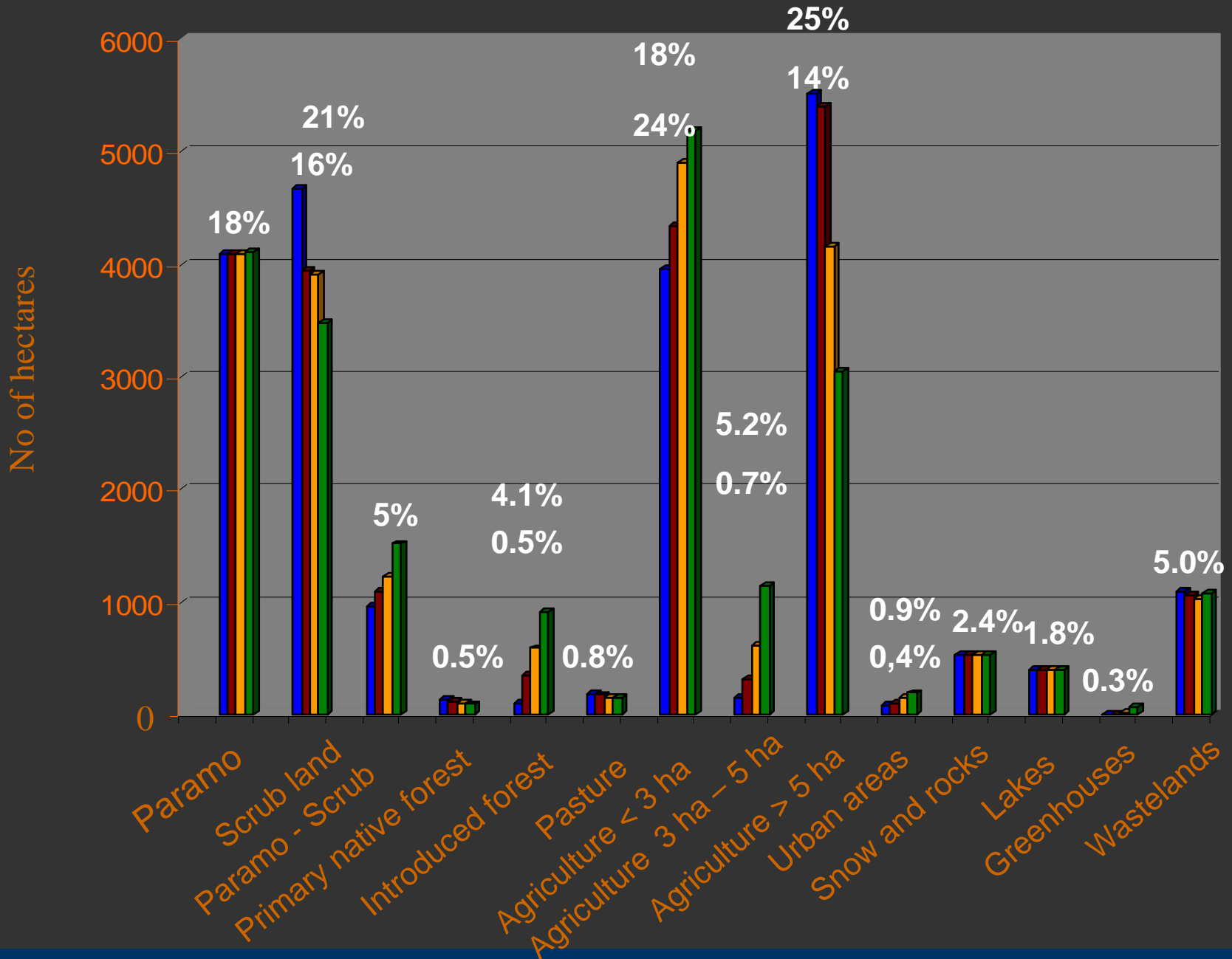
2000

# LAND USE VARIATIONS ACCORDING TO ALTITUDE

Cotacachi Mt. 4939 m



# LAND USE CHANGE DYNAMICS



# Select Land Use Change

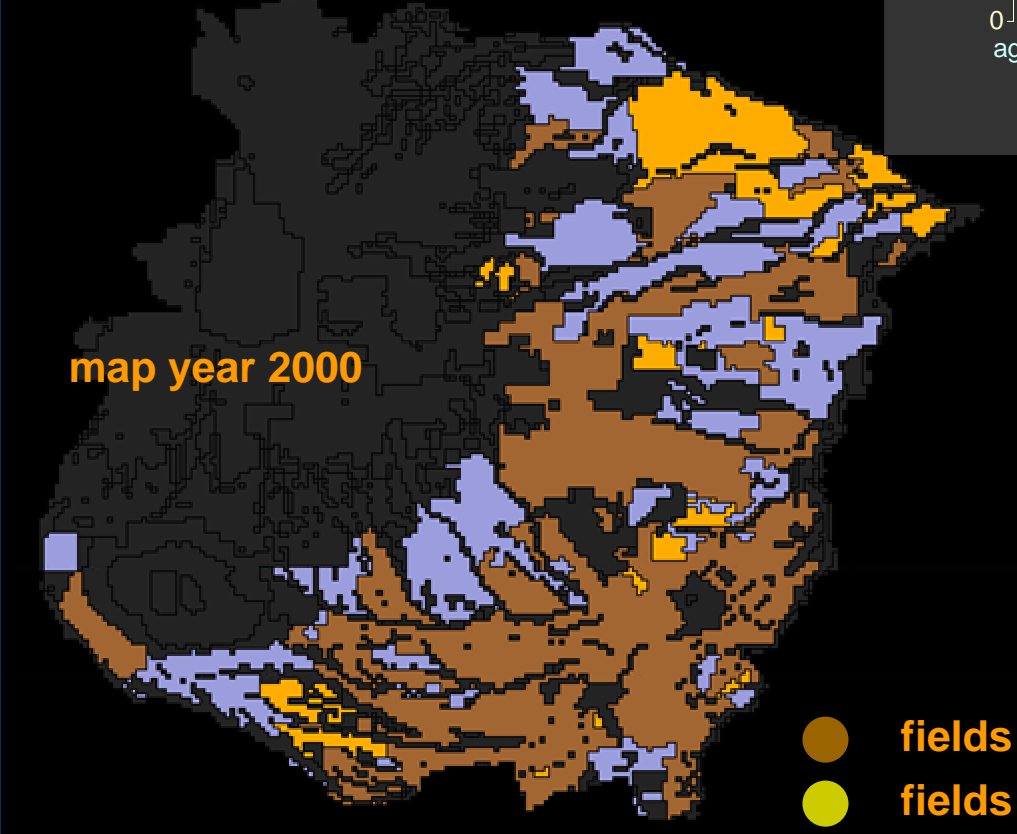
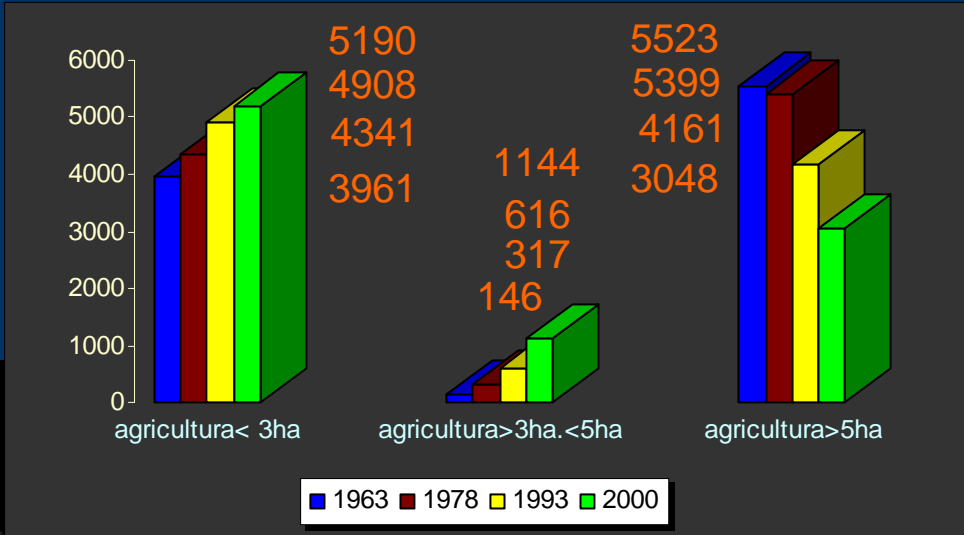
- Fields >5ha **decreased**: 5523ha to 3048ha
- fields 3-5 increased: 146ha to 1144ha
- Fields <3ha increased: 3961 to 5190ha
- Planted forests increased: 106ha to 906ha
- Urban zone increased: 83ha to 191ha
- Green houses increased: 0ha to 68ha



