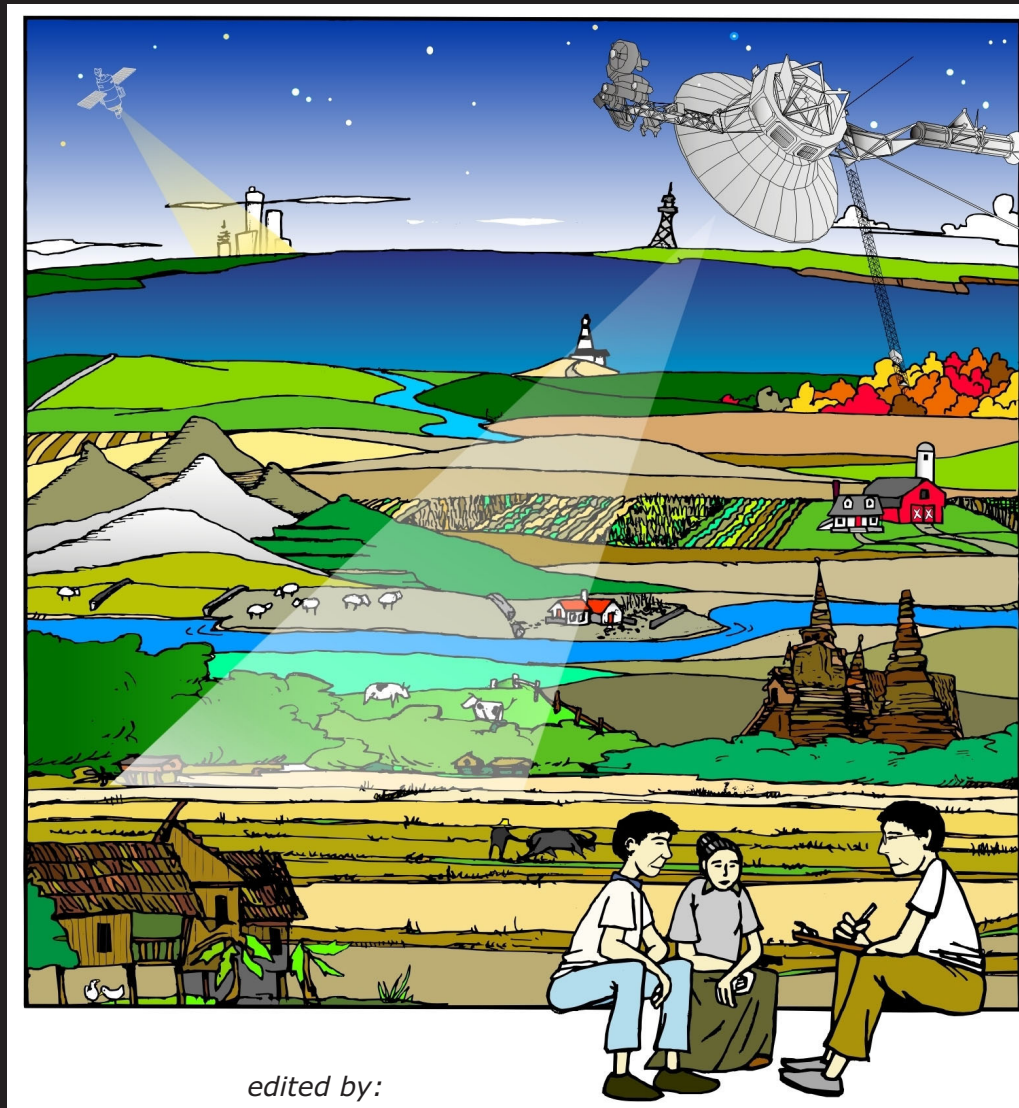


# PEOPLE AND THE ENVIRONMENT

*Approaches for Linking Household and Community Surveys to Remote Sensing and GIS*



Jefferson Fox, Ronald R. Rindfuss, Stephen J. Walsh, and Vinod Mishra

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# PEOPLE AND THE ENVIRONMENT

## Approaches for Linking Household and Community Surveys to Remote Sensing and GIS

*edited by:*

Jefferson Fox, Ronald R. Rindfuss, Stephen J. Walsh, and Vinod Mishra

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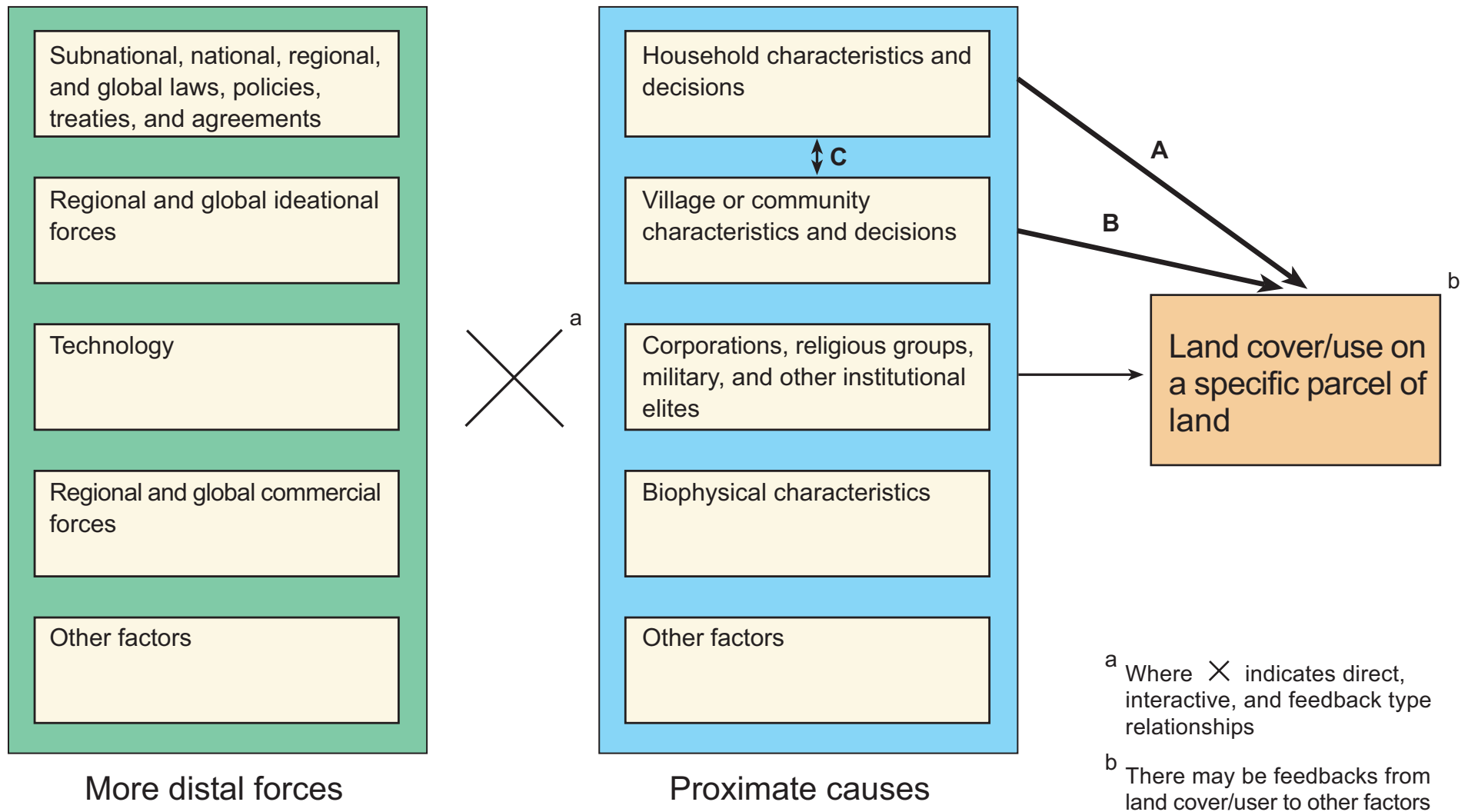
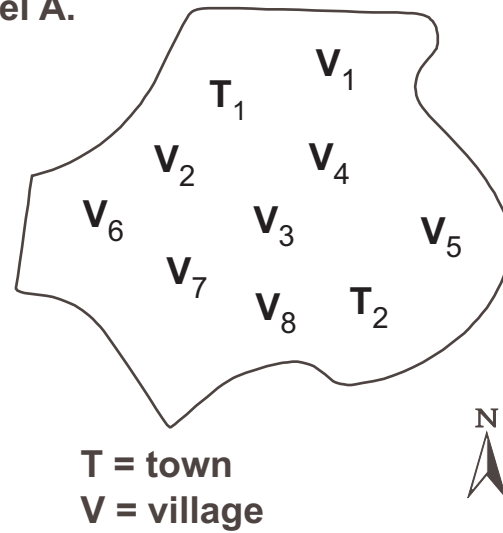
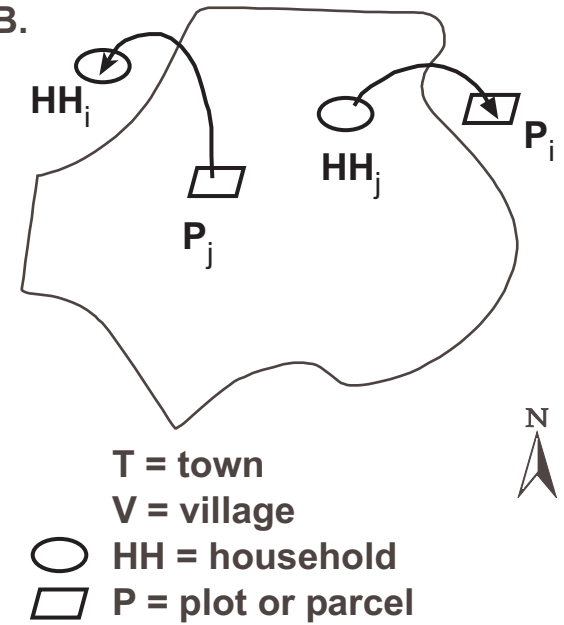


Figure 1. A conceptual model of factors influencing land-cover and land-use change.

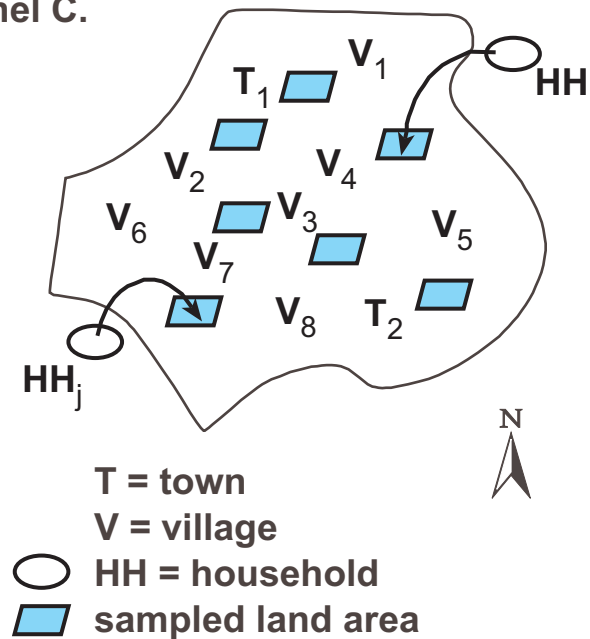
Panel A.



Panel B.



Panel C.



Panel D.

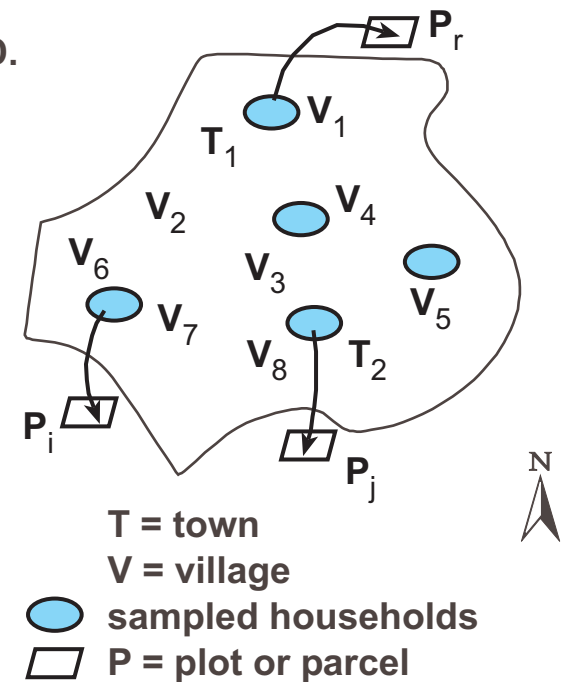


Figure 2. Sampling land or households.

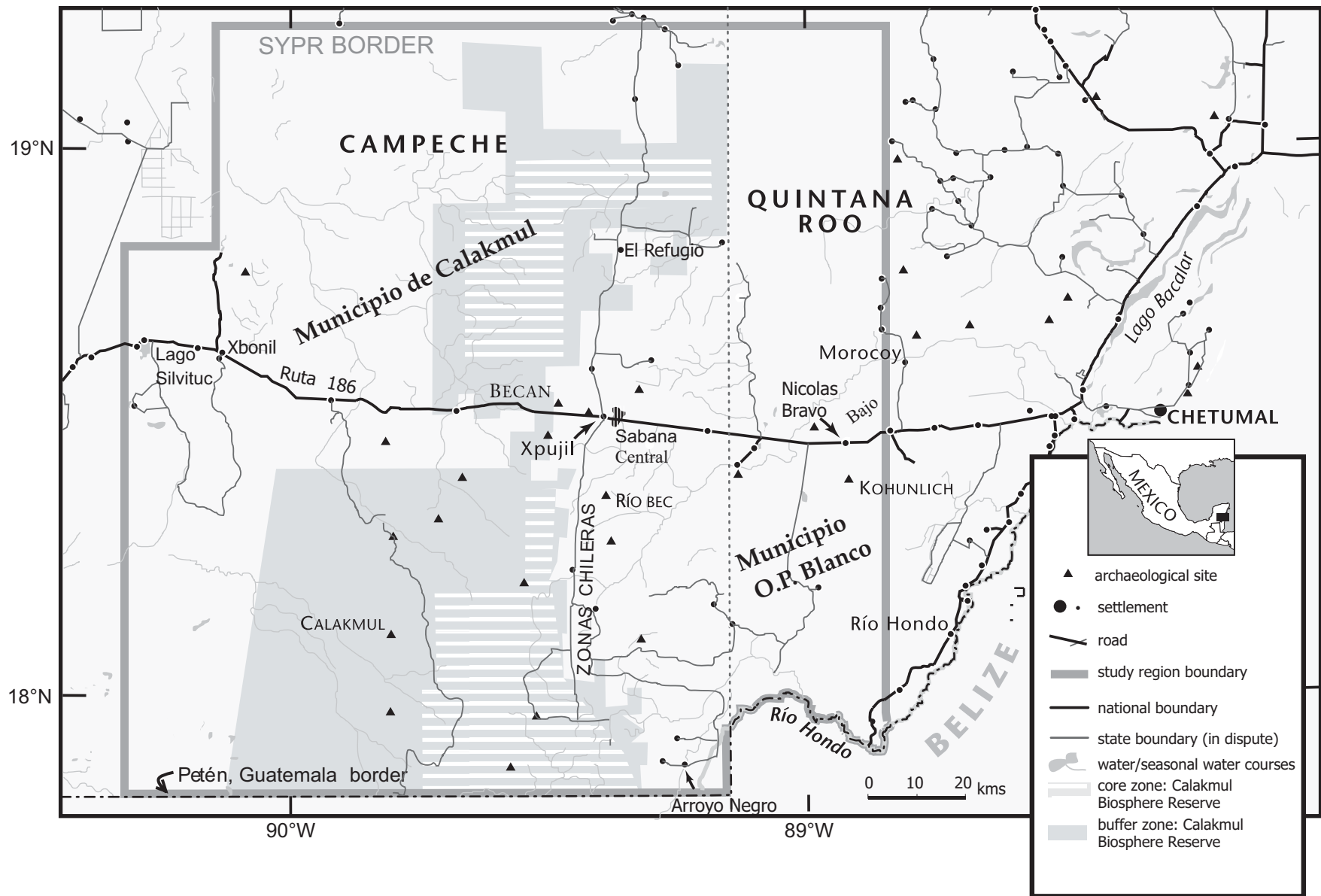


Figure 1. The southern Yucatán peninsular region.

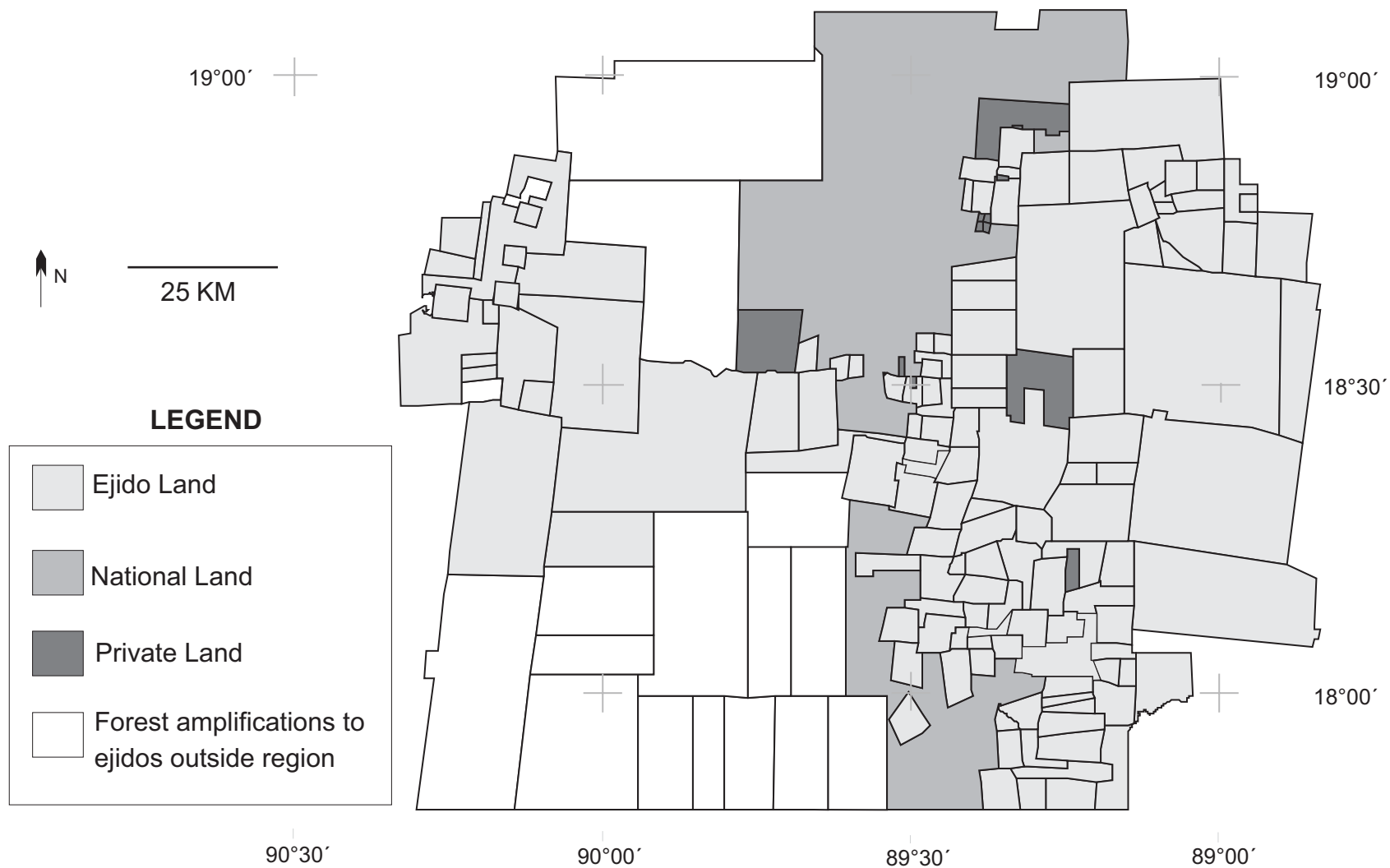


Figure 2. Types of ejidos in the study region.



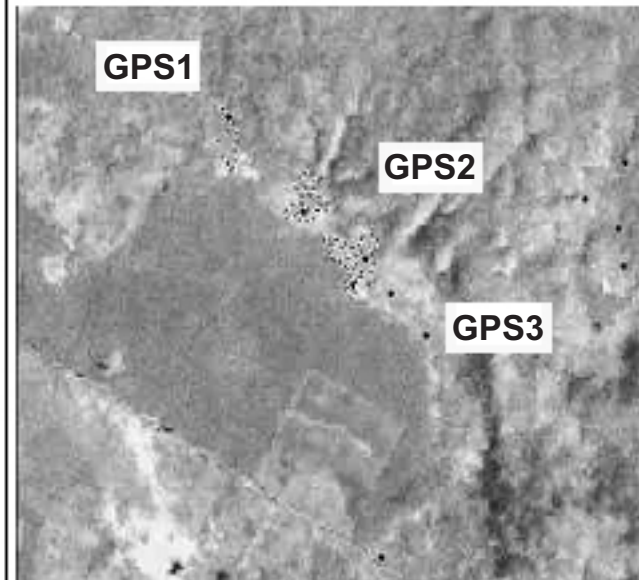
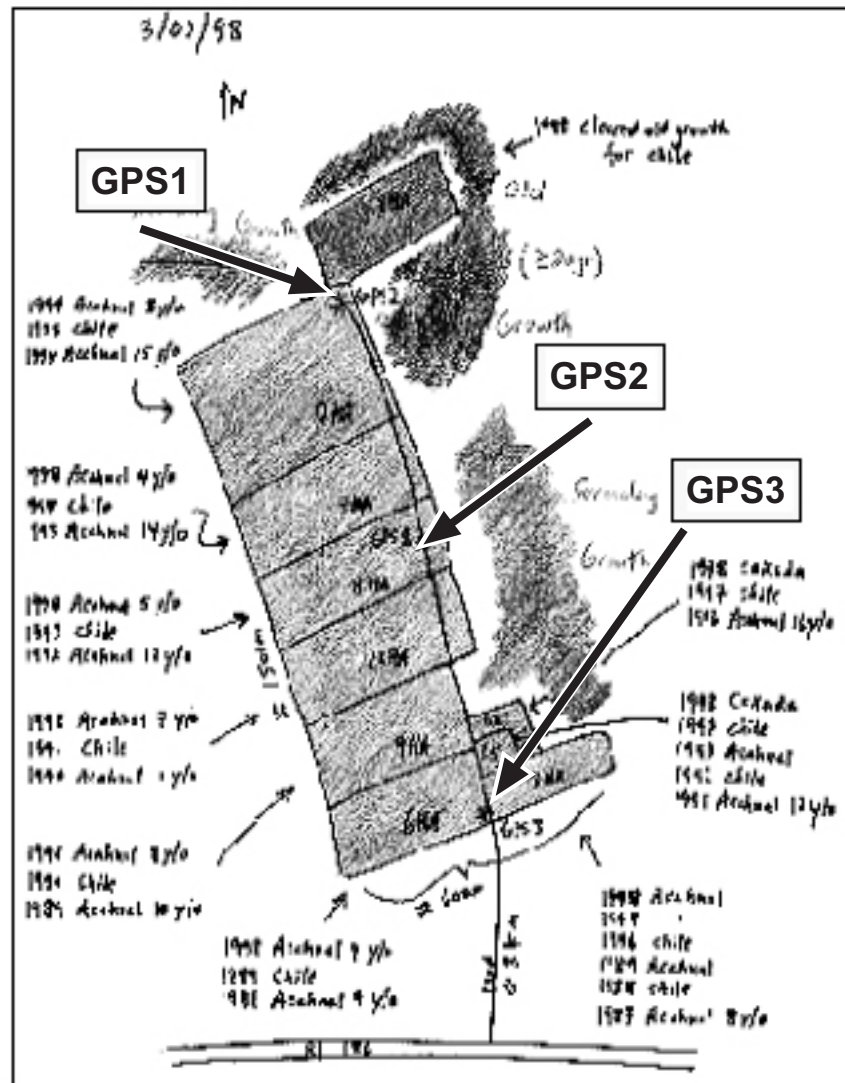


Figure 3. Example of a field sketch map.



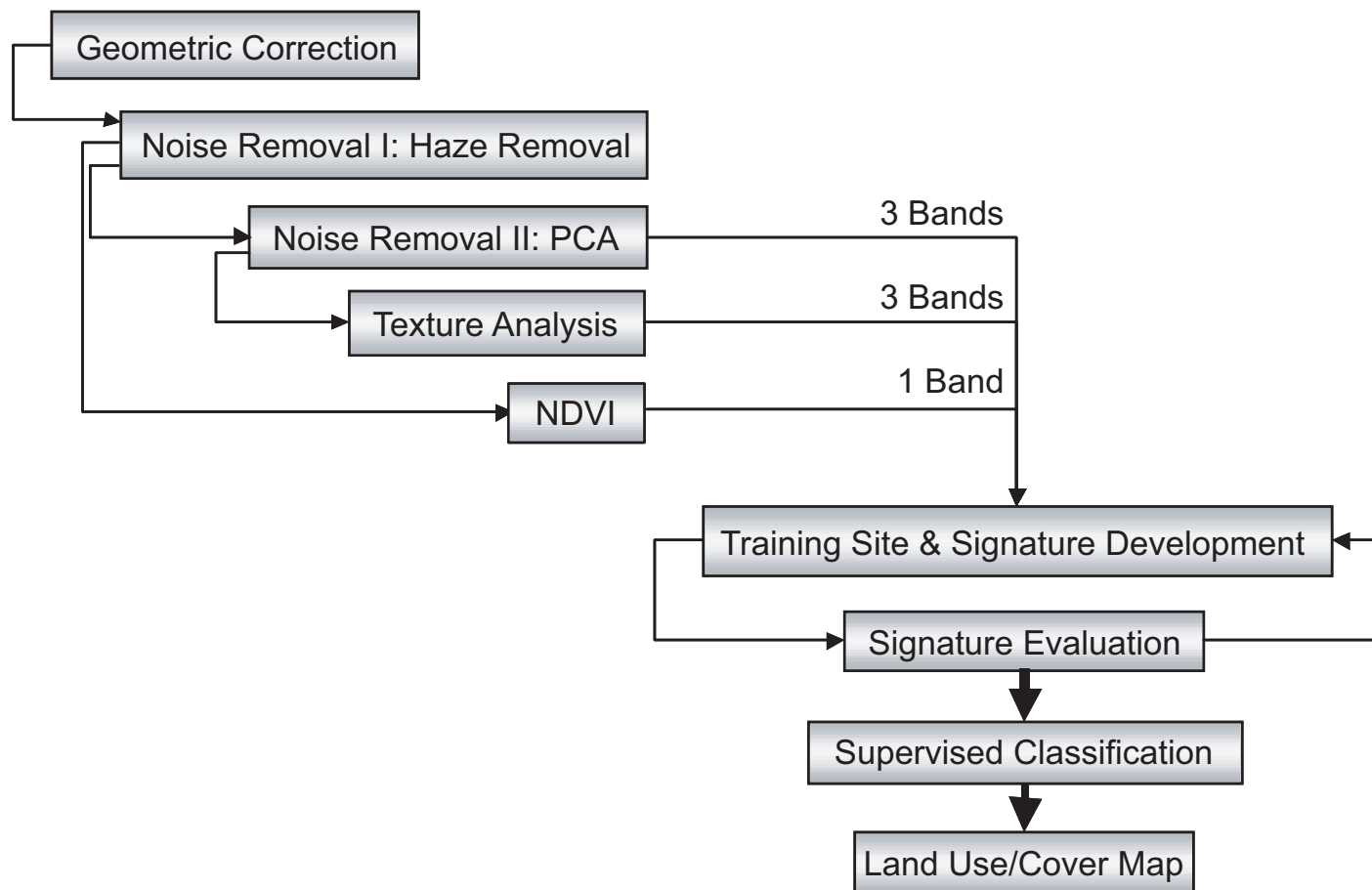


Figure 4. SYPR project image analysis methods.

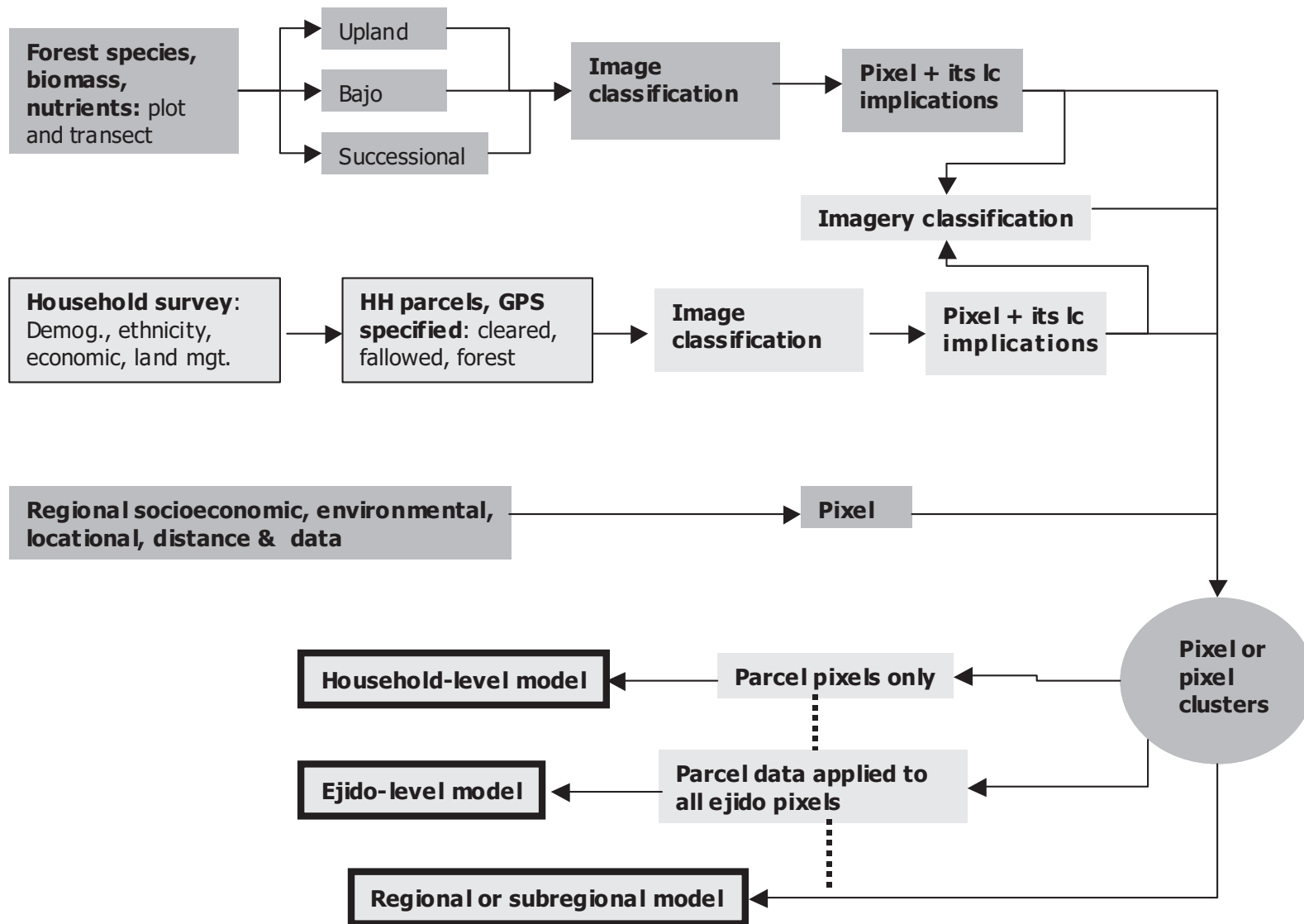


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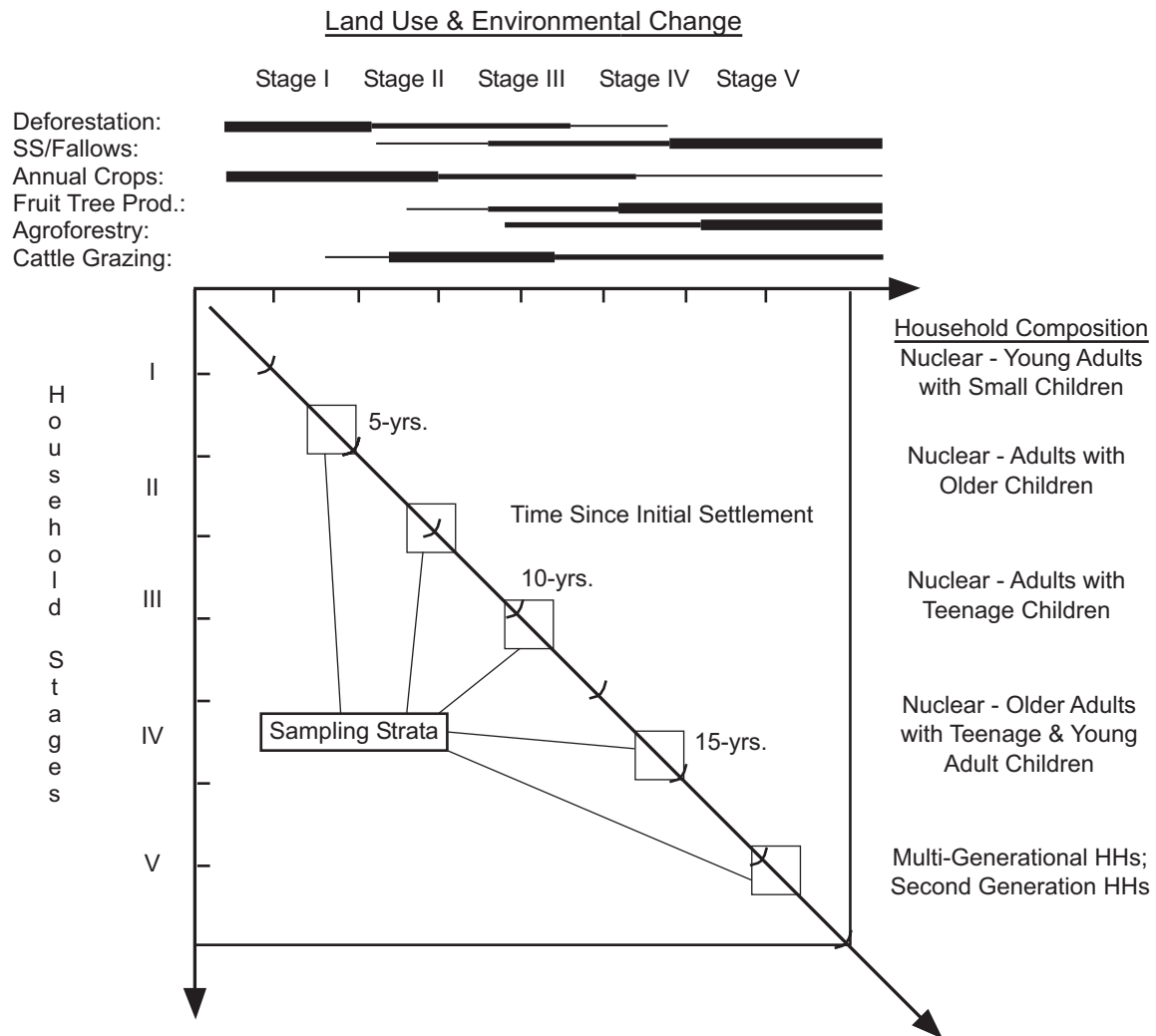
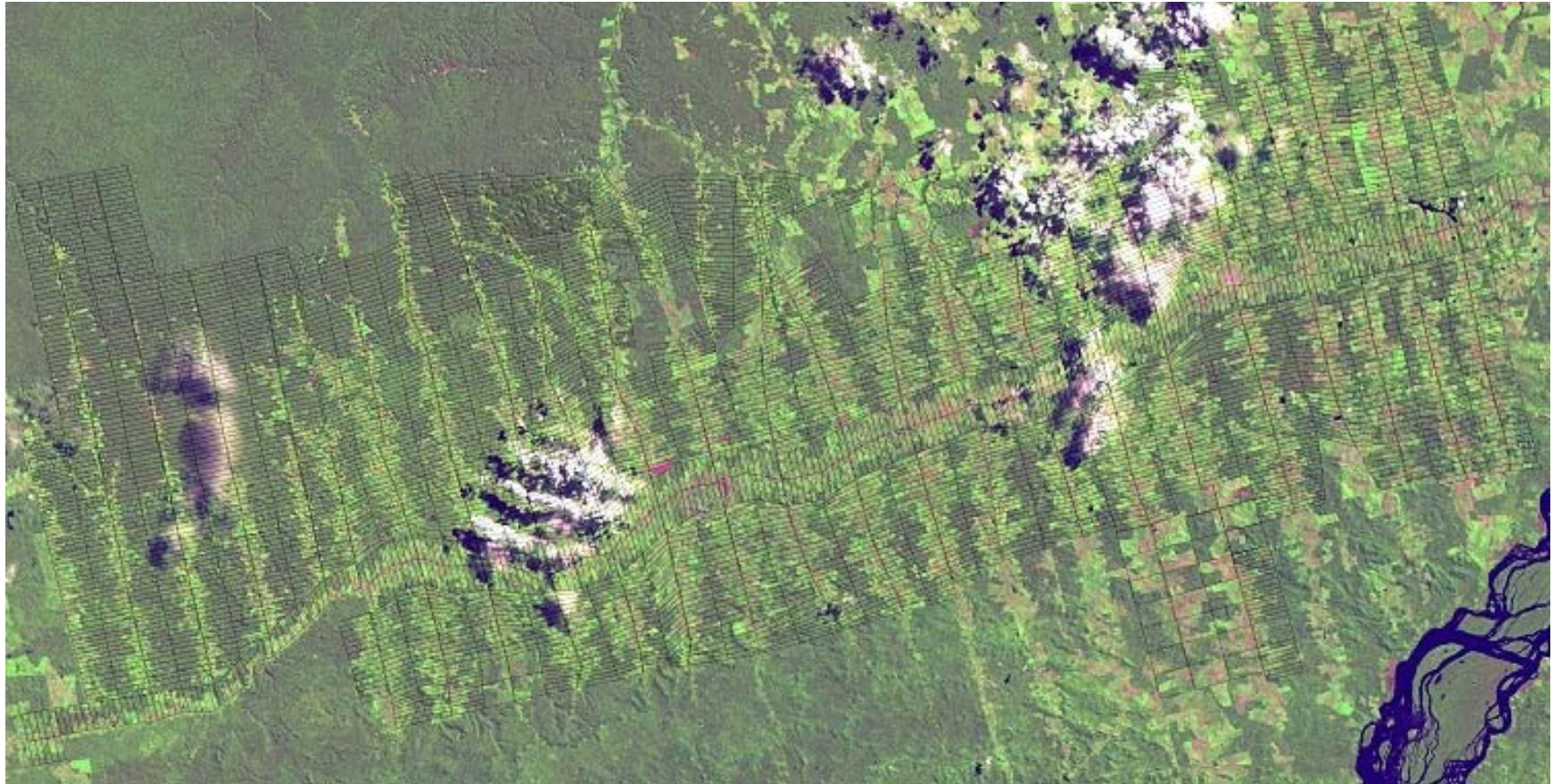


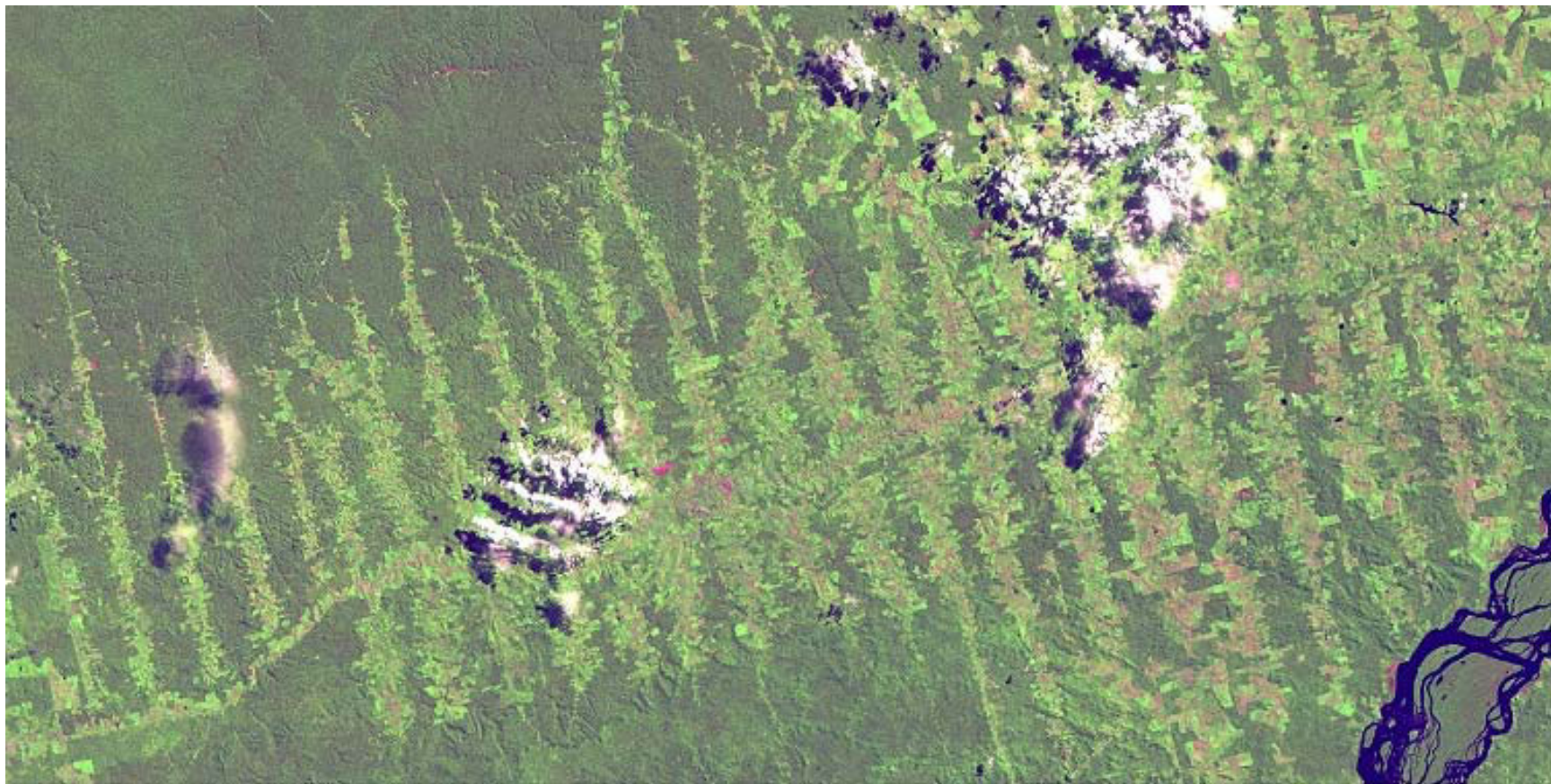
Figure 1. Conceptual model of demographic and environmental change.



5 0 5 10 15 20 Kilometers

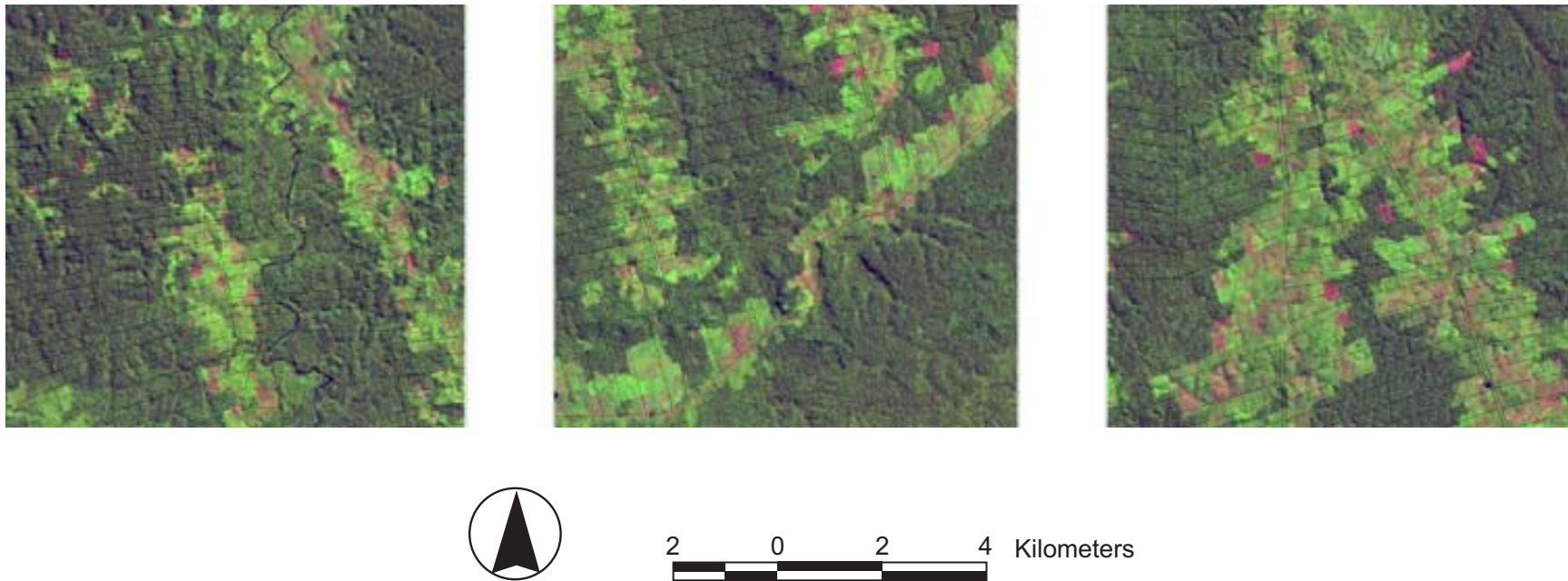
*Figure 2a. Property grid and landscape.*





5 0 5 10 15 20 Kilometers

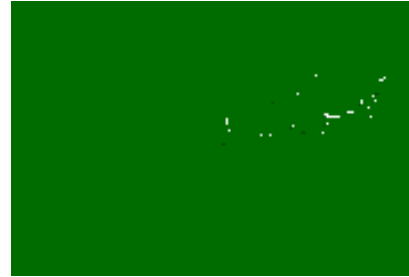
*Figure 2b.* Landscape (1996 Landsat TM image, bands 5, 4, 3).