# AGRICULTURE

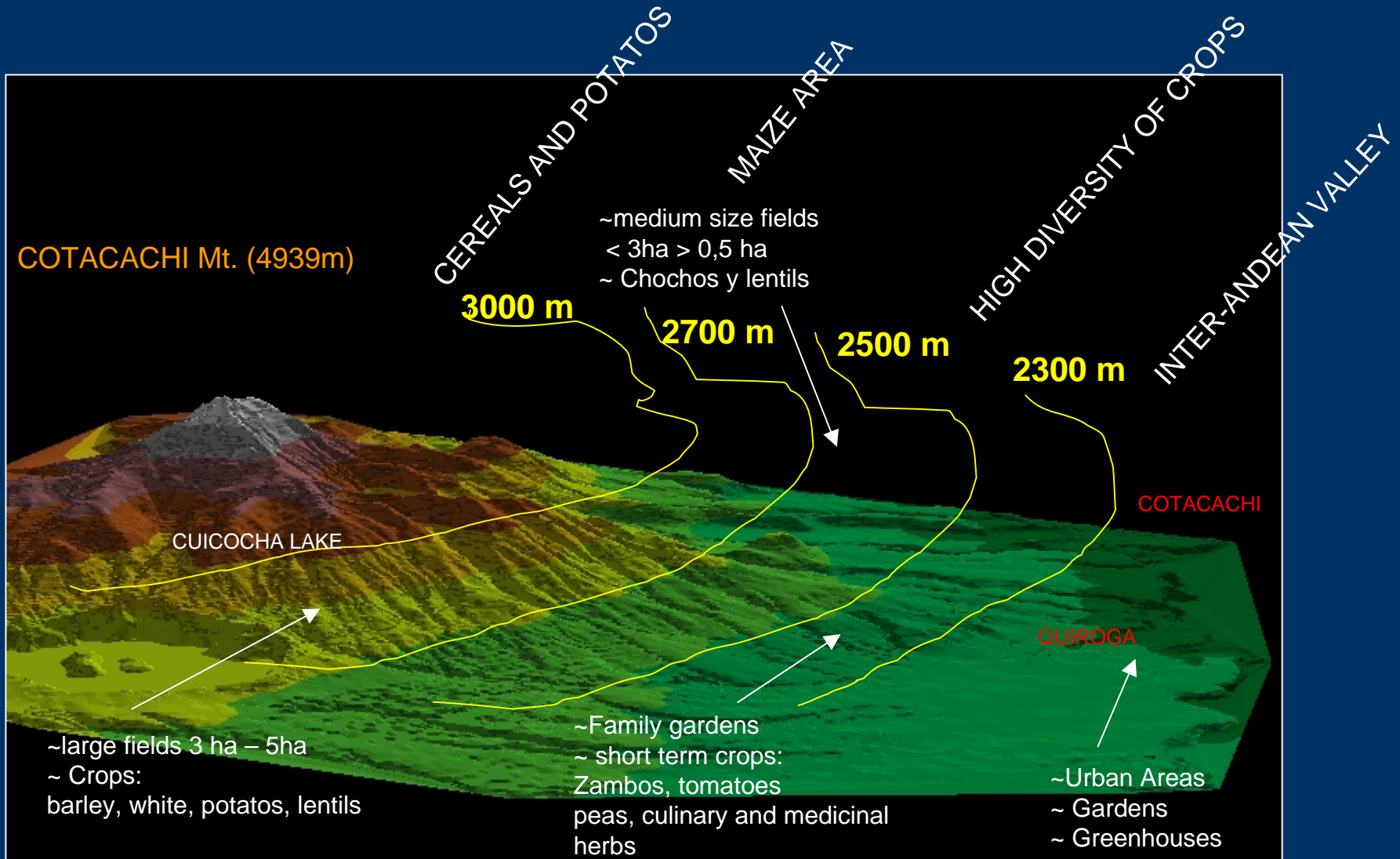


hectares

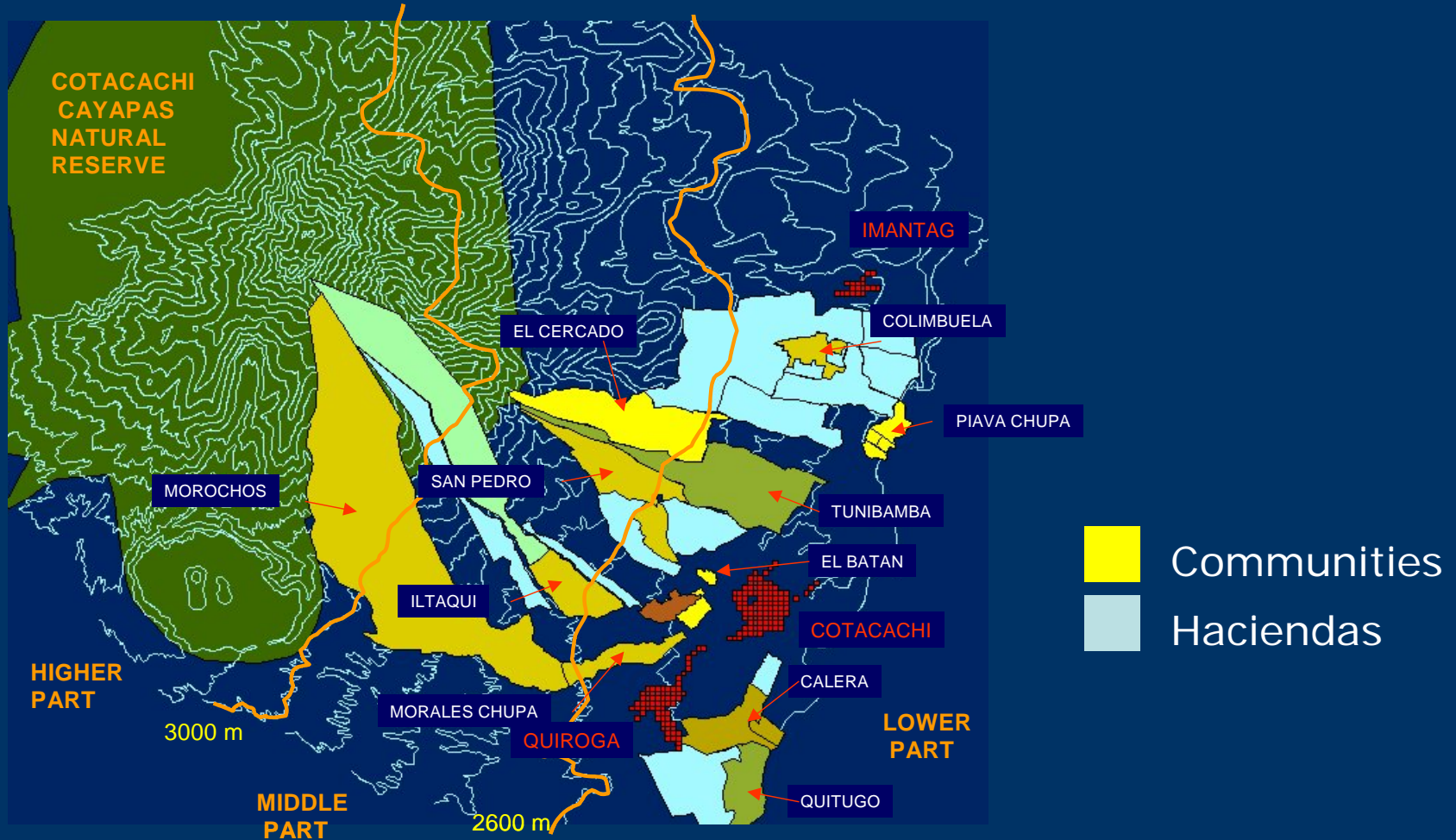


Aerial photo 13460, year 2000. Community of Colimbuela.

# Agricultural zones of Andean Cotacachi



# Communities and Haciendas at Cotacachi





## LAND USE CHANGE



Hacienda Ocampo (photo 13460 year 2000)  
Covered by eucalyptus trees.