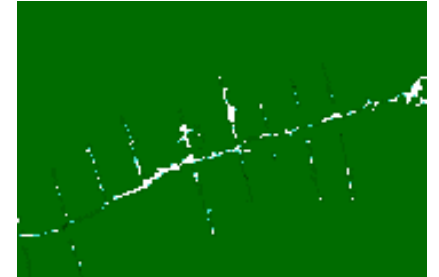
*Figure 3. Examples of atypical properties.*



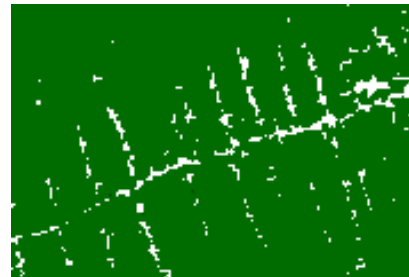
1970



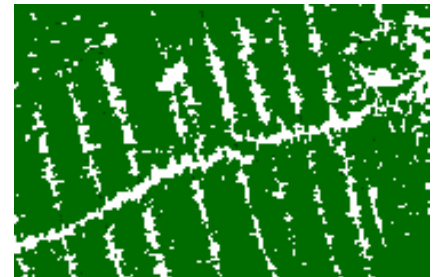
1973



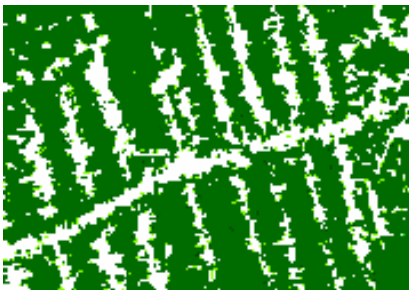
1976



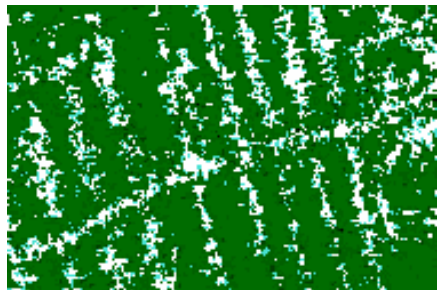
1979



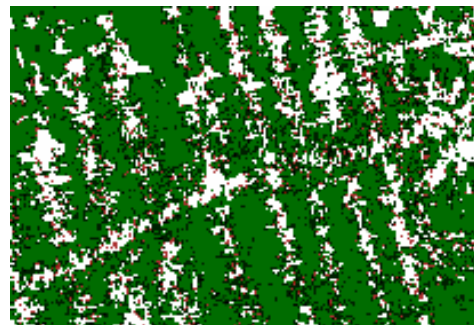
1985



1988



1991



1996

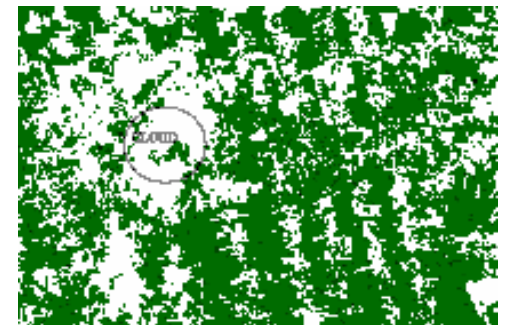


Figure 4. Time series of the trajectory of deforestation in Altamira.



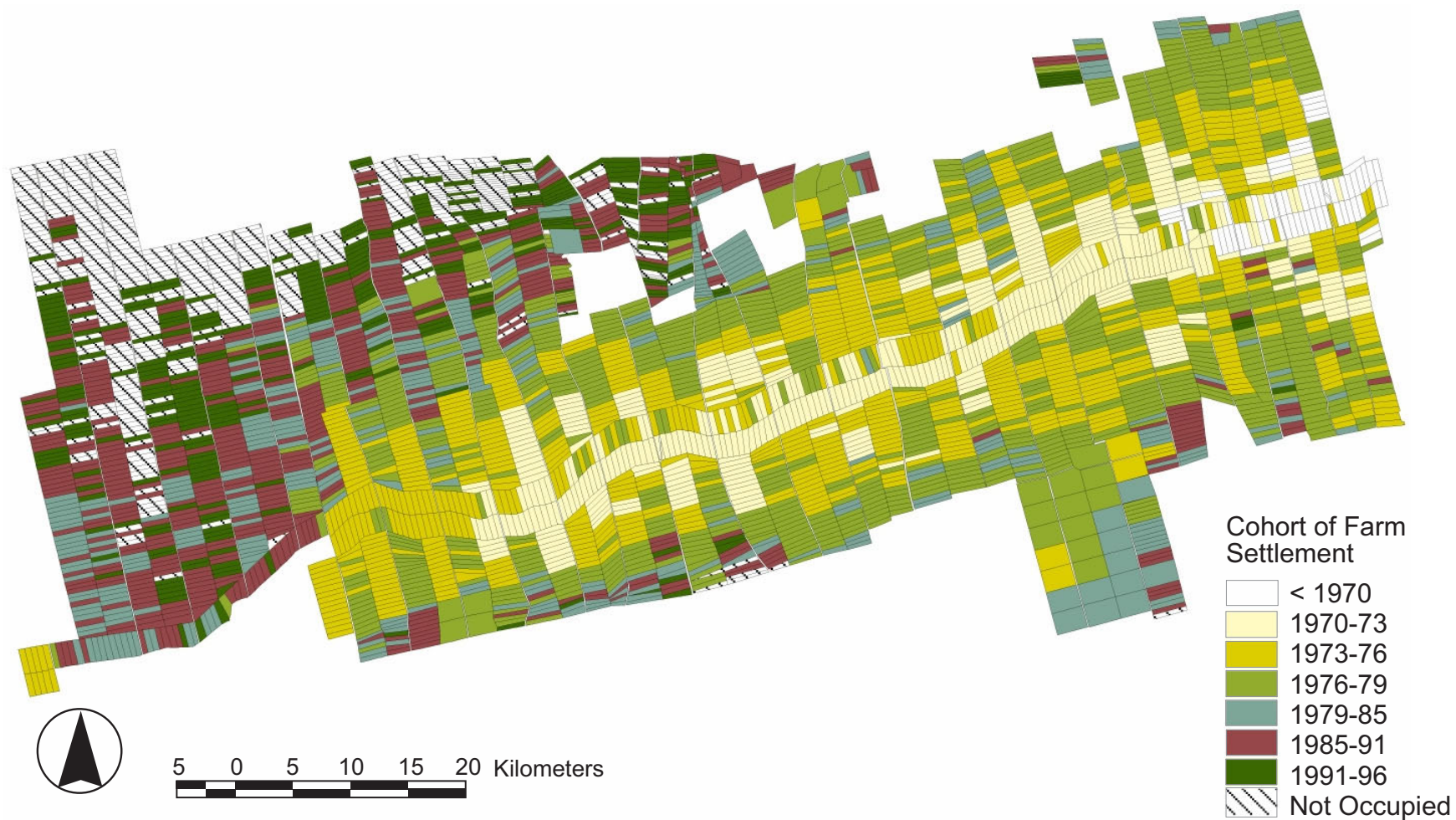
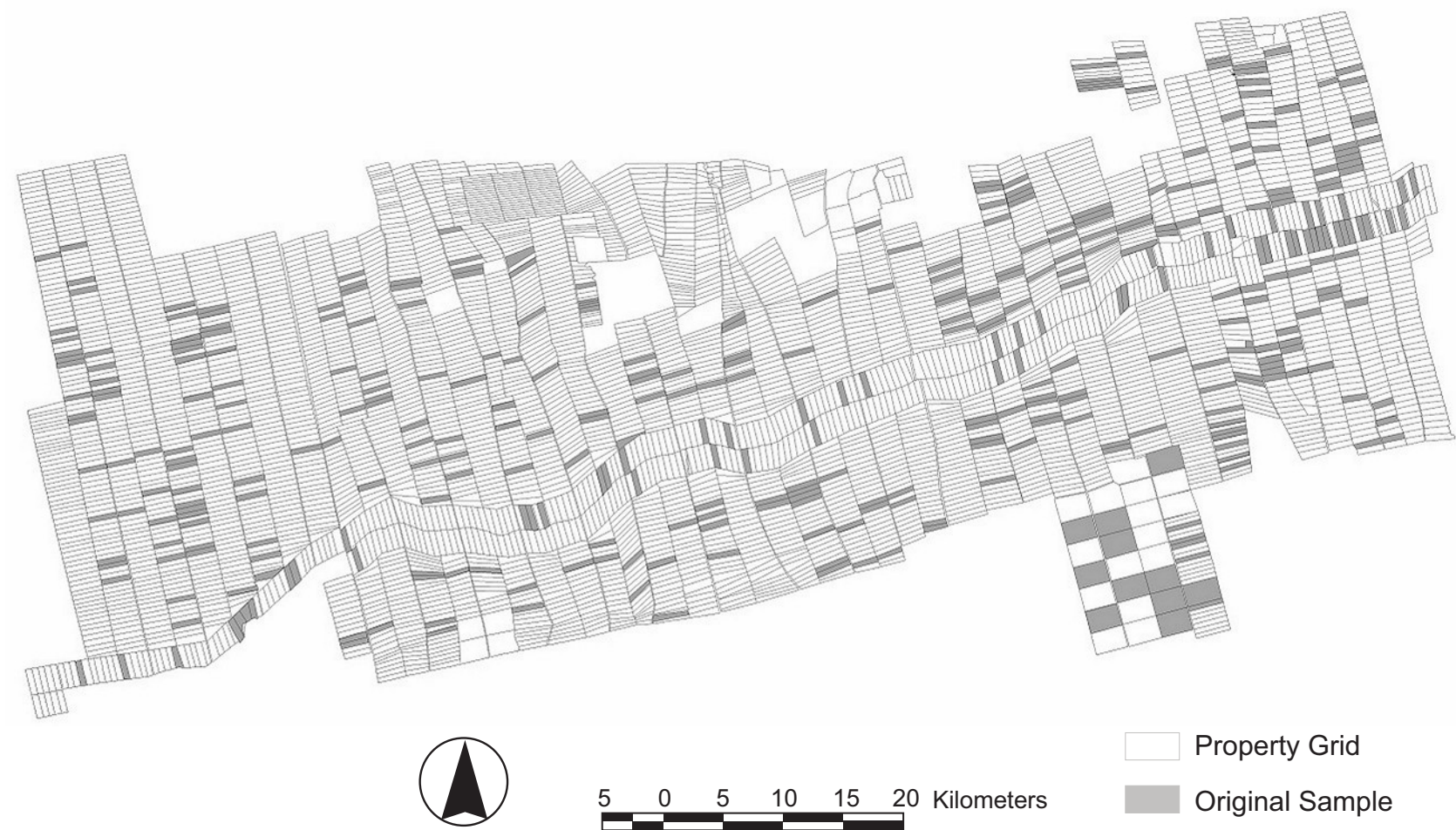


Figure 5. Farm property cohort of settlement.



*Figure 6. Property sampling strategy*



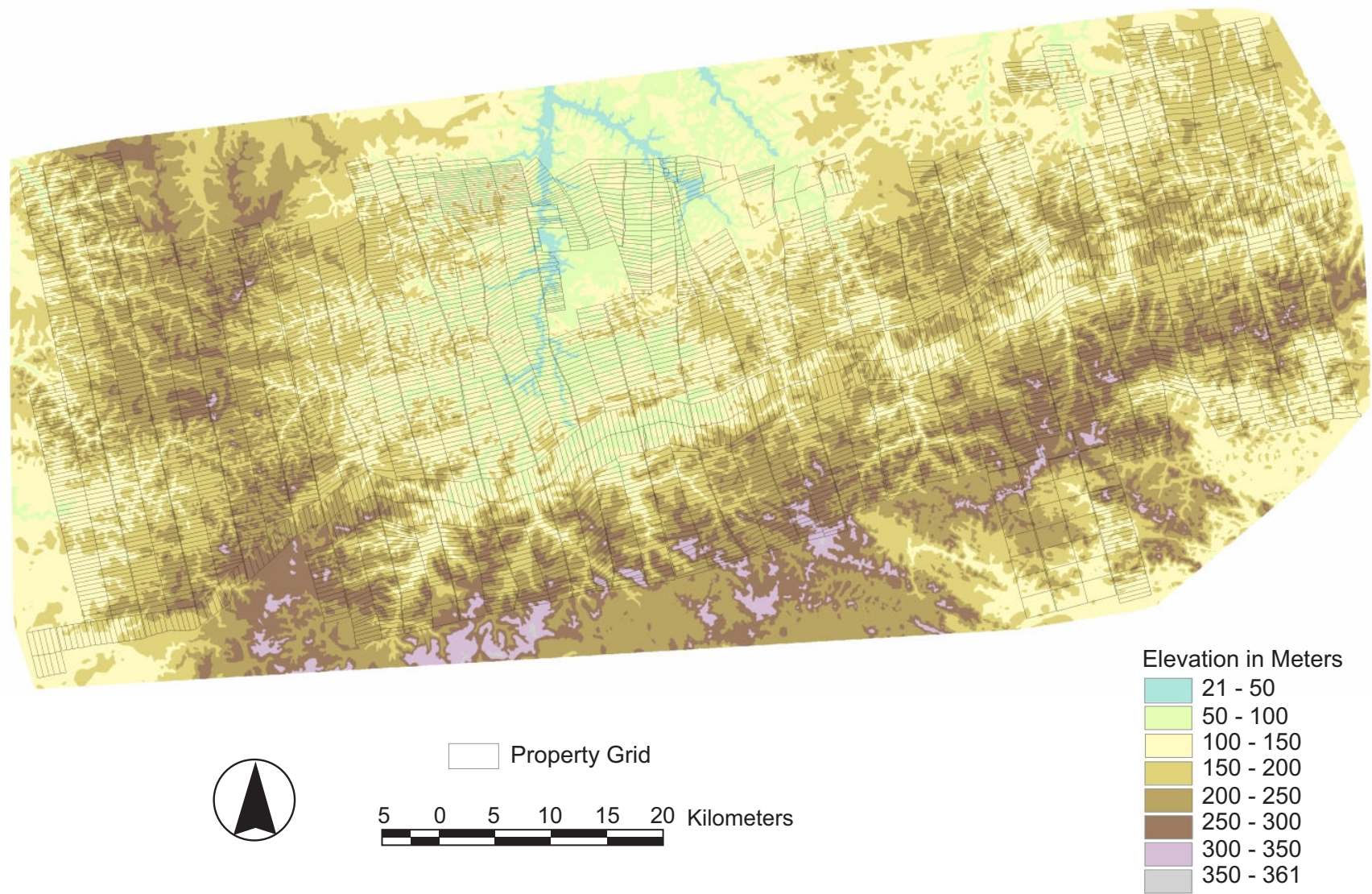


Figure 7. Digital elevation model with property grid overlay.





Landsat TM



28 meter pixel resolution

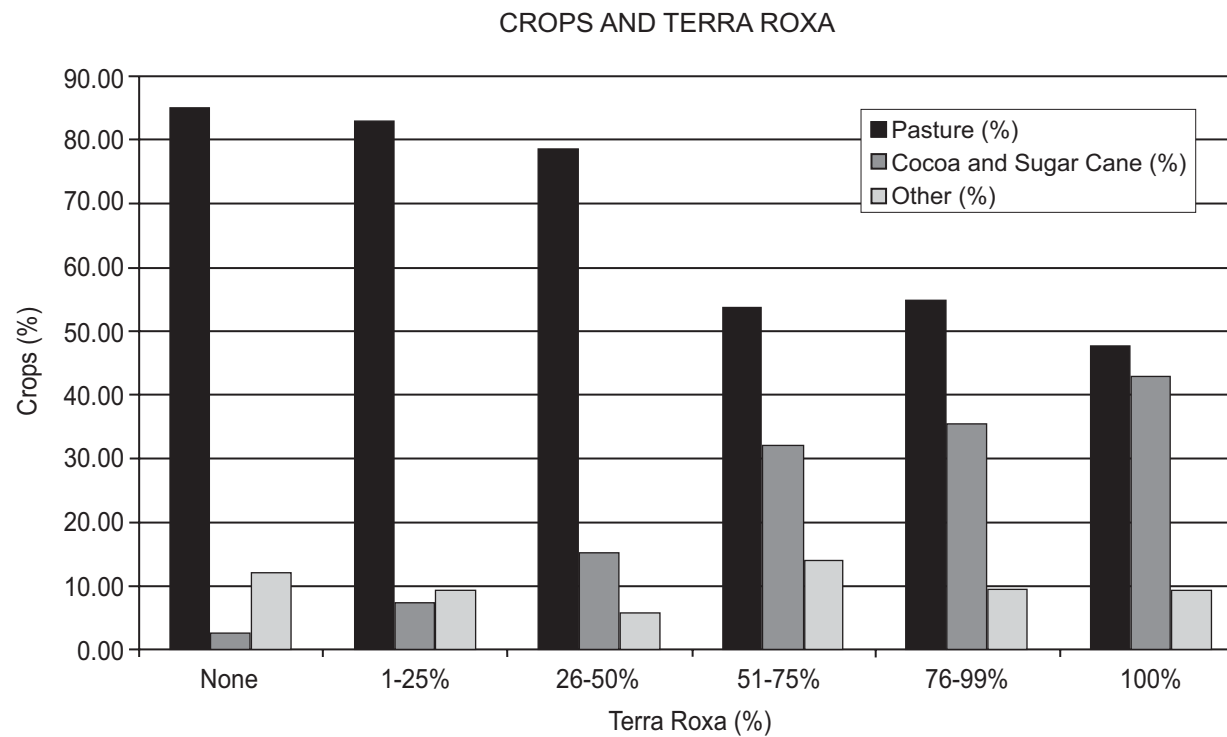
IKONOS (Multispectral)



4 meter pixel resolution



*Figure 9. Comparison of Landsat TM and IKONOS Multispectral data.*



Source: Survey in Altamira 1998, N=402

*Figure 10. Crops and terra roxa.*

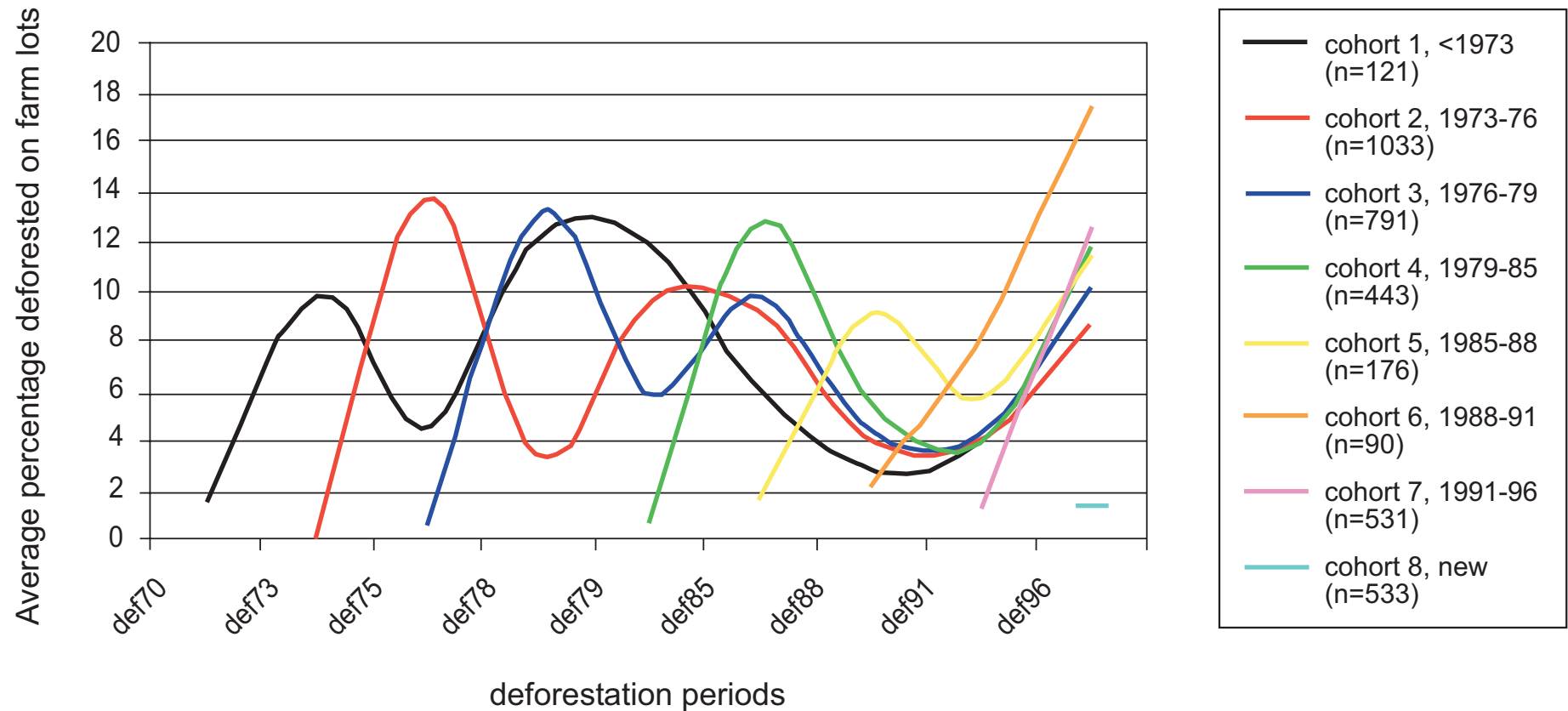


Figure 11. The colonist footprint: average deforestation trajectories across cohorts



# INCRA Colonization: Altamira, Brasil Novo, Medicilandia Distribution of Colonization Cohorts and % Deforestation

(estimated from multiple source remote sensing data and colonization property grid)

N Farm lots = 3718

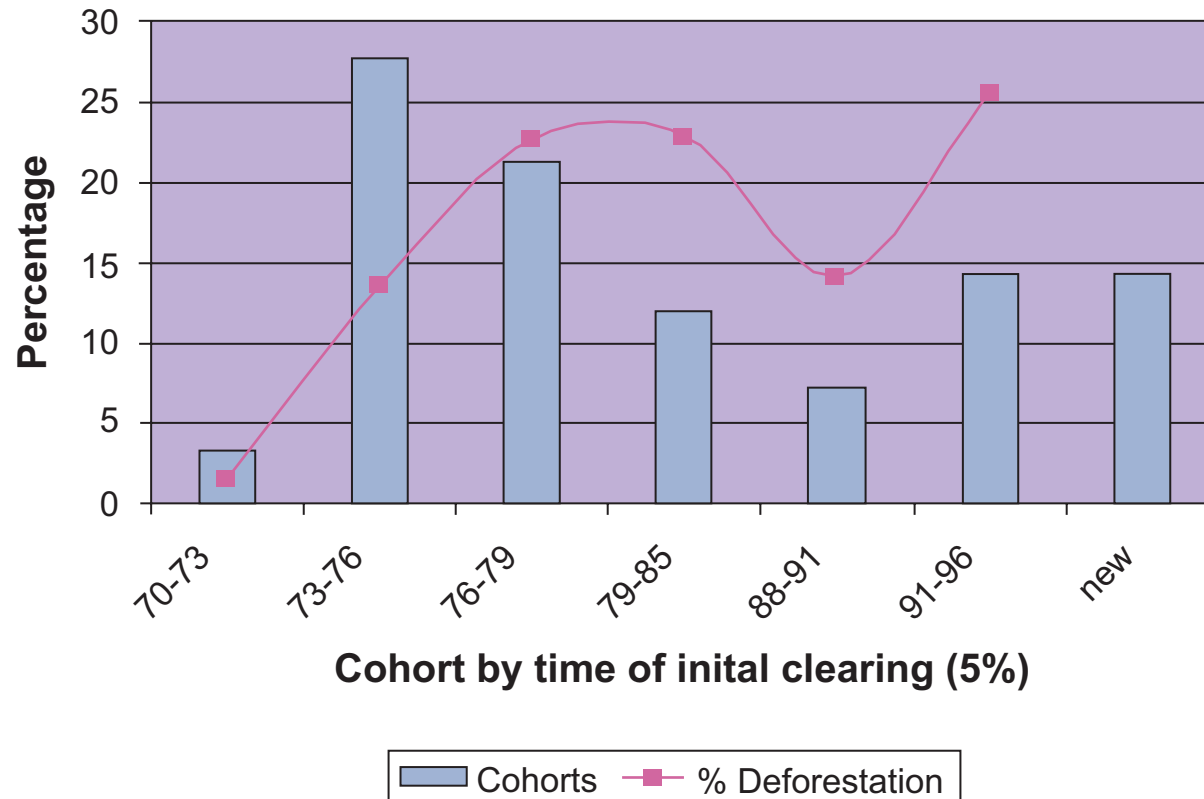


Figure 12. INCRA colonization: Altamira, Brasil Novo, Medicilandia -- distribution of colonization cohorts and % deforestation.