Process of fragmentation  
of indigenous lands

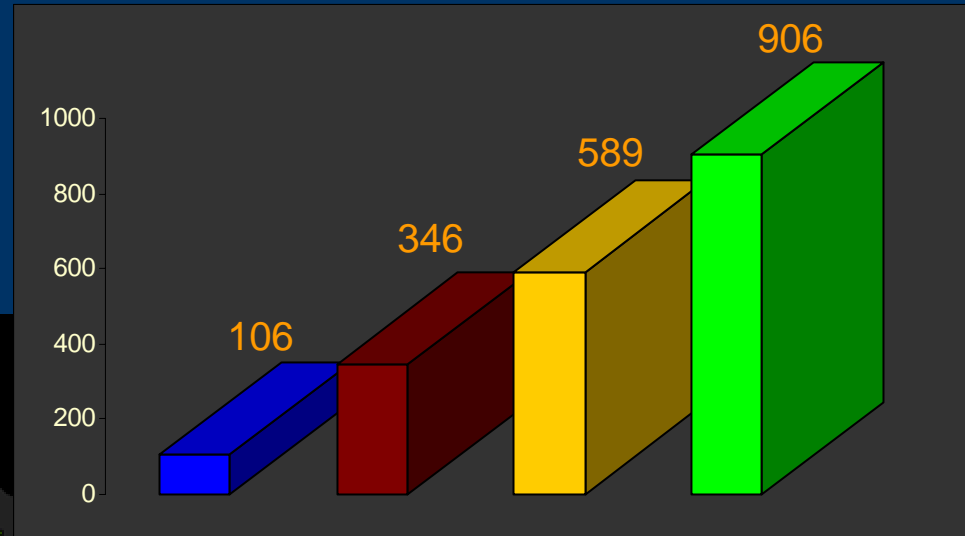


Hacienda Ocampo (photo 7723 year 1963)  
Used for cultivation.