## Percentage of forest in 1996 / farm lot / cohort

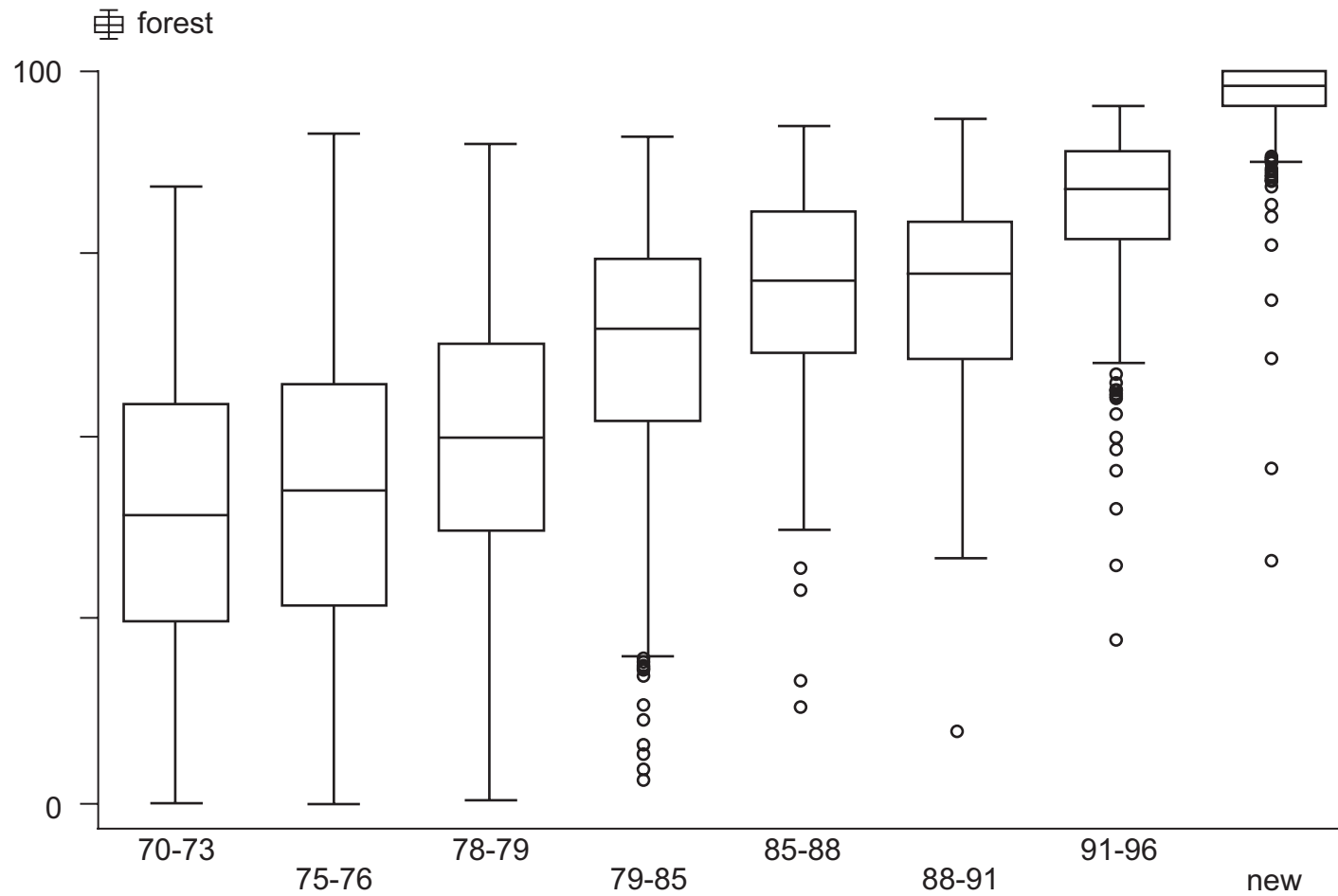


Figure 13. Percentage of forest in 1996 / farm lot / cohort.

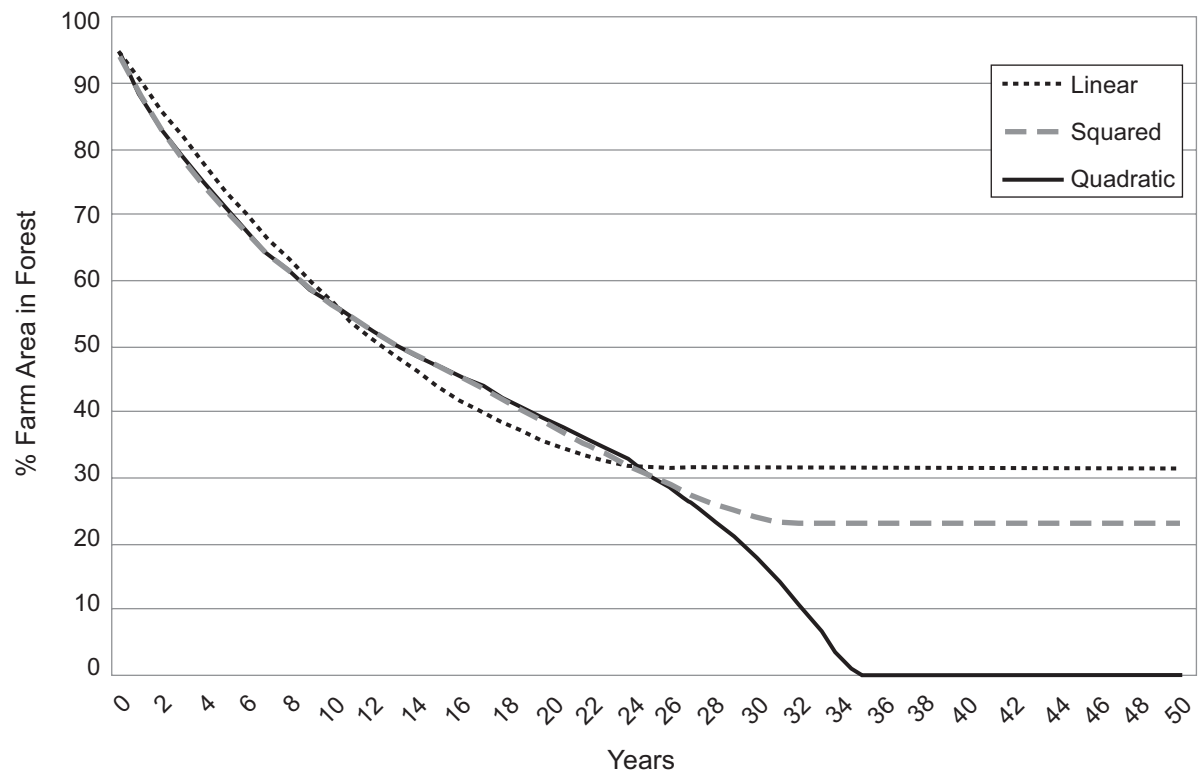


Figure 14. General age pattern associated with deforestation on farms.

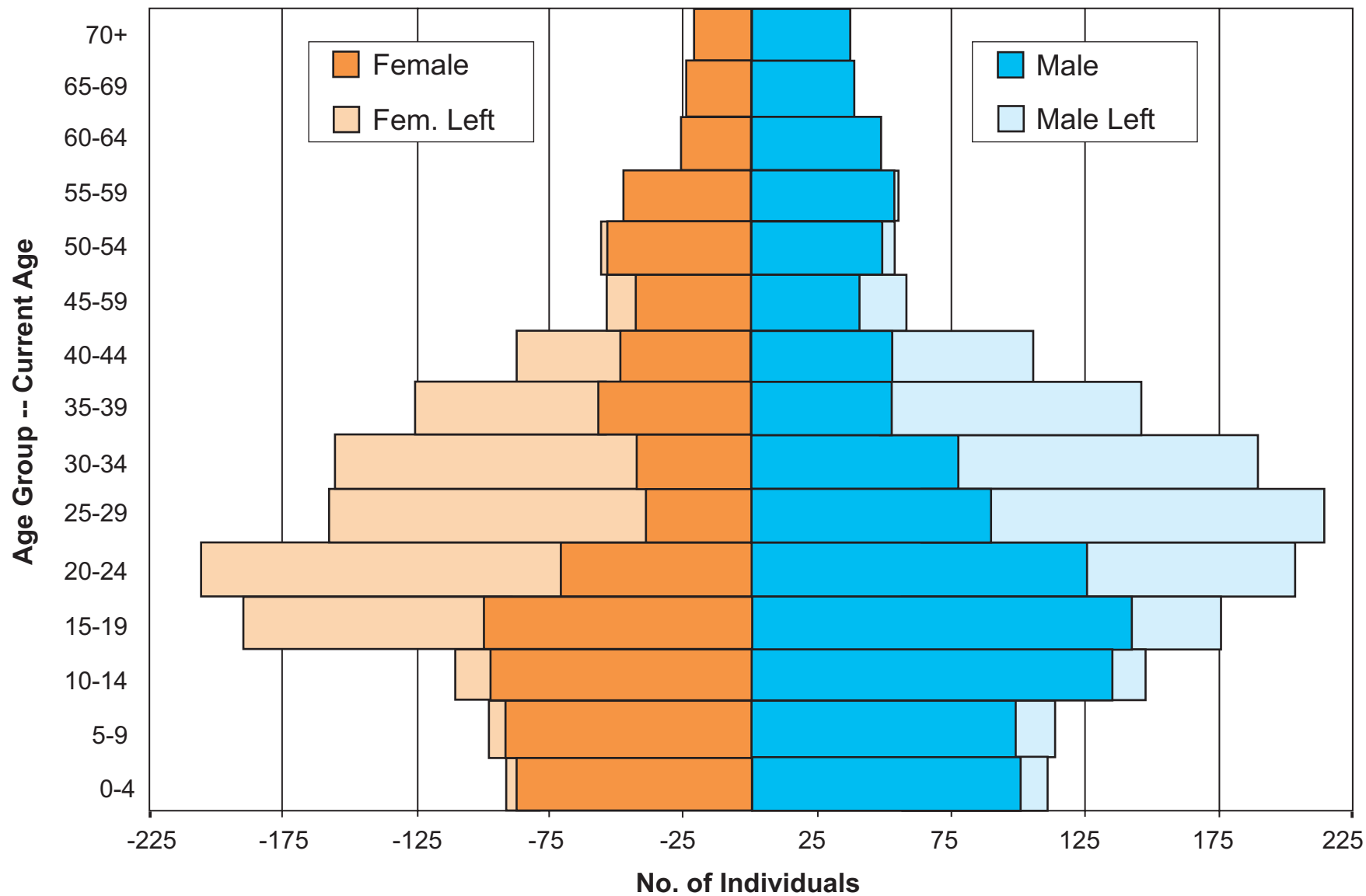


Figure 15. Current age/sex of household members (original & joining) and children who have left.

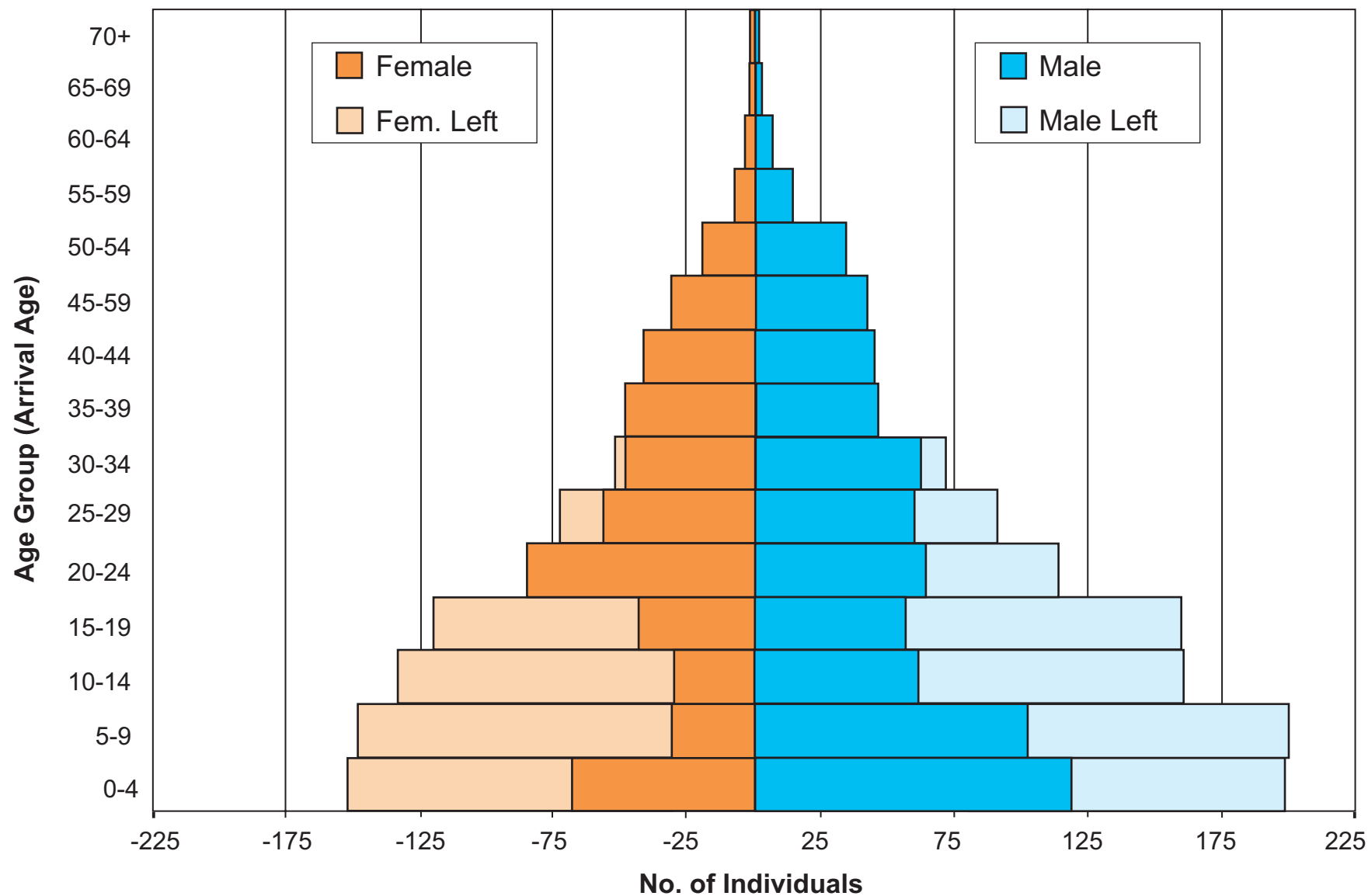
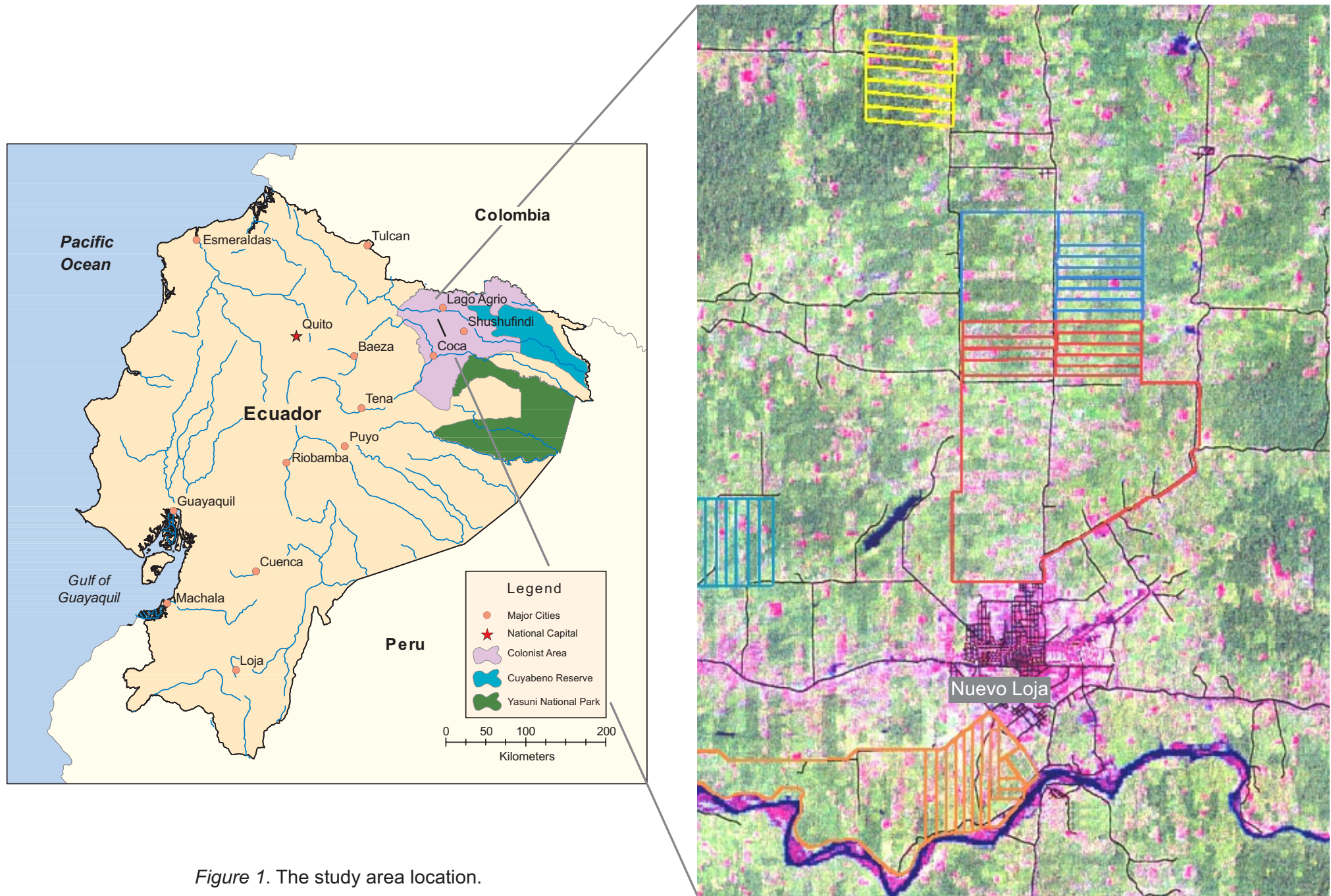


Figure 16. Age/sex of household members at time of arrival.





Second Lineas →  
~ 2000 meters



Figure 2. Settlement patterns in the Oriente.



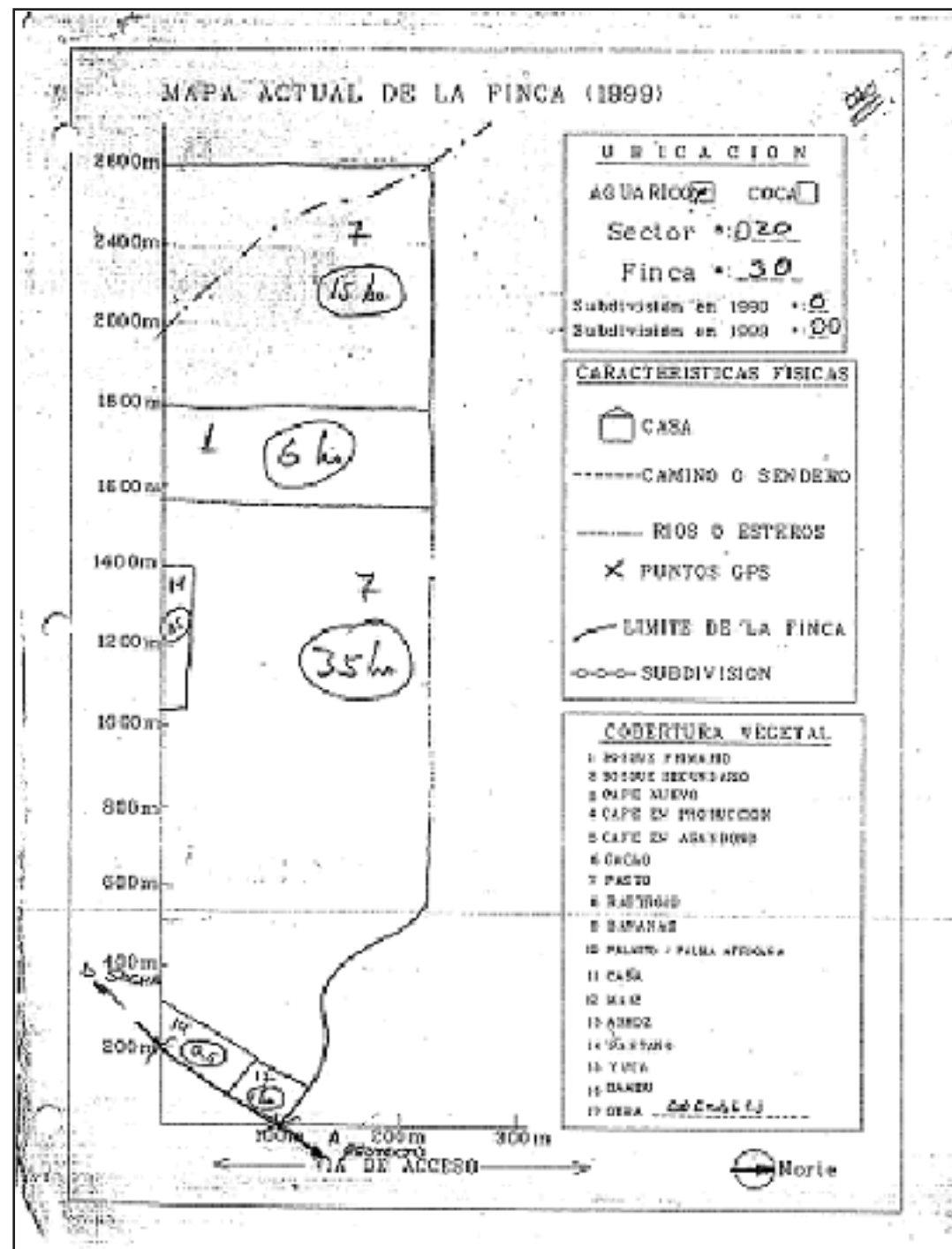
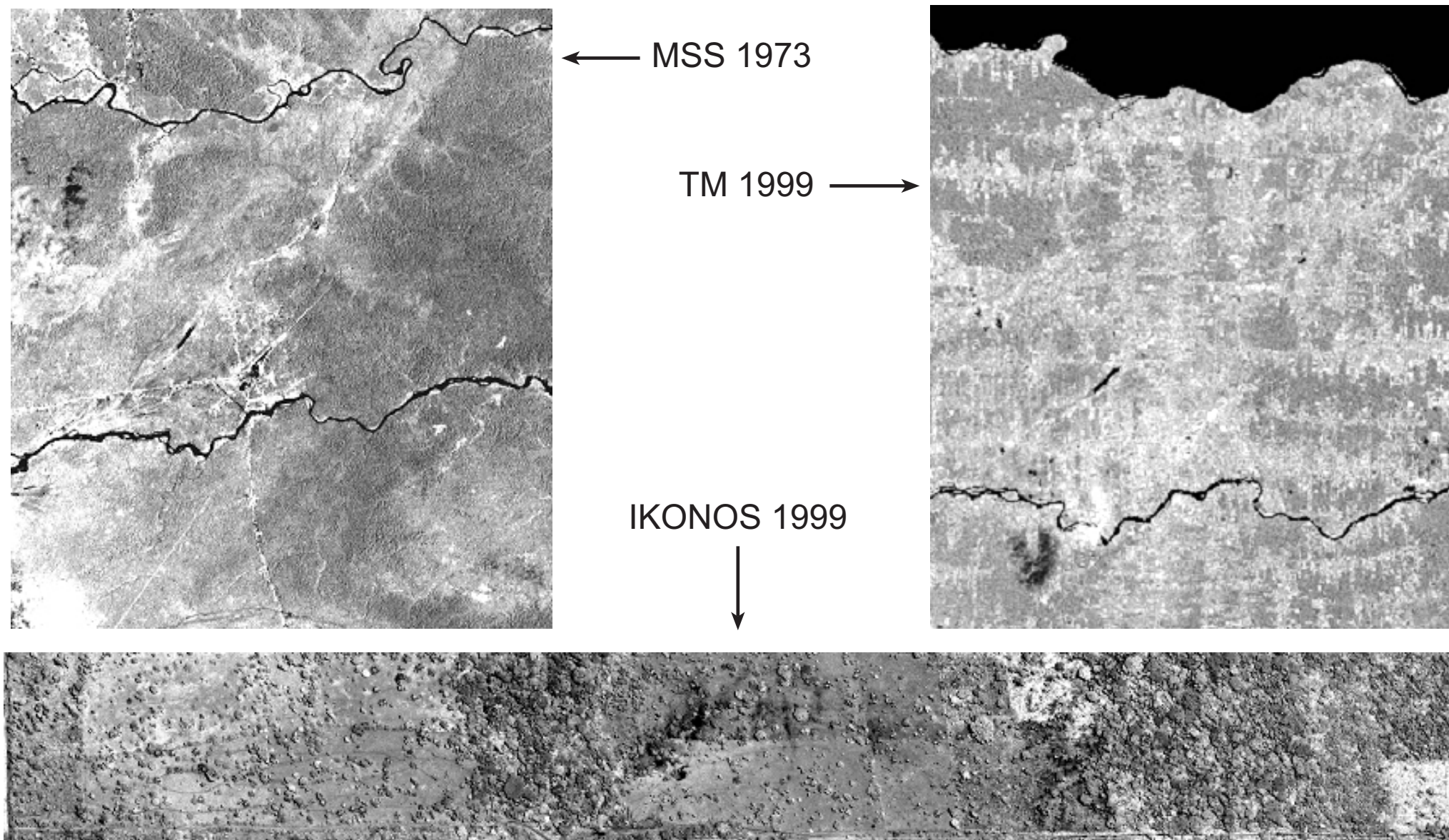


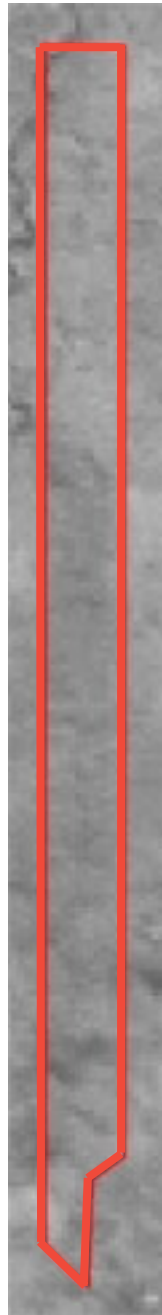
Figure 3. An example of a sketch map for a finca.



*Figure 4. Digital image data used in this research.*

Sector 20, Finca 30

## Panchromatic



# Multispectral

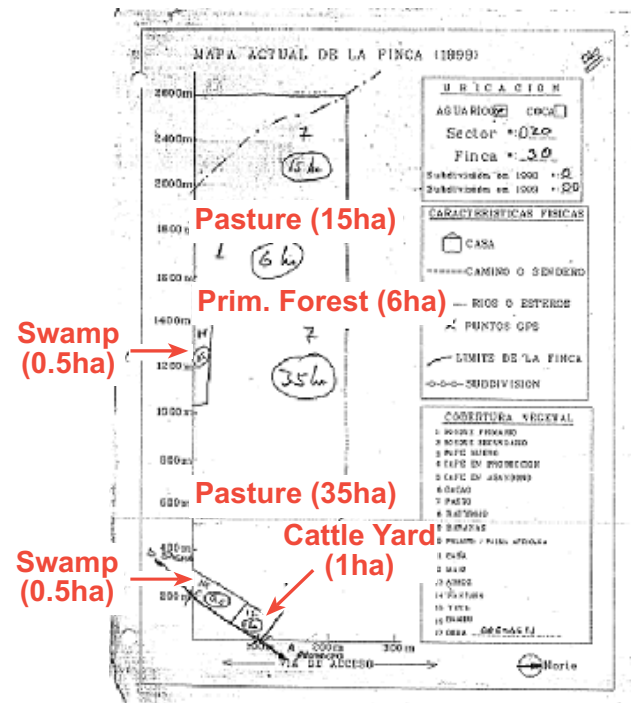


Figure 5. Landsat TM image with a sector and finca boundaries superimposed.



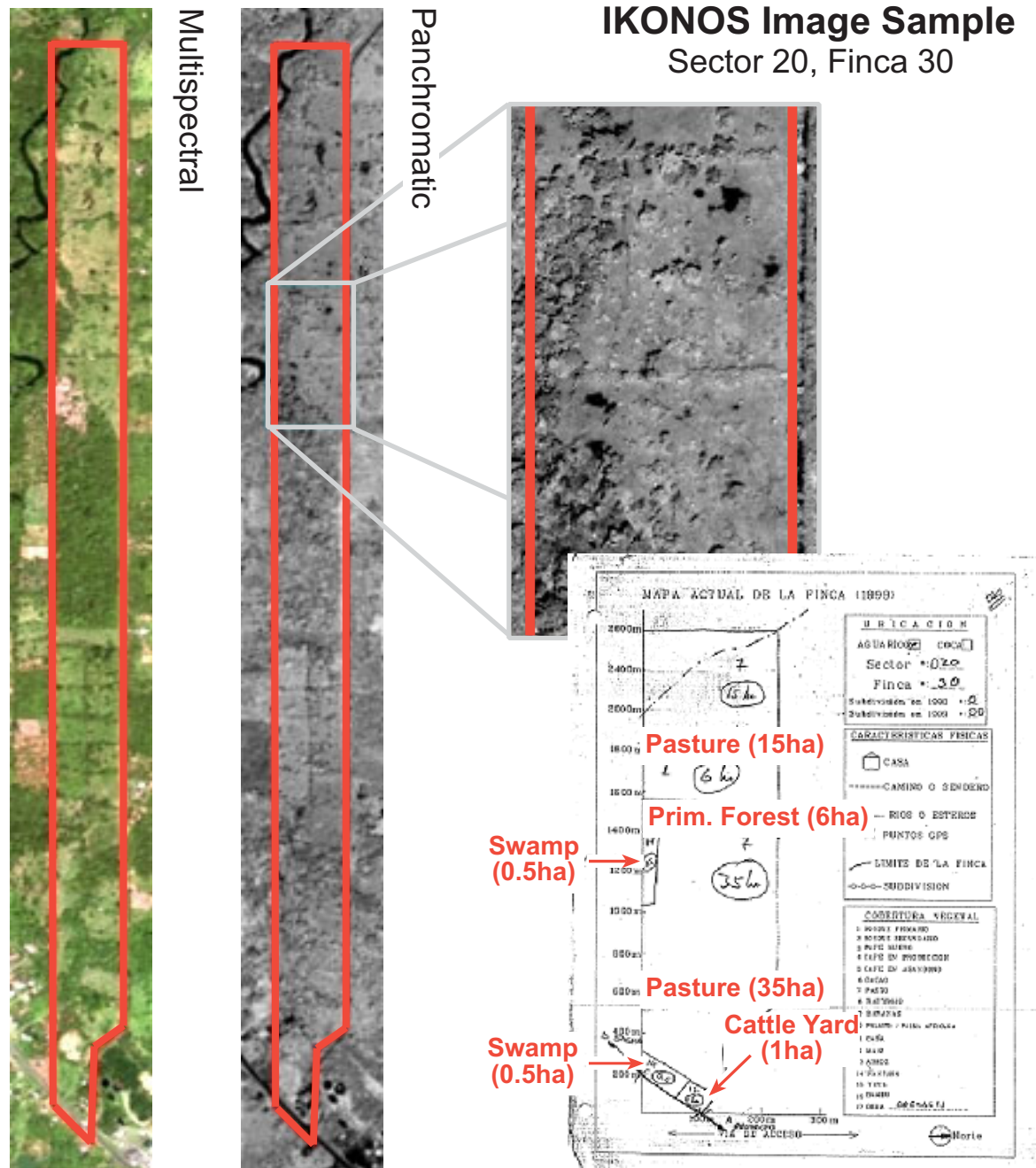
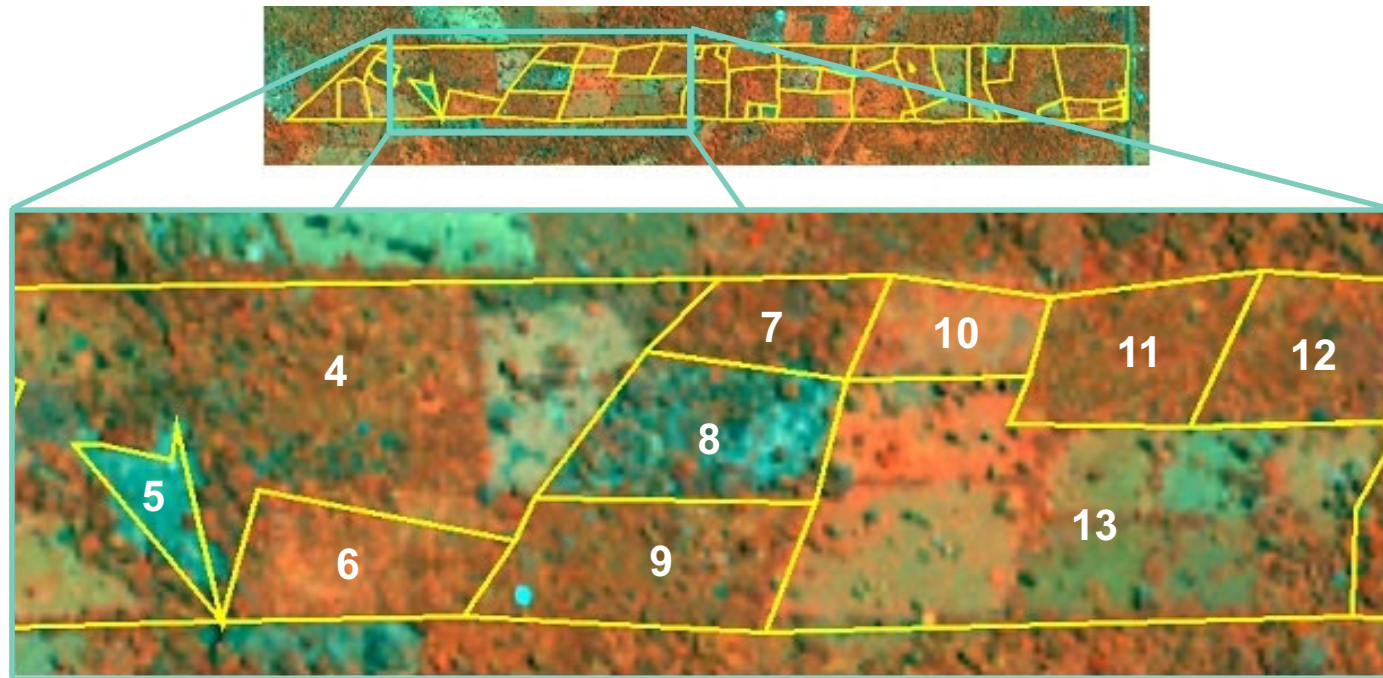


Figure 6. IKONOS multispectral and panchromatic images.



# Intensive Finca LULC Surveys

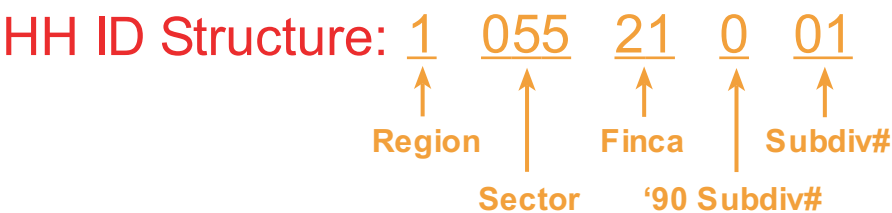
IKONOS Multispectral



Poly ID	t - 2	t - 1	t	t + 1
4	Sec. Forest	Sec. Forest	Sec. Forest	Pasture
5	Sec. Forest	Pasture	Pasture	Pasture
6	Pasture	Coffee	Coffee	Fallow
7	Pasture	Pasture	Coffee	Fallow
8	Sec. Forest	Pasture	Palm	Palm
...	...	...	...	...

Figure 7. Referencing LCLU on a finca.

Household ID Example: 105521001



Original spatial data structure

HHID	VAR1	VAR2	VAR3
105521001	1	86.95	0
105521002	2	54.75	0
105522000	1	45.62	1
105523101	2	78.21	1
105523102	3	96.37	0
105523201	3	13.64	1

Step 1: Add the finca madre ID

Spatial data structure  
*finca madres*

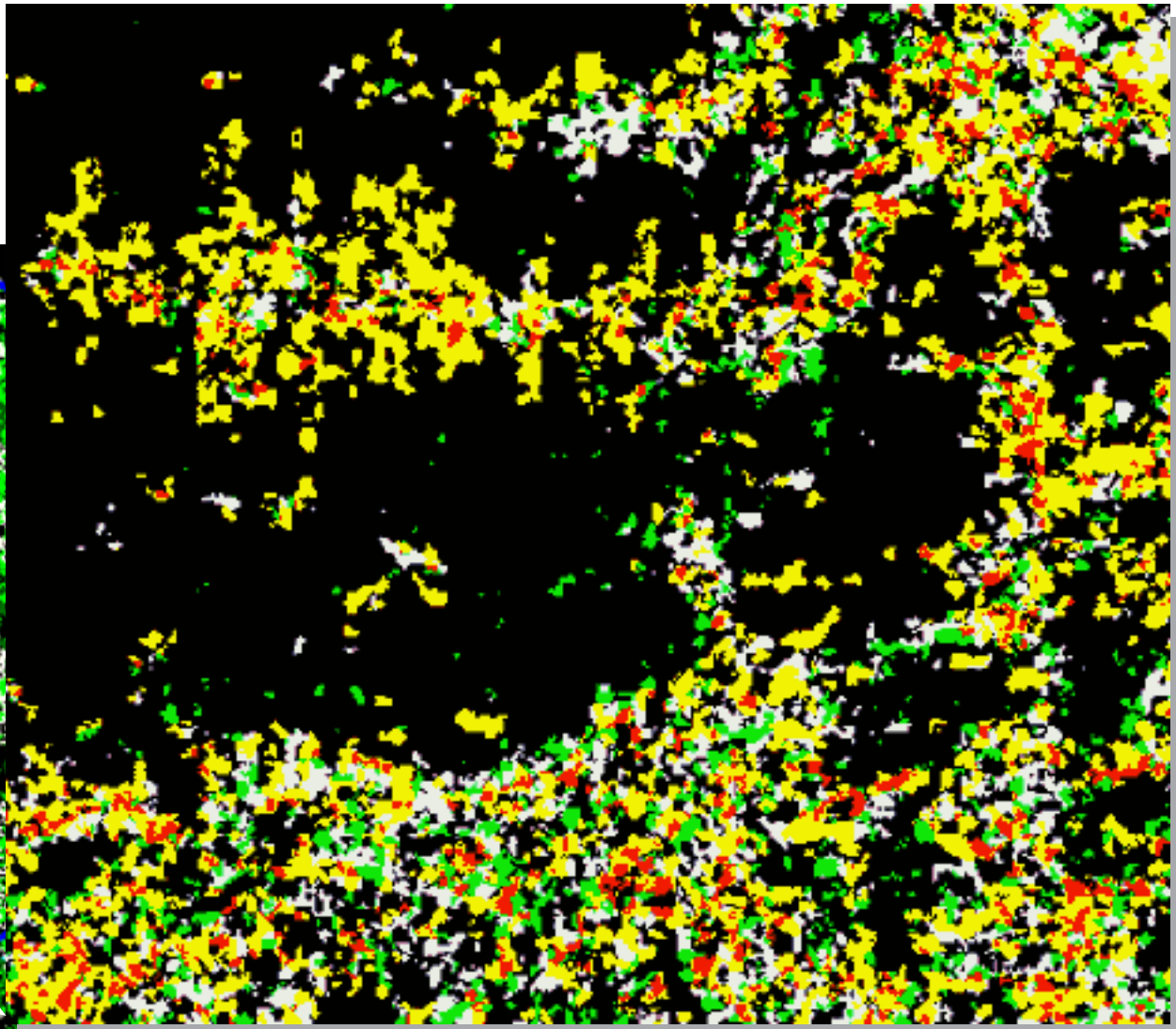
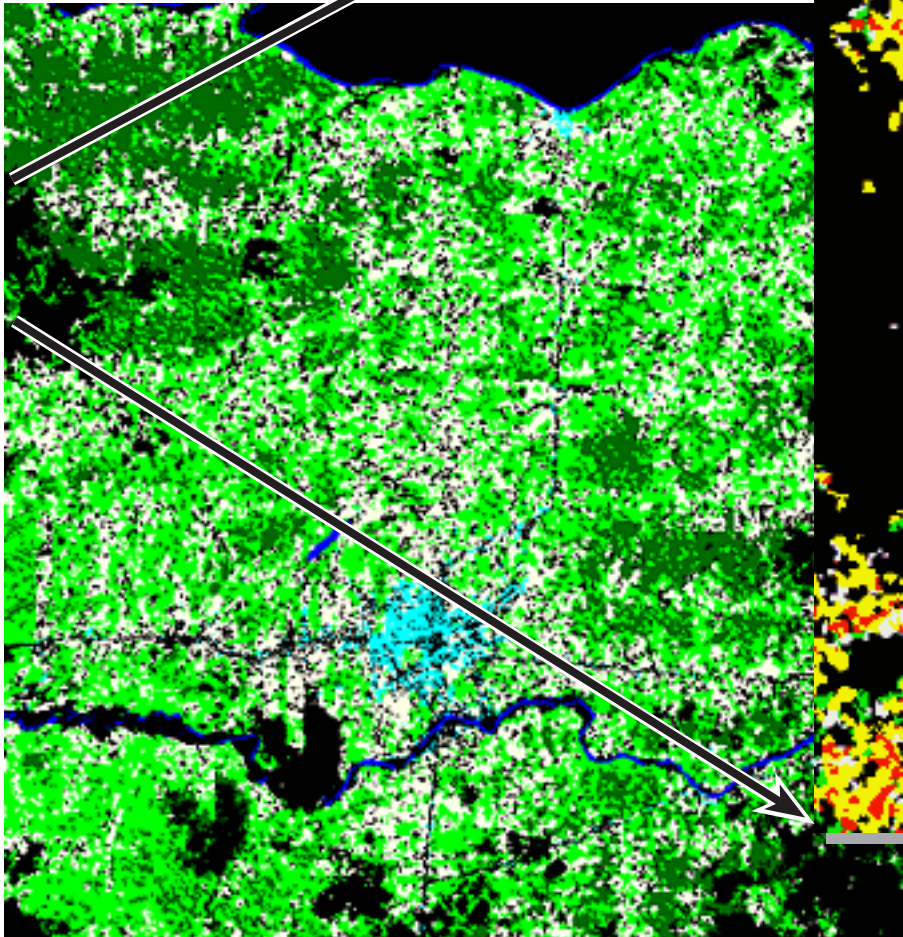
105521000
105522000
105523000

Step 2: Link to  
spatial data

HHMID	HHID	VAR1	VAR2
105521000	105521001	1	86.95
105521000	105521002	2	54.75
105522000	105522000	1	45.62
105523000	105523101	2	78.21
105523000	105523102	3	96.37
105523000	105523201	3	13.64

Figure 8. Tracking the links between subdivided fincas and finca madres.

**Panel Data &  
Bi-Directional Change**  
1973-1999



Red: Long-term Ag    Green: New Forest    Yellow: New Ag

*Figure 9. Pixel change trajectories.*

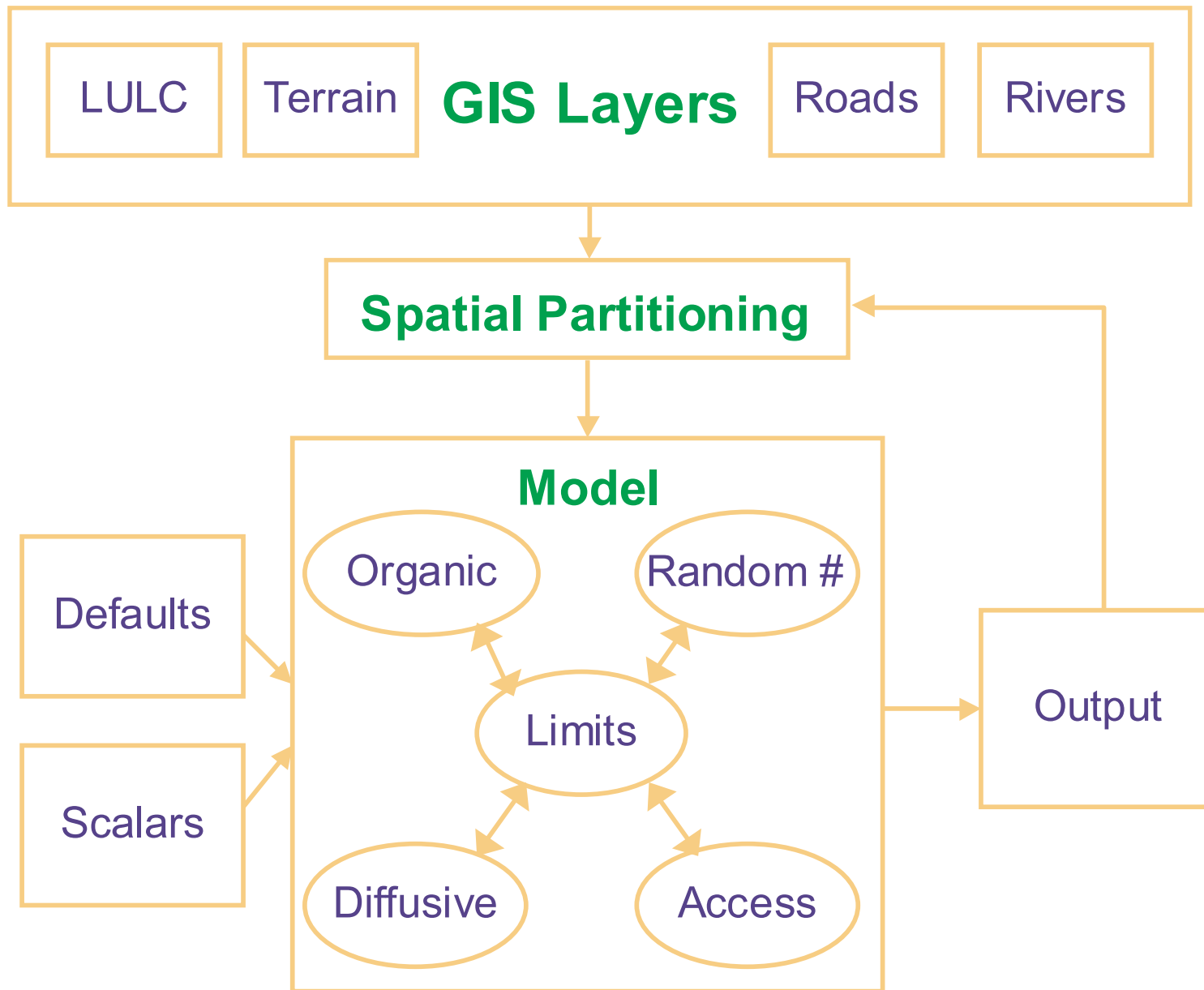


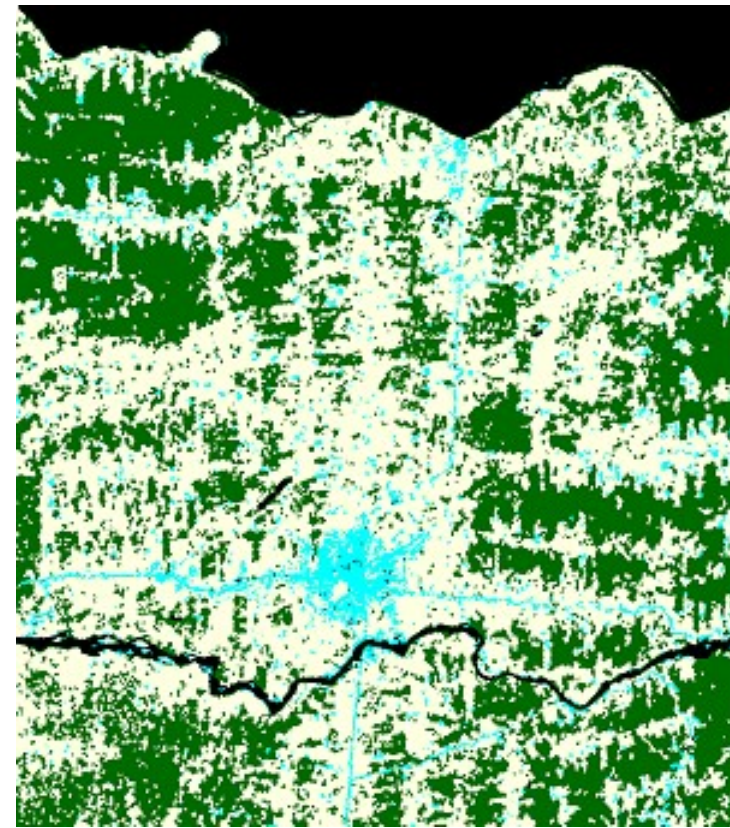
Figure 10. General structure of the CA model used for LCLU simulation.