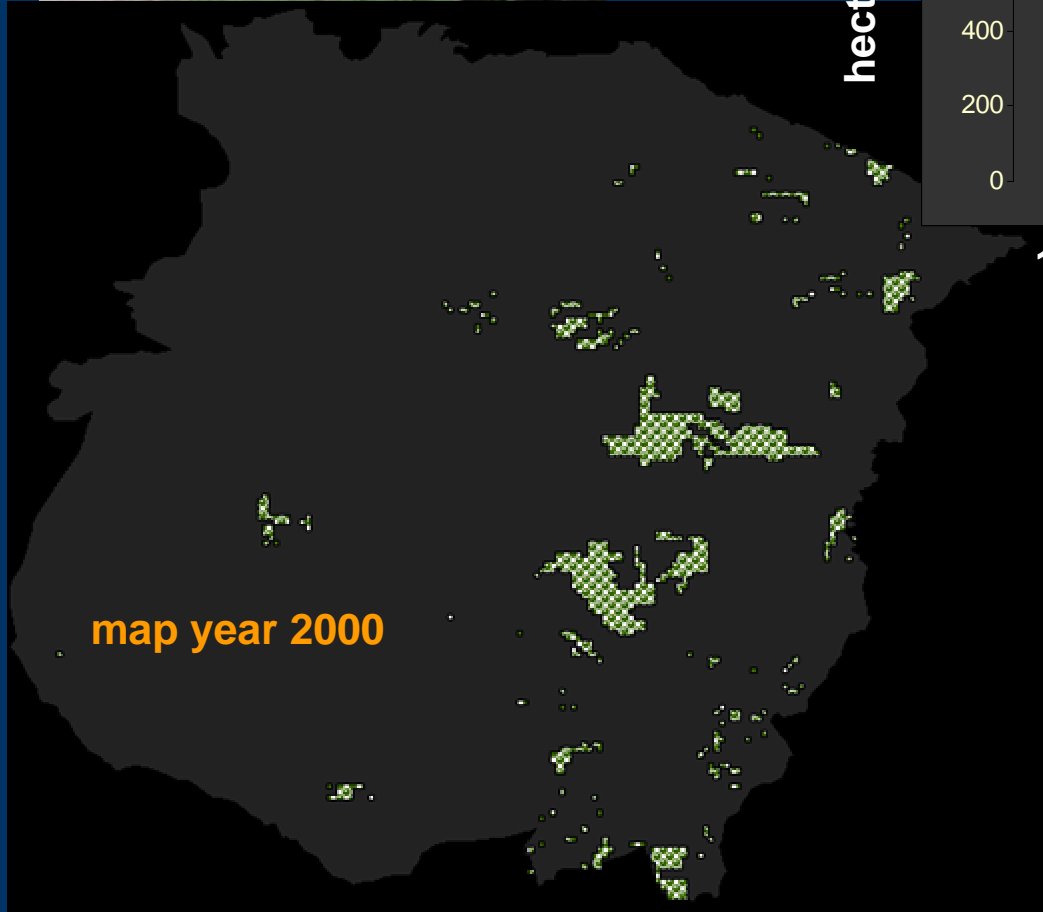
# PLANTED FOREST



hectares



1963 1978 1993 2000

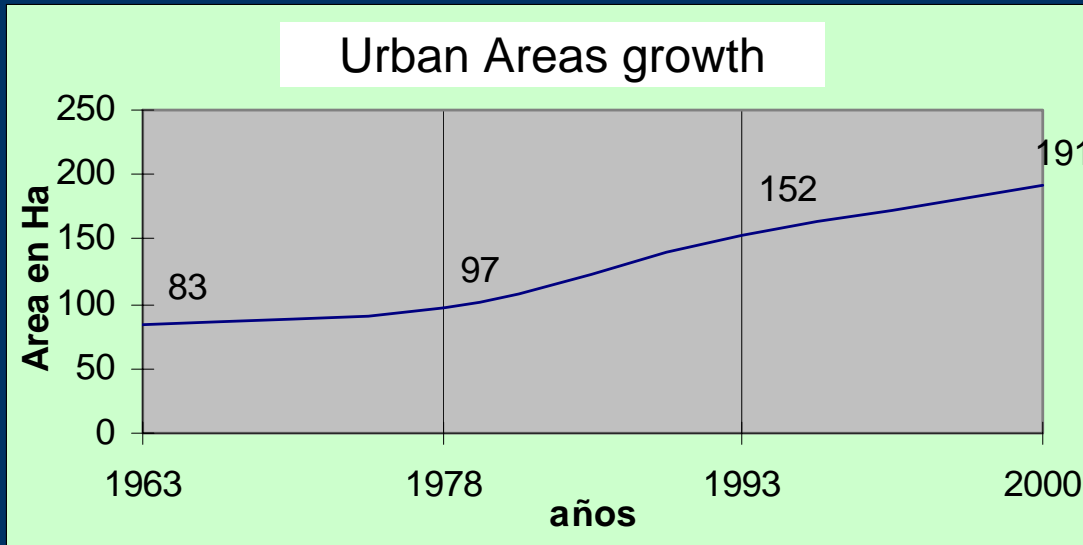


Aerial photo 13459, year 2000

# URBAN AREAS



## COTACACHI

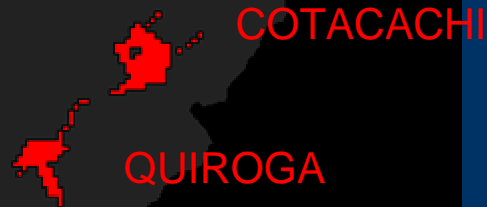


Year	Cotacachi	Quiroga	Imantag	TOTAL
1974	9855	4388	3095	17338
1082	10659	4728	3723	19110
1990	11301	4860	3927	20088
2001	15002	5561	4660	25223