Predicted 1996



Actual 1996



Total Area in Hectares

	1986	1996 Predicted	1996 Actual
Urbanized	48036	30015	31853
Forested	1050	3591	3774
Agriculture	27158	45072	43029

Summary Correlations

Forested	Urbanized	Agriculture
70.95%	7.80%	23.08%
2.15%	54.50%	3.94%
26.90%	37.70%	72.98%

Figure 11. Comparison of “observed” and “expected” LCLU patterns.



*Figure 1.* Study area location, Nang Rong District, northeast Thailand.

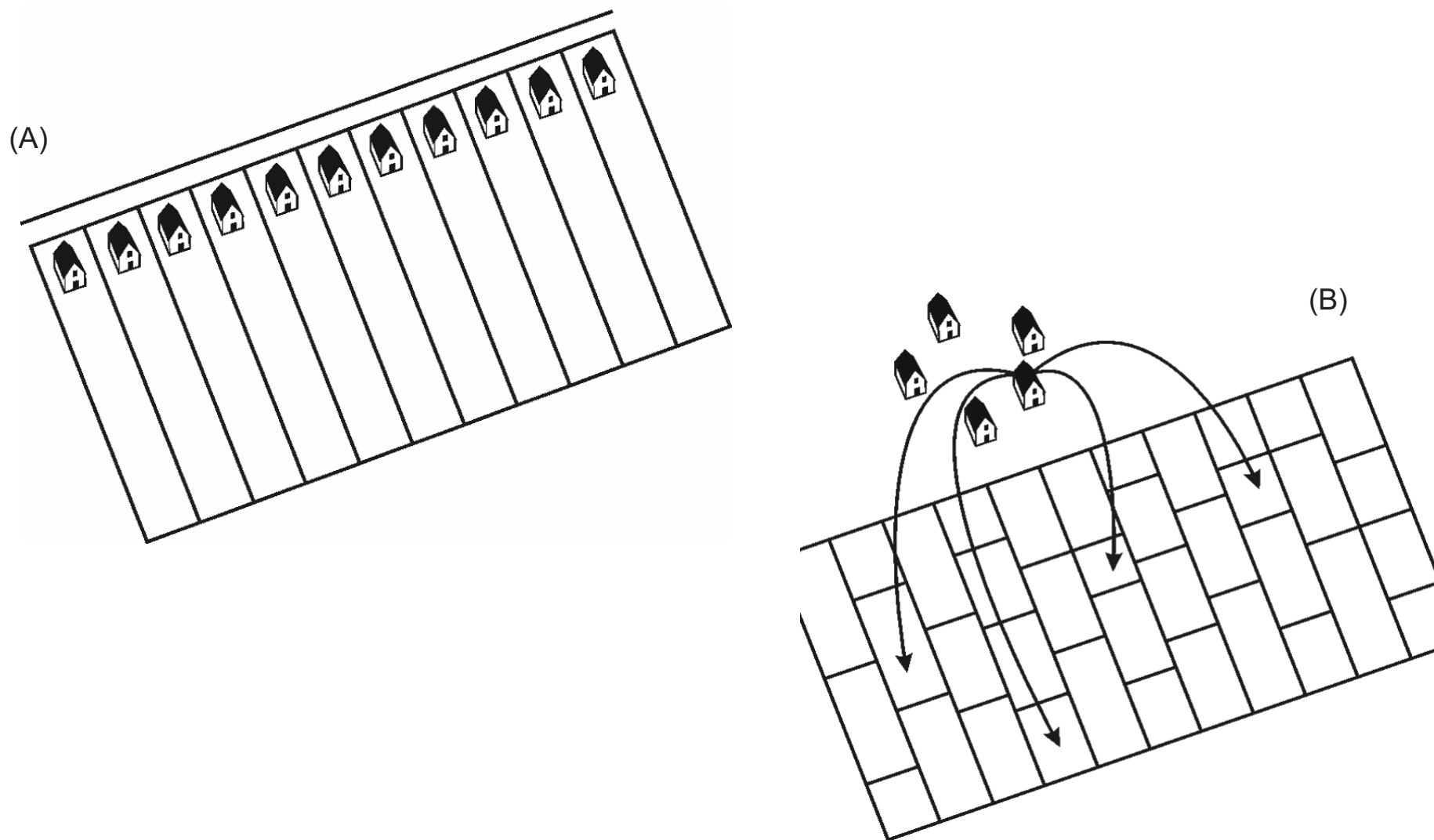


Figure 2. Illustration of households in nonclustered and clustered villages.

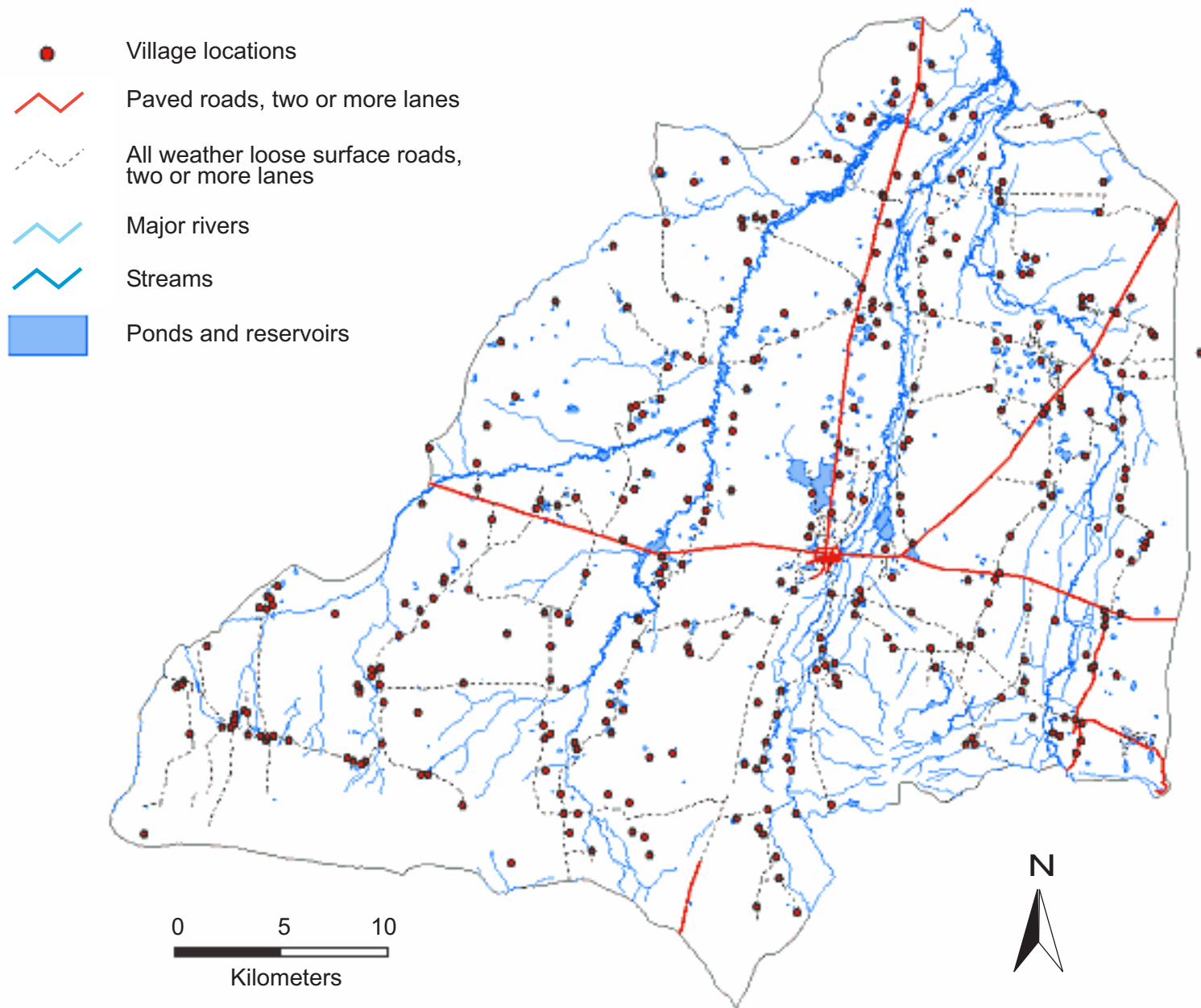
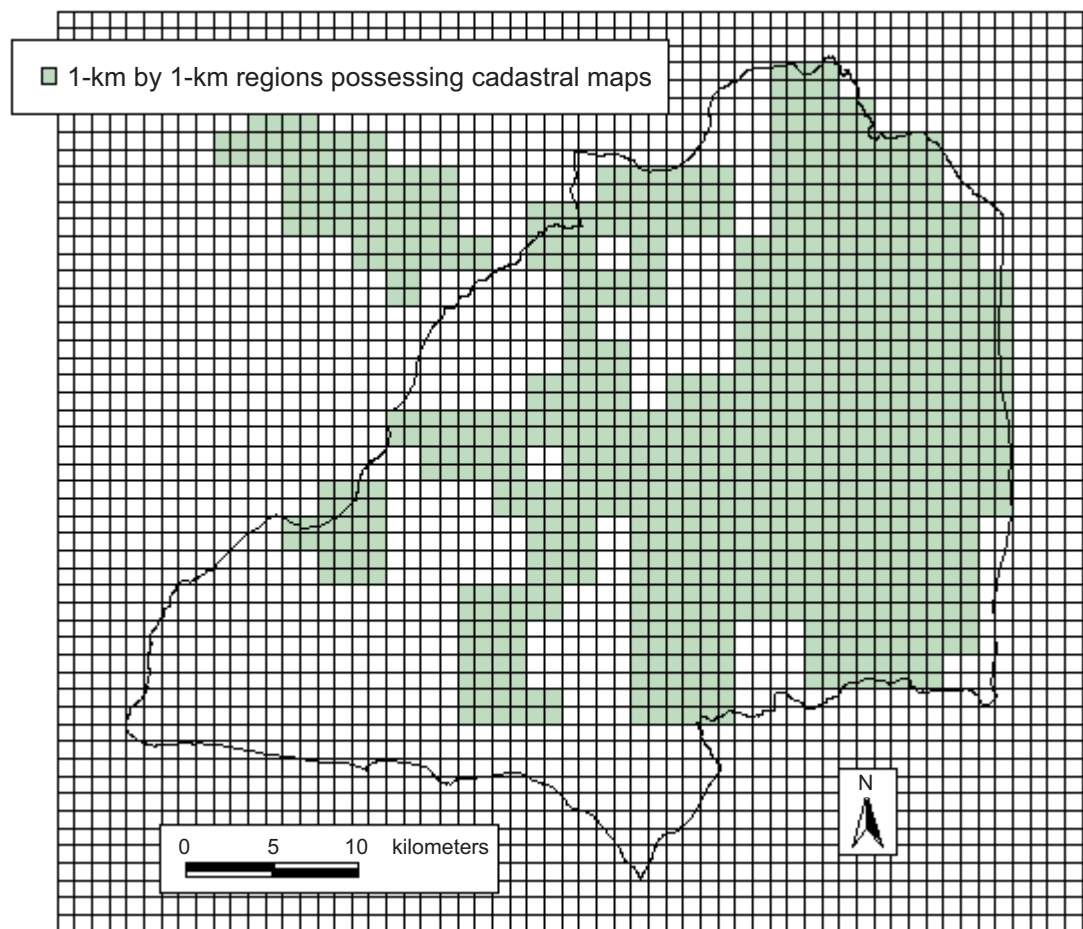
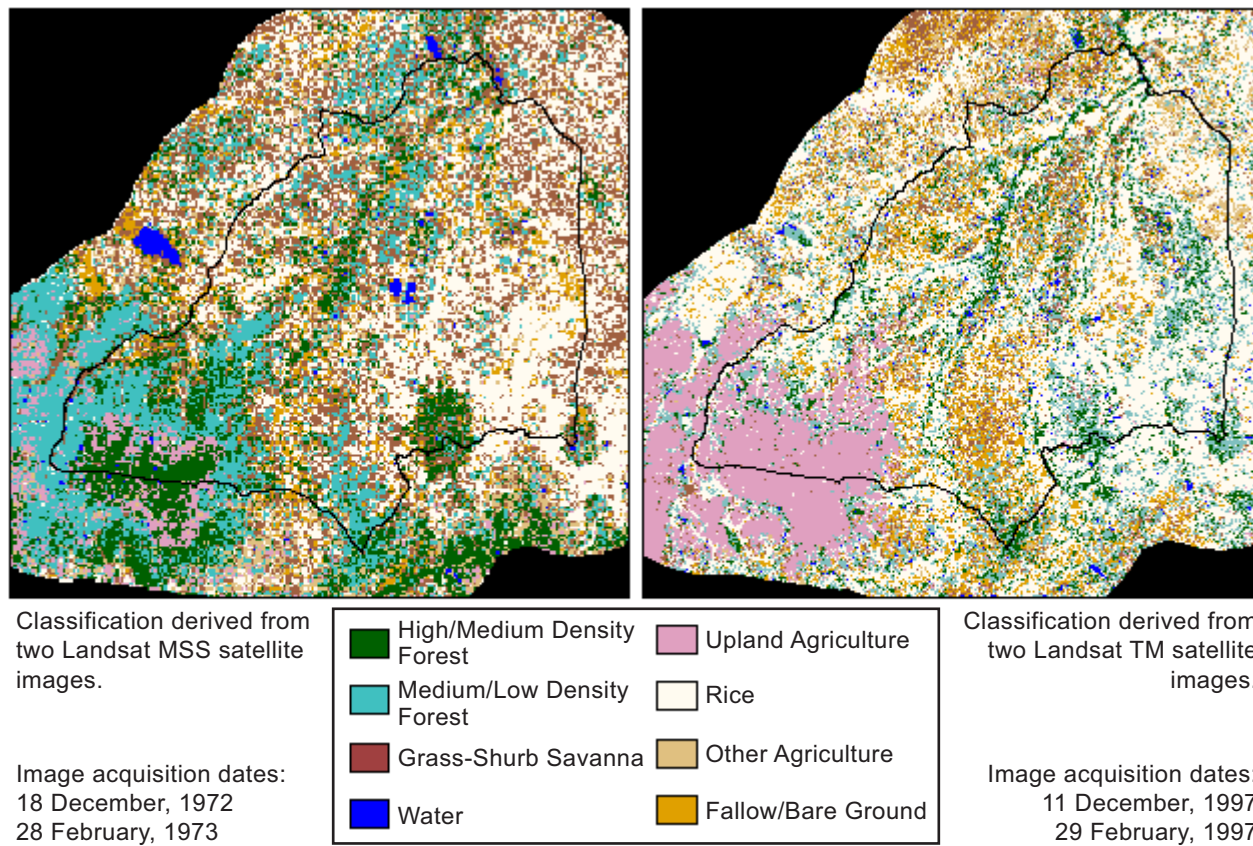


Figure 3. Nang Rong District with village locations from the 2000 survey.



Figure 4. Cadastral map coverage of Nang Rong District in 1999.

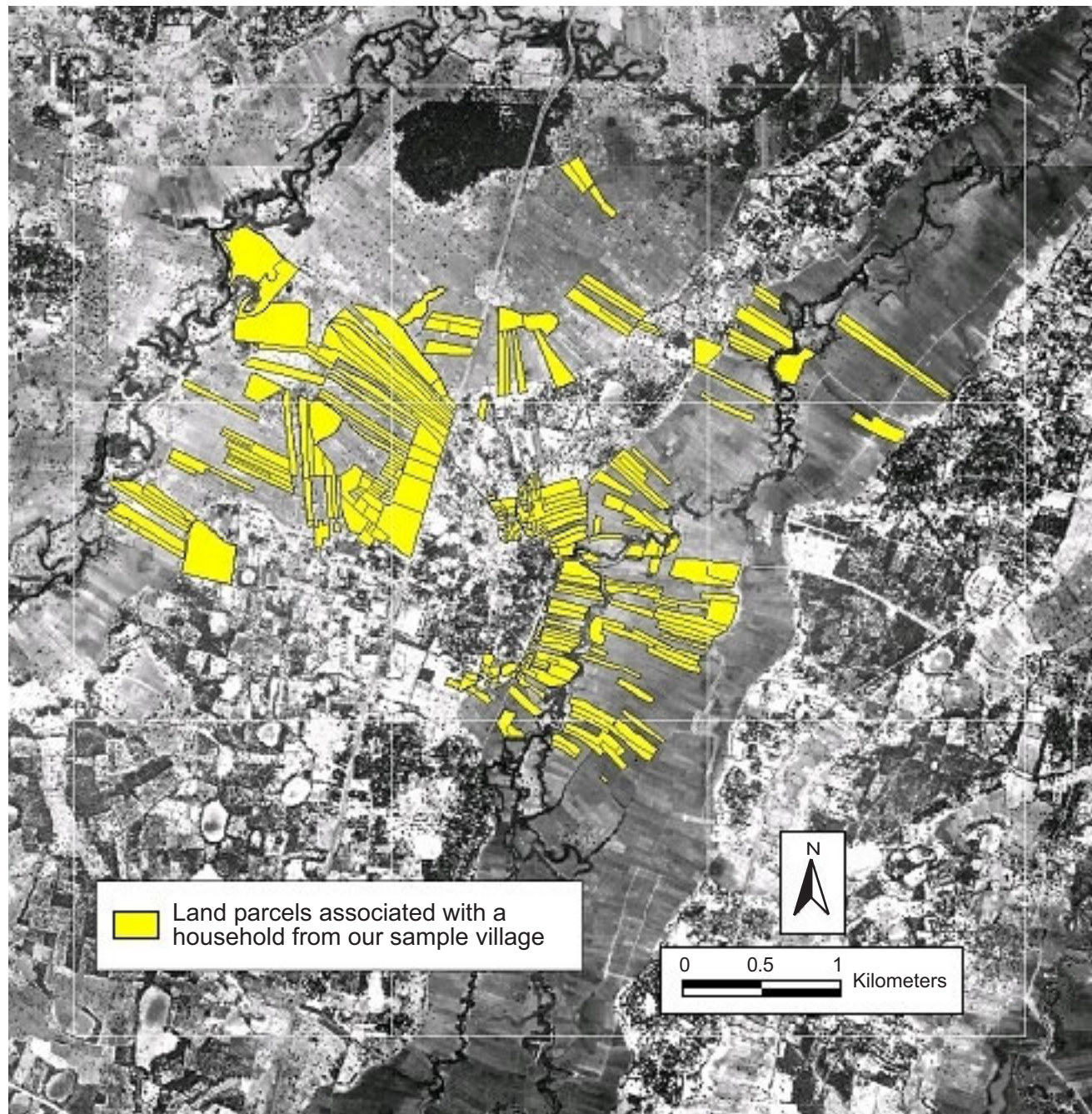




*Figure 5.* Landsat Thematic Mapper classifications of the study area.







*Figure 7. Map showing land parcels associated with our sample village.*



- A Prior to data collection
  - Obtain cadastral maps
  - List of names from earlier rounds
  - Digitize cadastral maps
  - Create field maps
- B Spatial team-phase I
  - HH listing
  - Dwelling unit GPSing
  - GPS village centroid
  - Community interviews
- C Household interview team
  - Locate and interview old HHs
  - Interview new HHs
- D Spatial team-phase II
  - Group interviews
  - Spot checking
- E Matching and checks
  - Matching household and group interview data
  - Matching cadastral and household data

*Figure 8. Steps in the Nang Rong household-land parcel linking, 2000.*

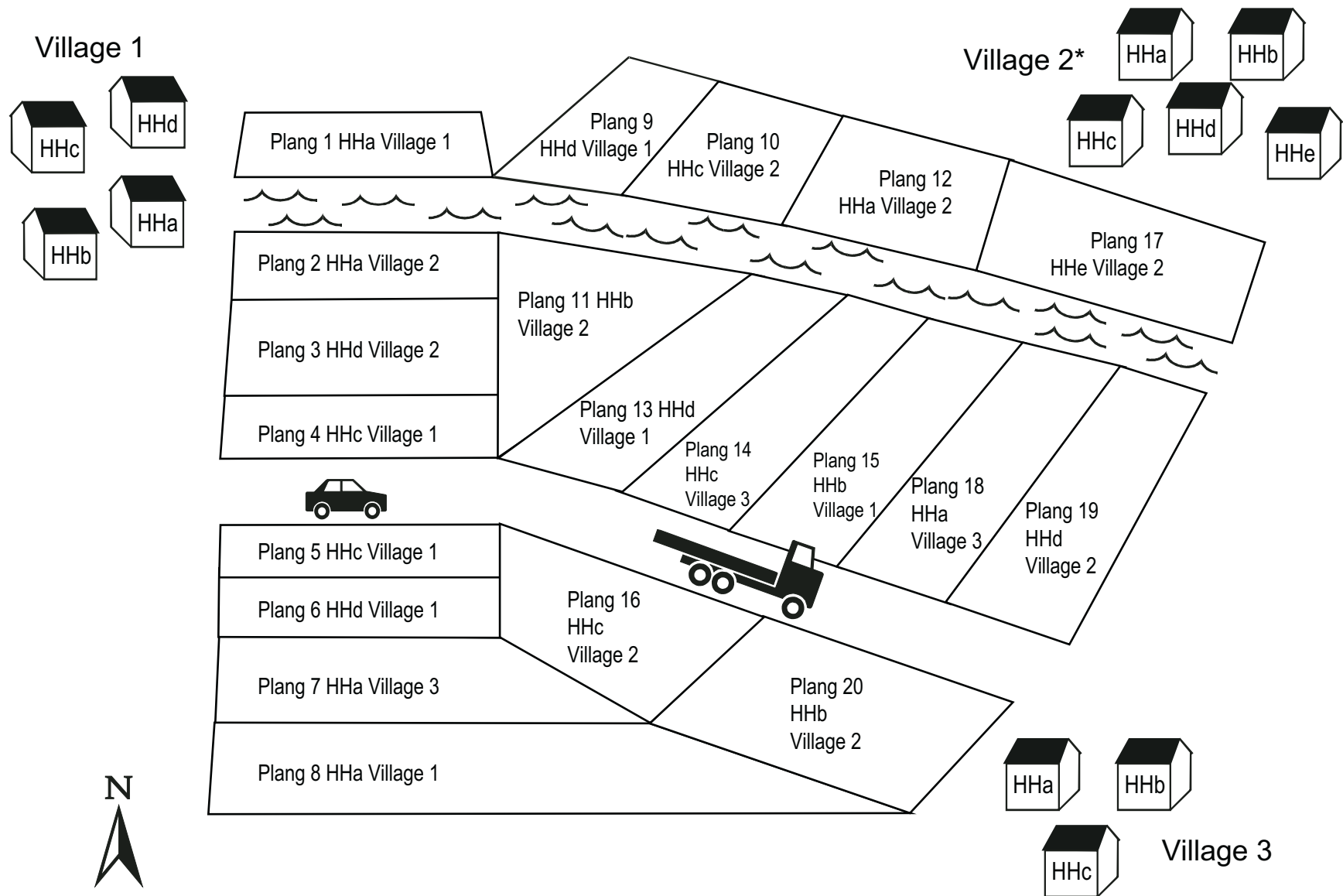
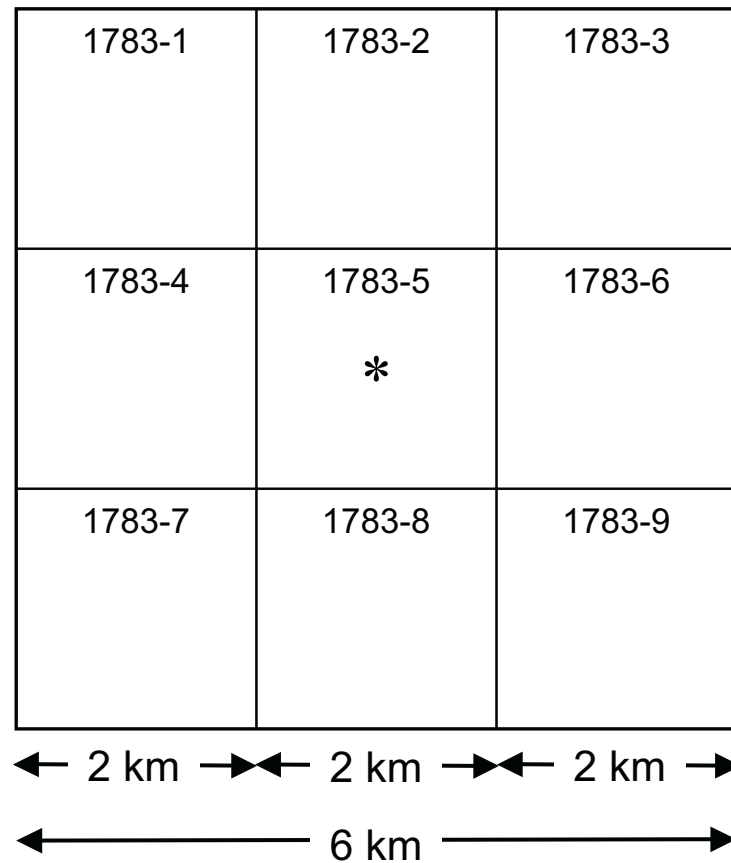


Figure 9. Illustration of households in clustered villages.



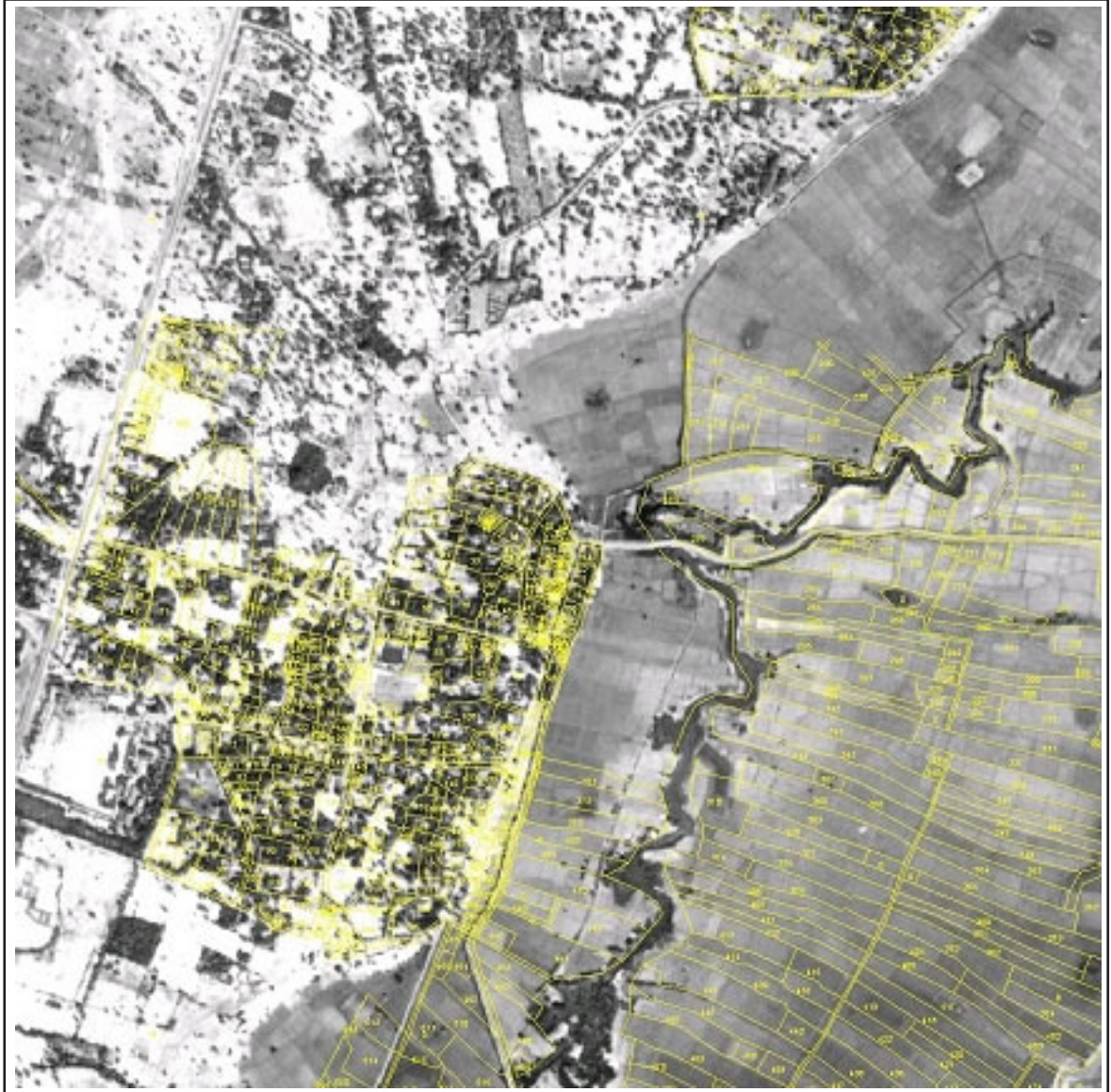
\*The center of the map set ( \*, tile 5 ) is the GPS location of the study village.

*Figure 10a. Villages and map sets.*



*Figure 10b.* Group discussion and map sets.





*Figure 11.* Field maps used by the spatial team for year 2000 survey.

**Village Name      Village ID - Map ID**



0      0.5  
kilometers

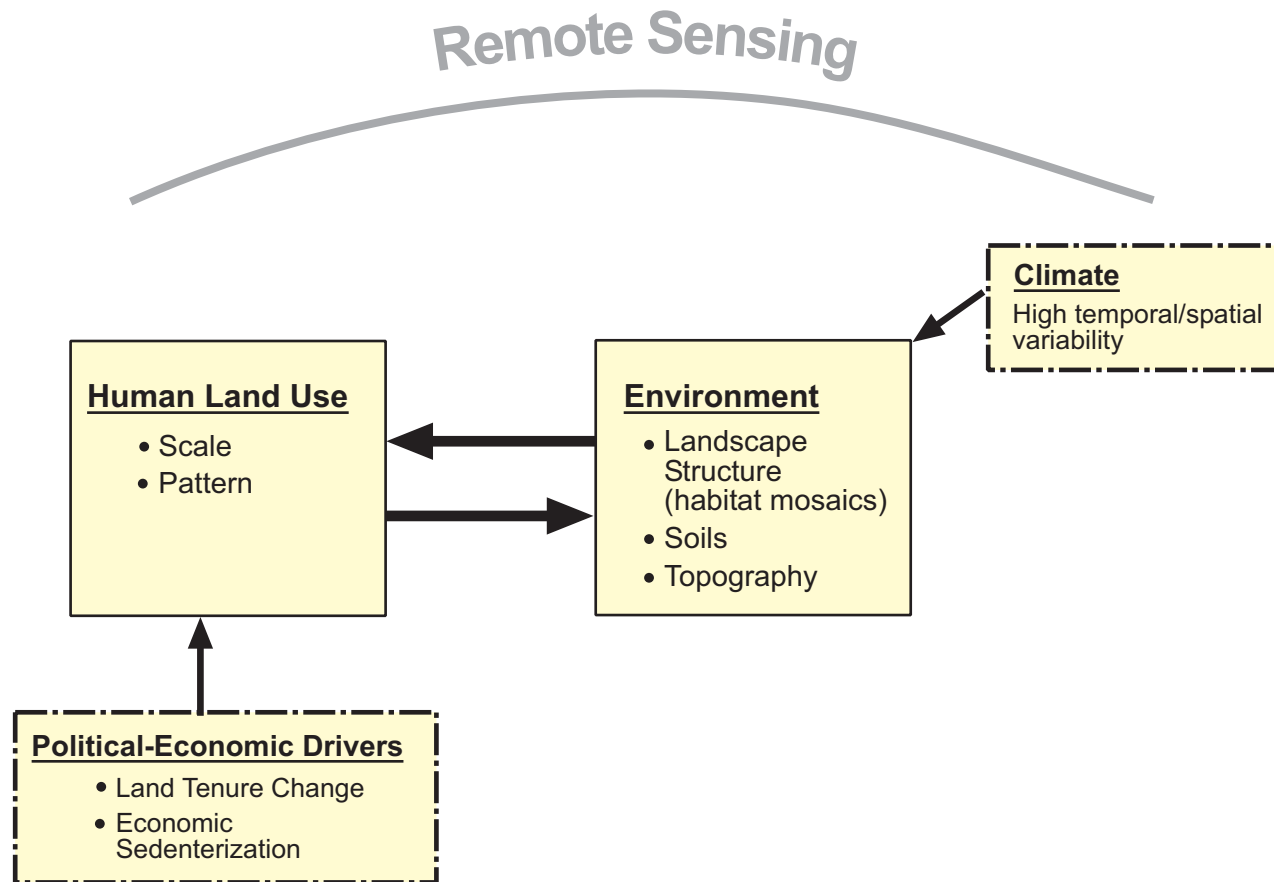


Figure 1. Conceptual model.

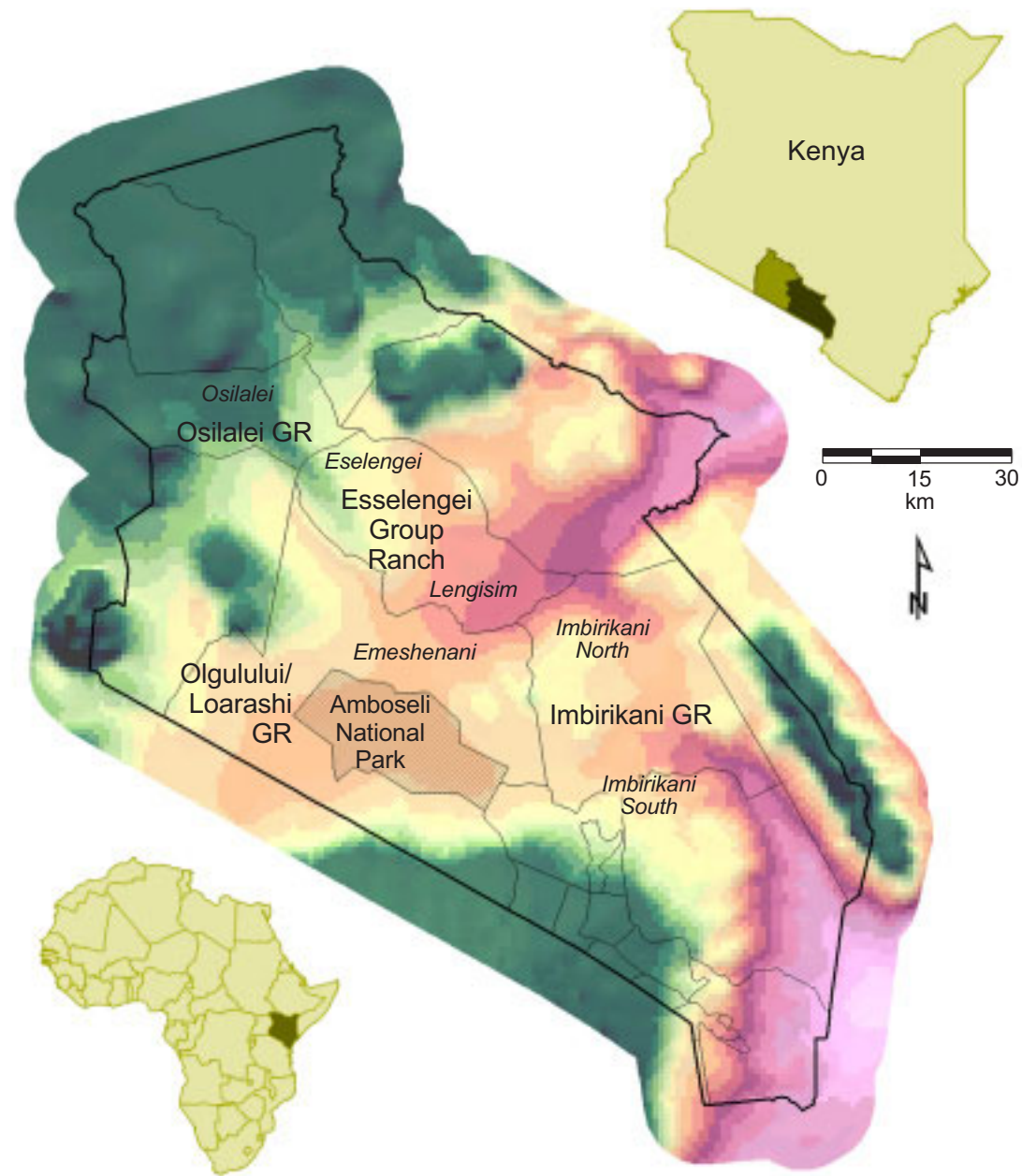


Figure 2. The study region.

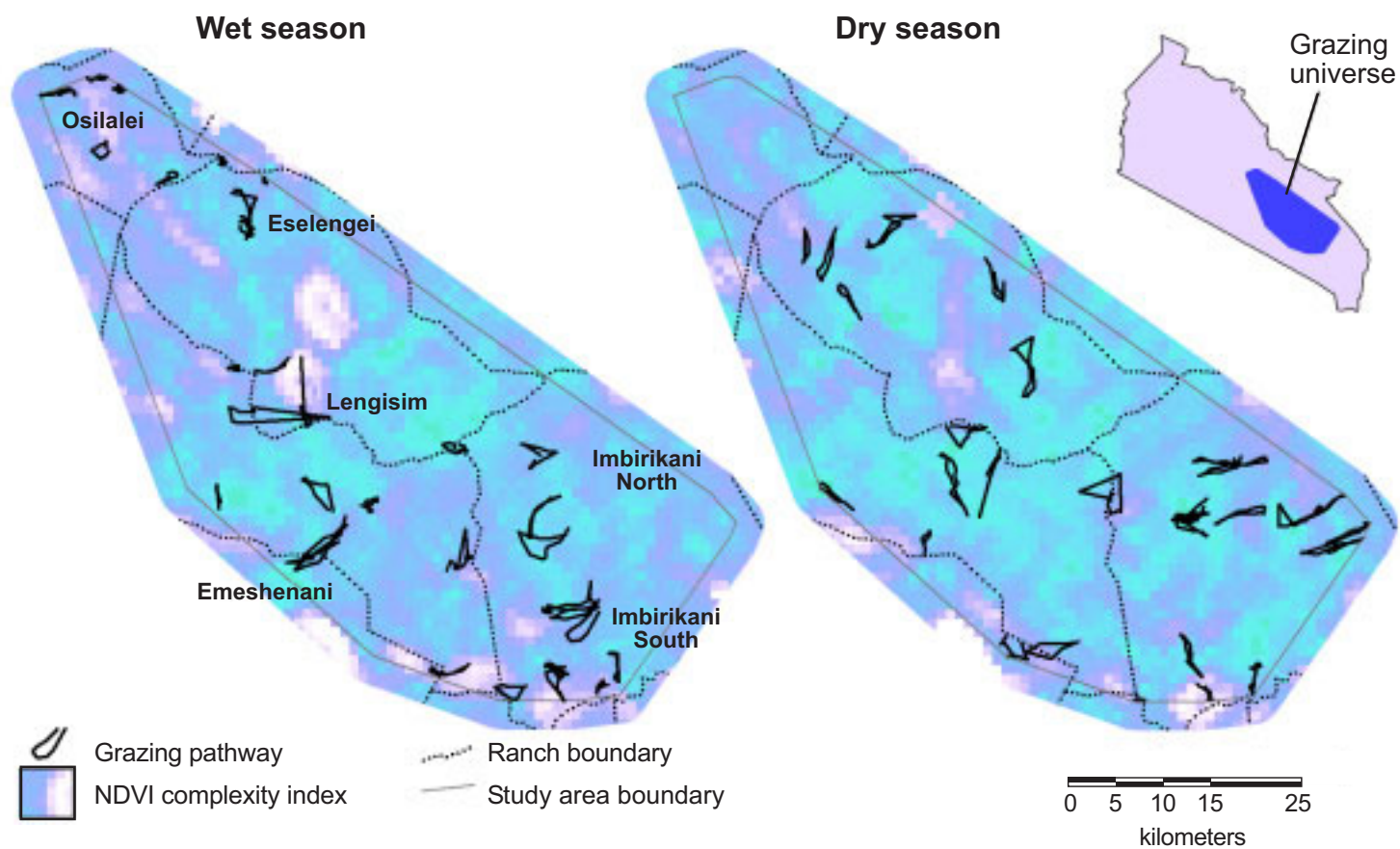


Figure 3. Grazing pathways in southern Kajiado.



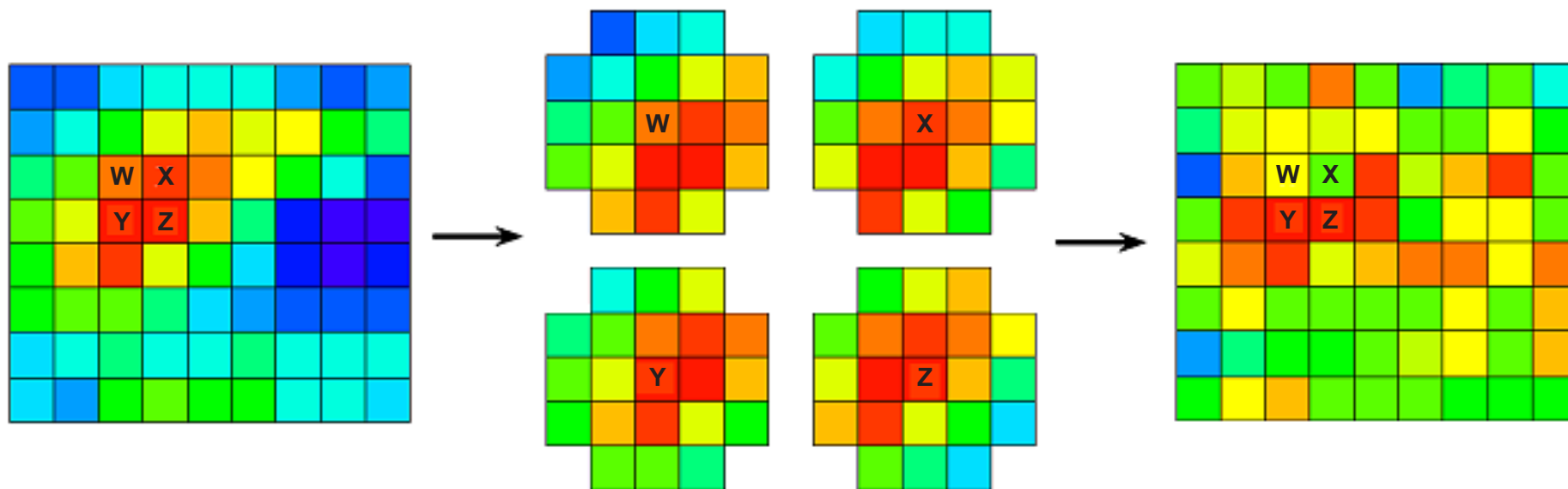


Figure 4. Complexity scores are based upon focal statistics.

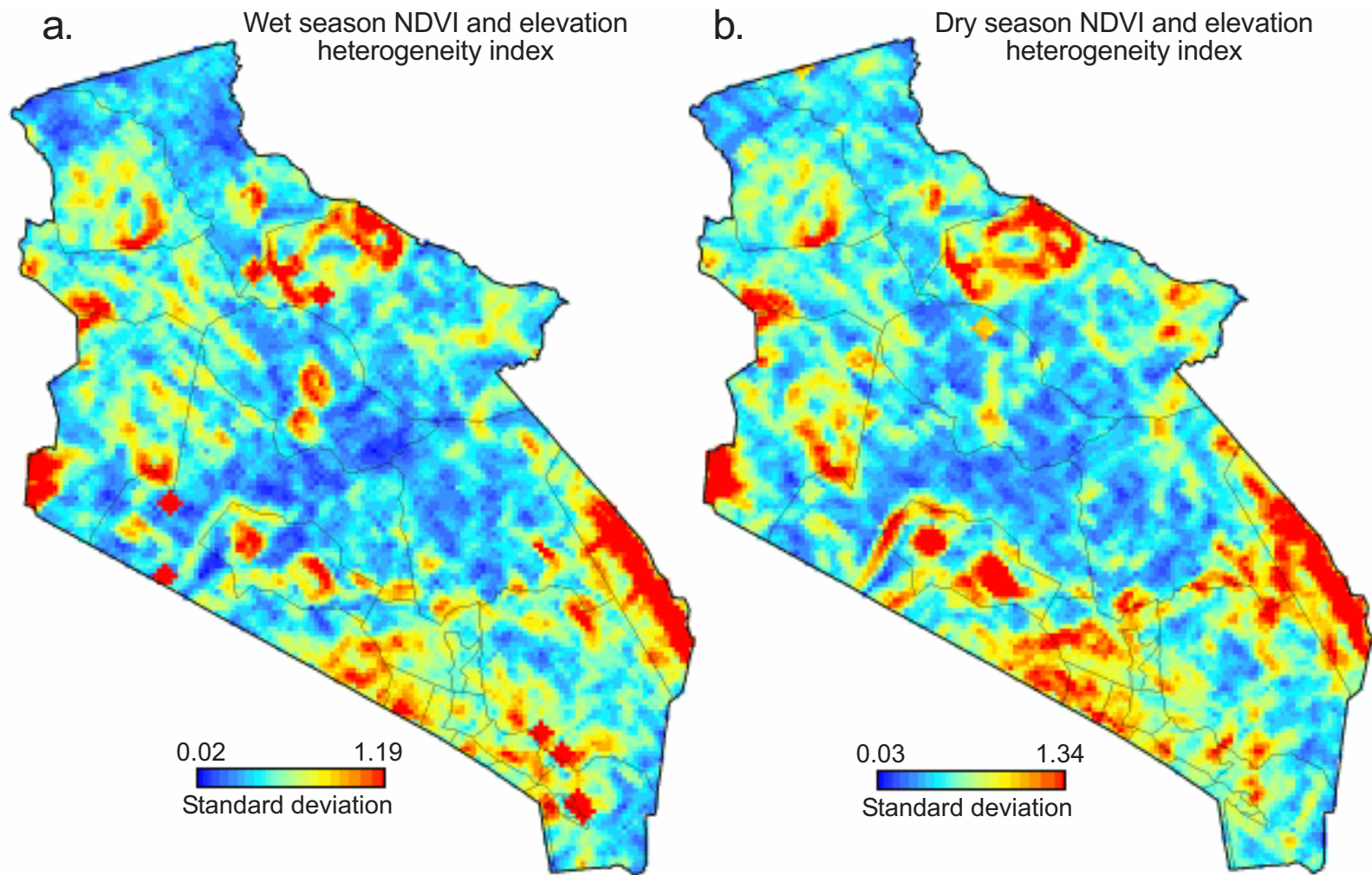


Figure 5. Heterogeneity indices for southern Kajiado District.