IMANTAG

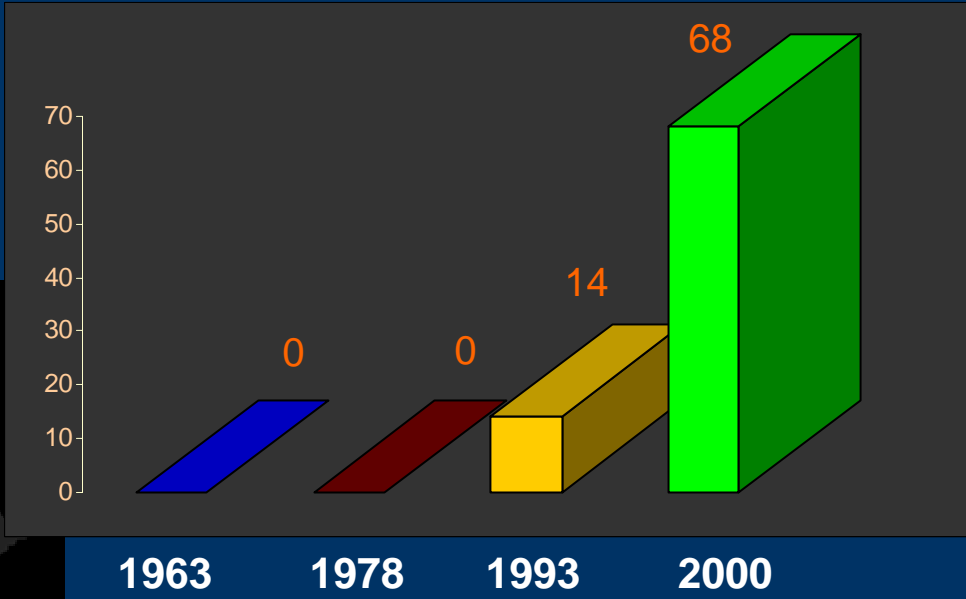
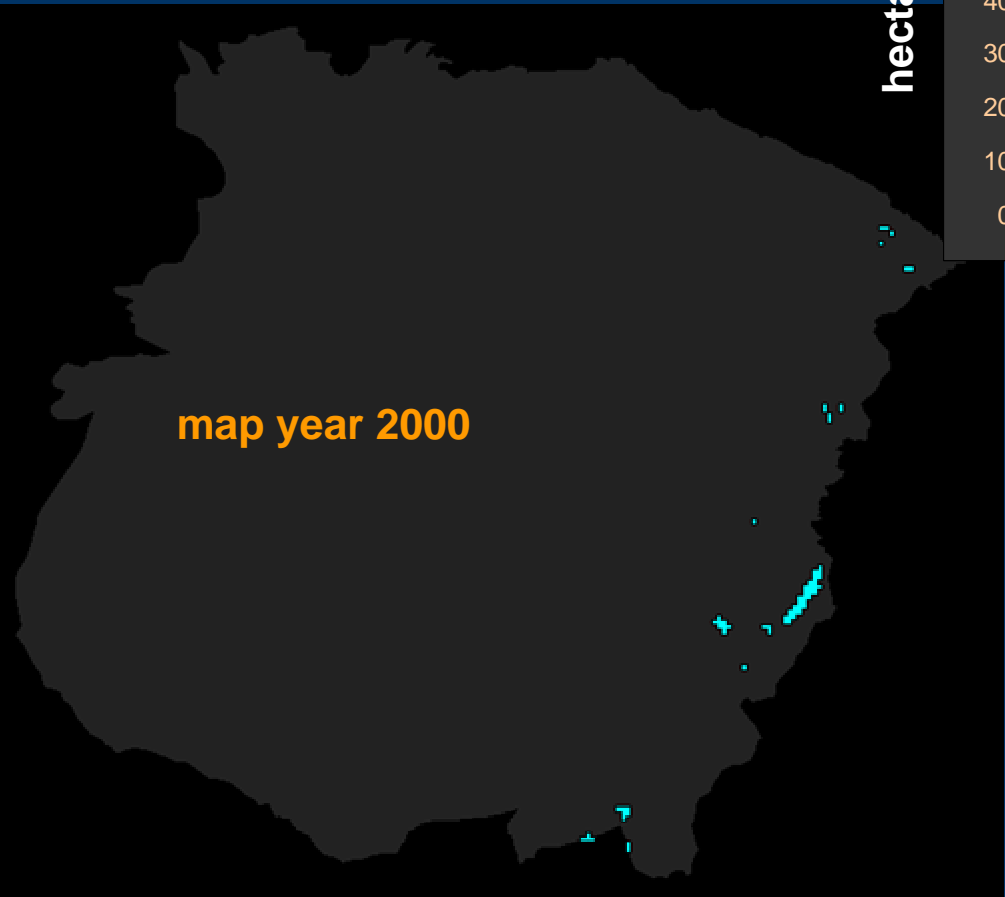
Source: INEC

map year 2000



Aerial photo 13459, year 2000

# GREENHOUSES



Aerial photos 13459, year 2000

# Significant Social and Economic Changes

- 1960s Agrarian Reform
  - Huasipungero system collapses
  - Concentration of indigenous lands
- 1970s “voluntary” parcelization of haciendas
  - Adoption of “Green Revolution”
  - Tree plantations
  - Indigenous cyclic labor migration
  - Indigenous organization (UNORCAC)
- 1980s Fragmentation of indigenous lands
  - “Middle-sizing” of haciendas
- 1990s Growth of urban sector
  - Green House industry
  - Indigenous organization: “Development”
  - Globalization
  - International migration

1963



2000



# Implications

- Land use change driven by socio-economic and historic forces
- Narrow focus on smallholders prevents understanding of whole
- Local development “discourse” is not sufficient for setting priorities
- Land use decisions produce new challenges (e.g., “water crisis”)
- Effective action requires understanding complexity, scale, trade-offs, and multiple stakeholders