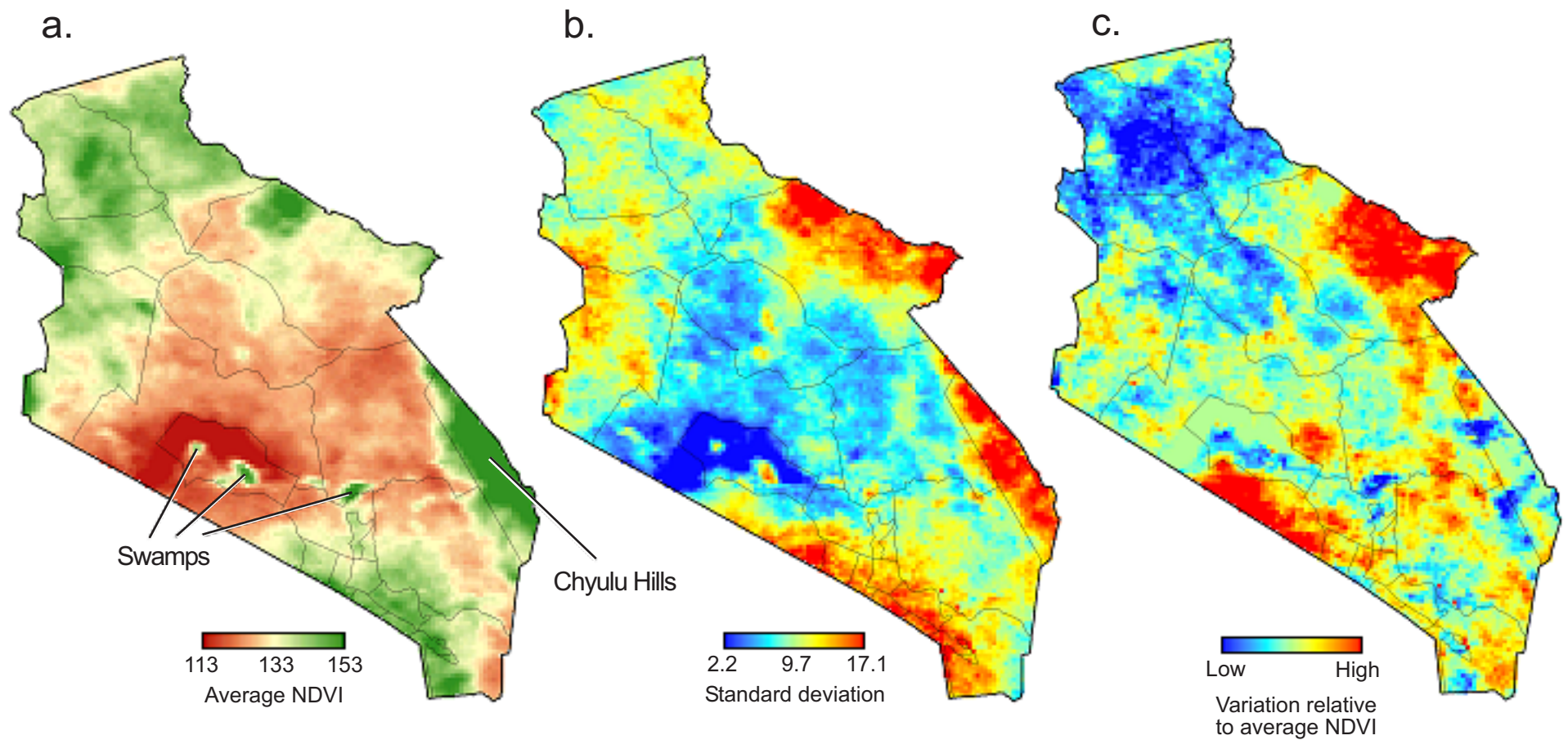


Figure 6. NDVI patterns in southern Kajiado district in the mid-1990s.



Figure 1. Tat hamlet: The study area in northern Vietnam.



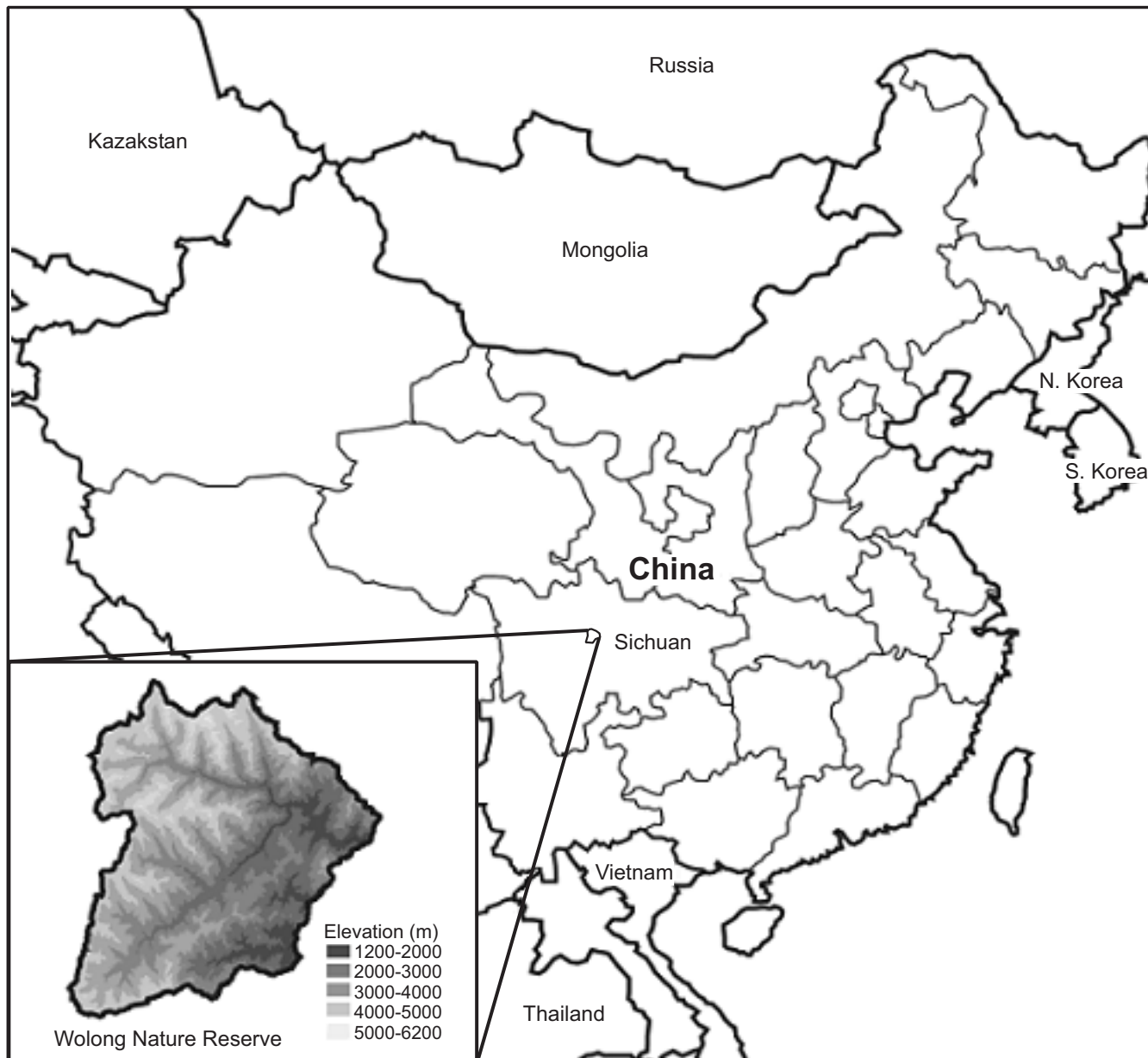


Figure 1. Location map of Wolong Nature Reserve.

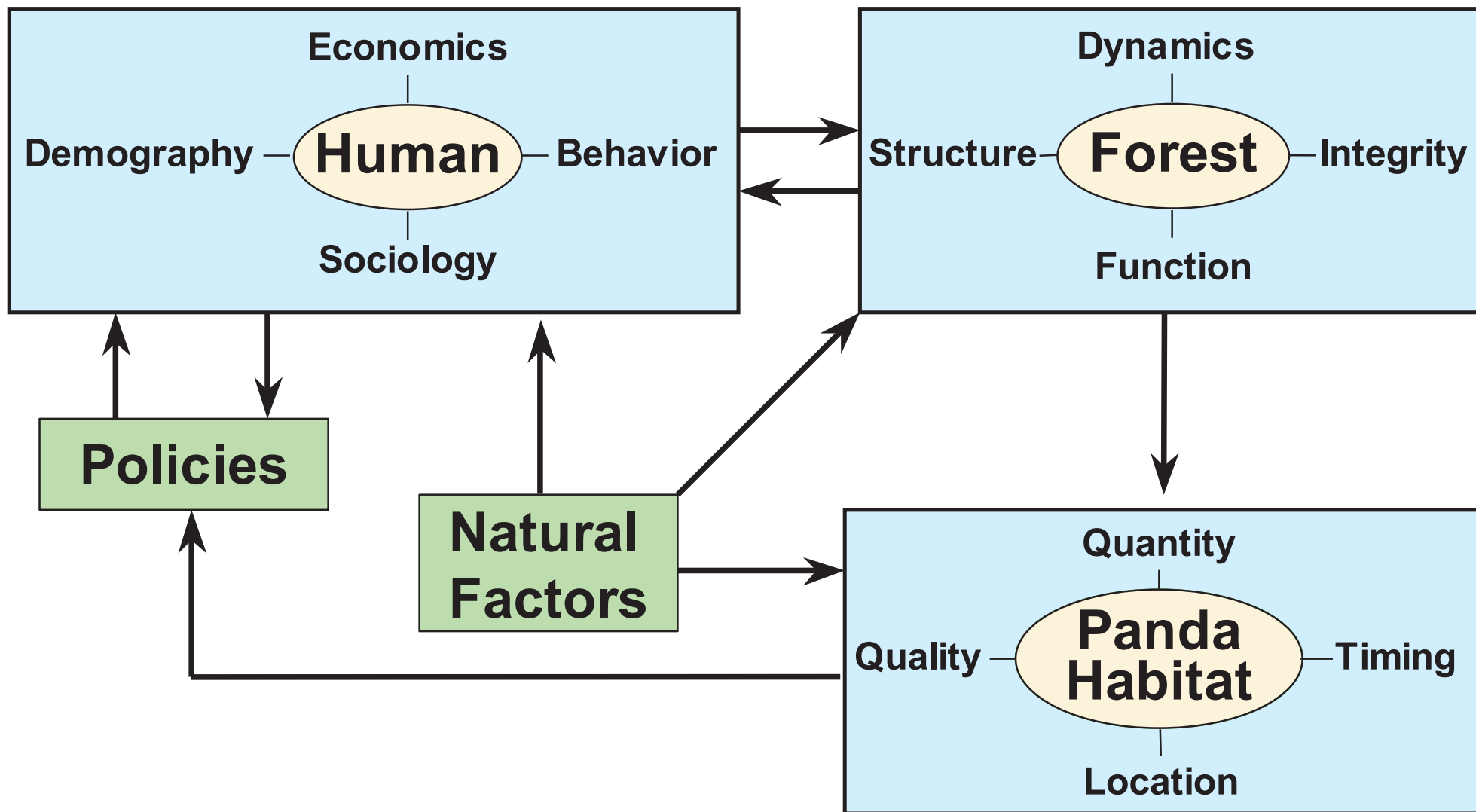


Figure 2. A conceptual framework.

波阳县外镇51普查区4普查小区走向示意图

To Xiaojing County

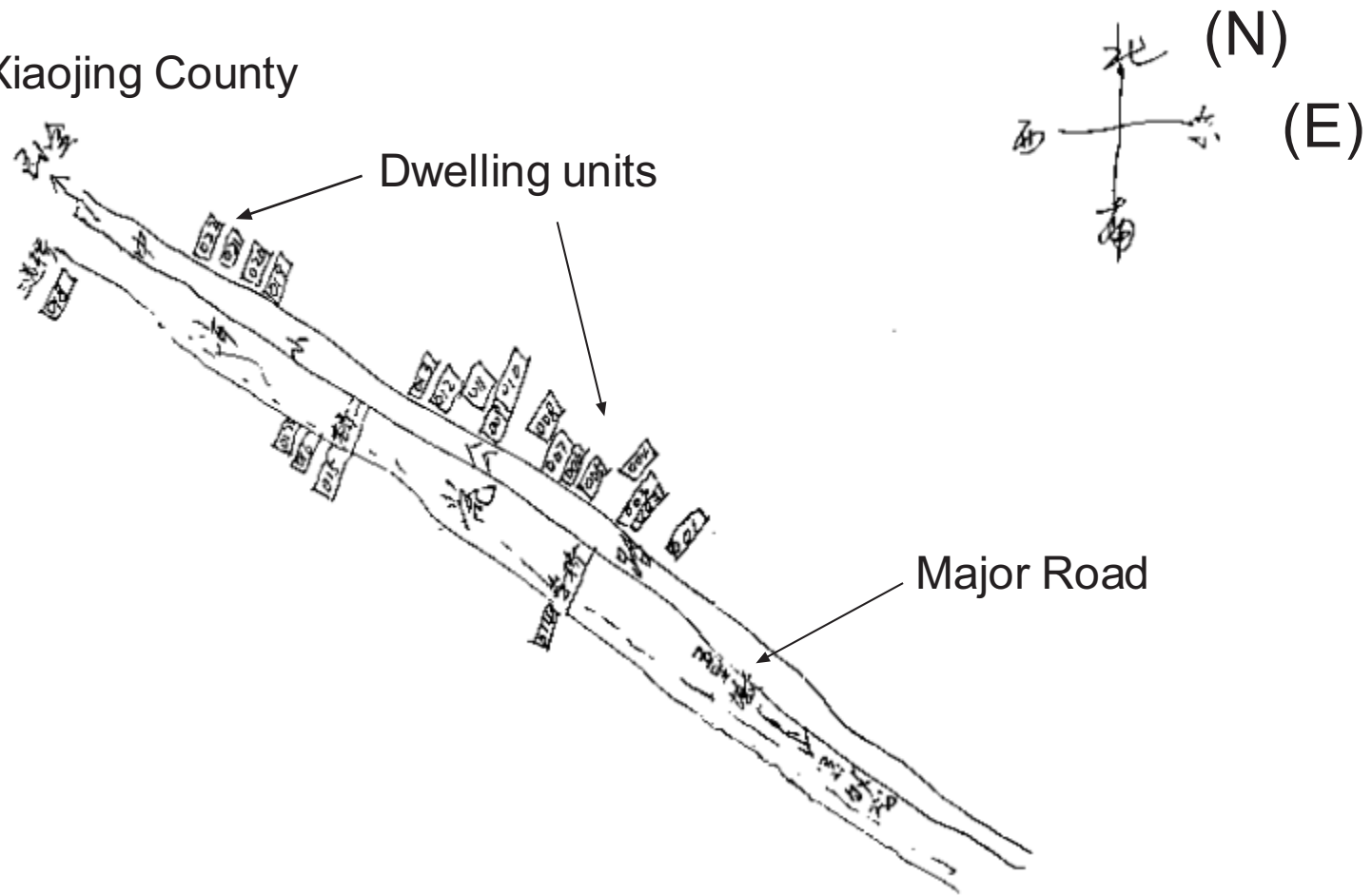


Figure 3. Sketch map.

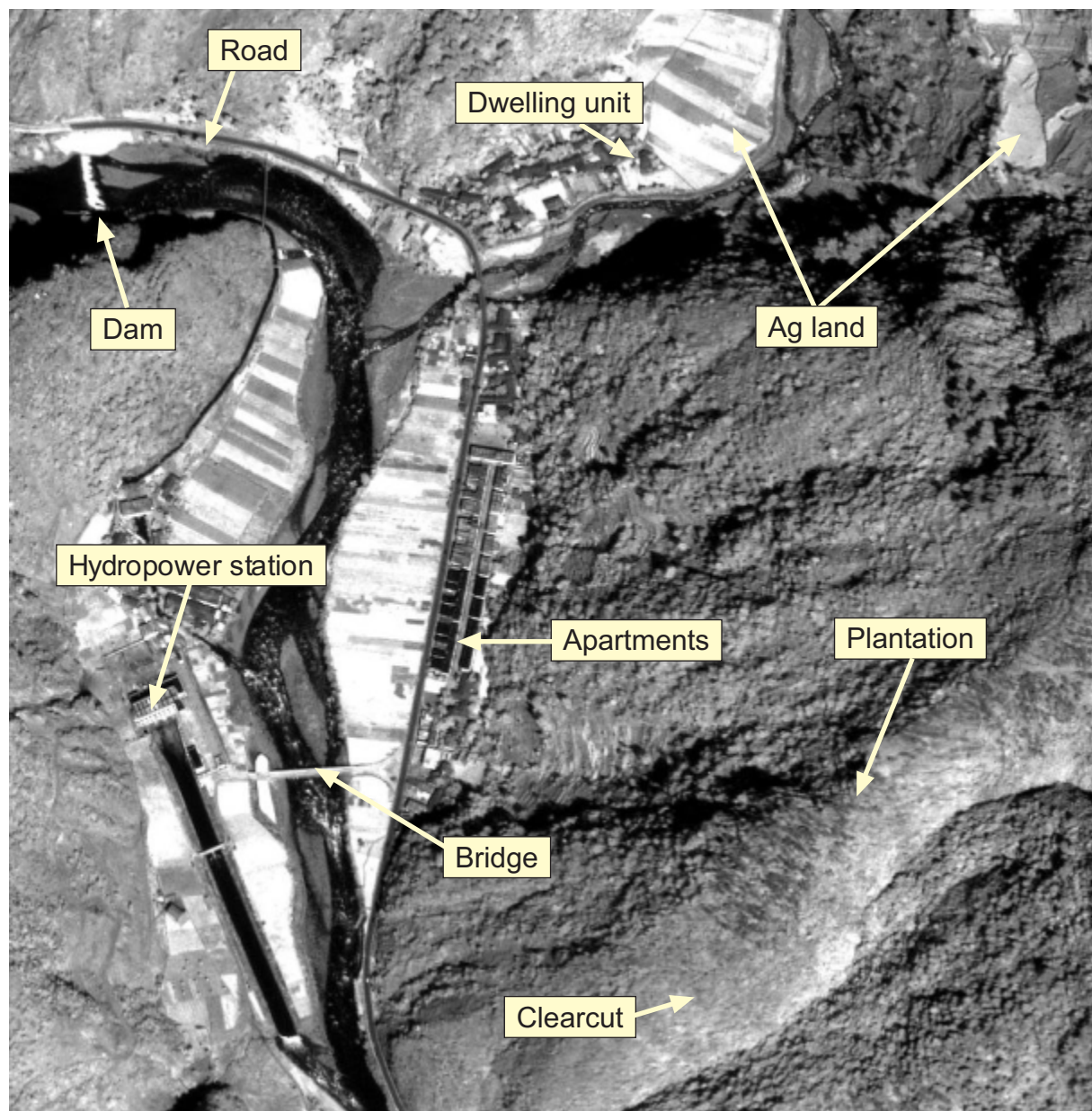


Figure 4. A subset of a panchromatic IKONOS image.



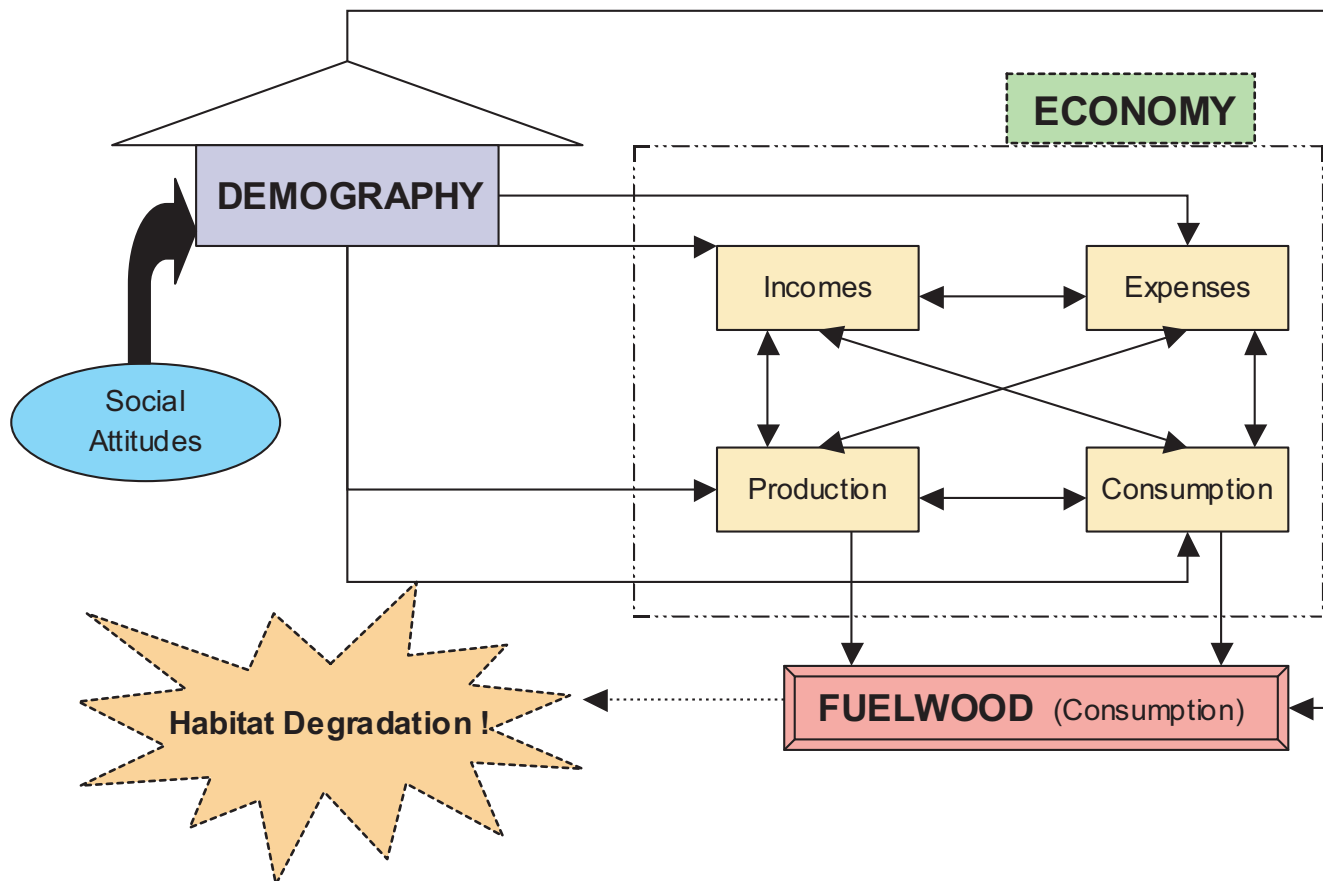




Figure 5. Conceptual structure of a household-level model.



 Matrix

 Edge

*Figure 1. Remnants of tropical forest.*

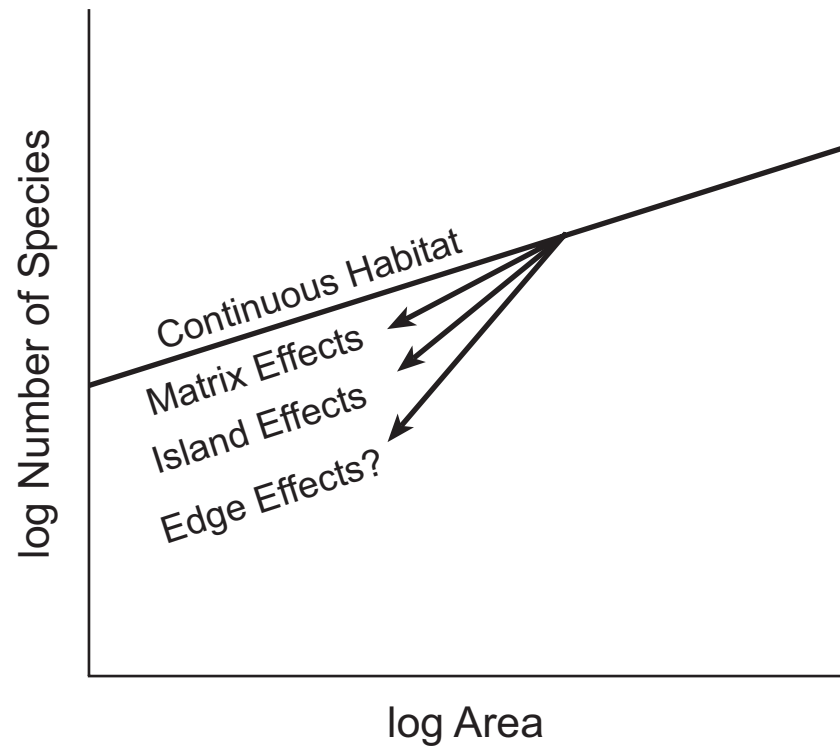


Figure 2. The species-area relationship of island biogeography.