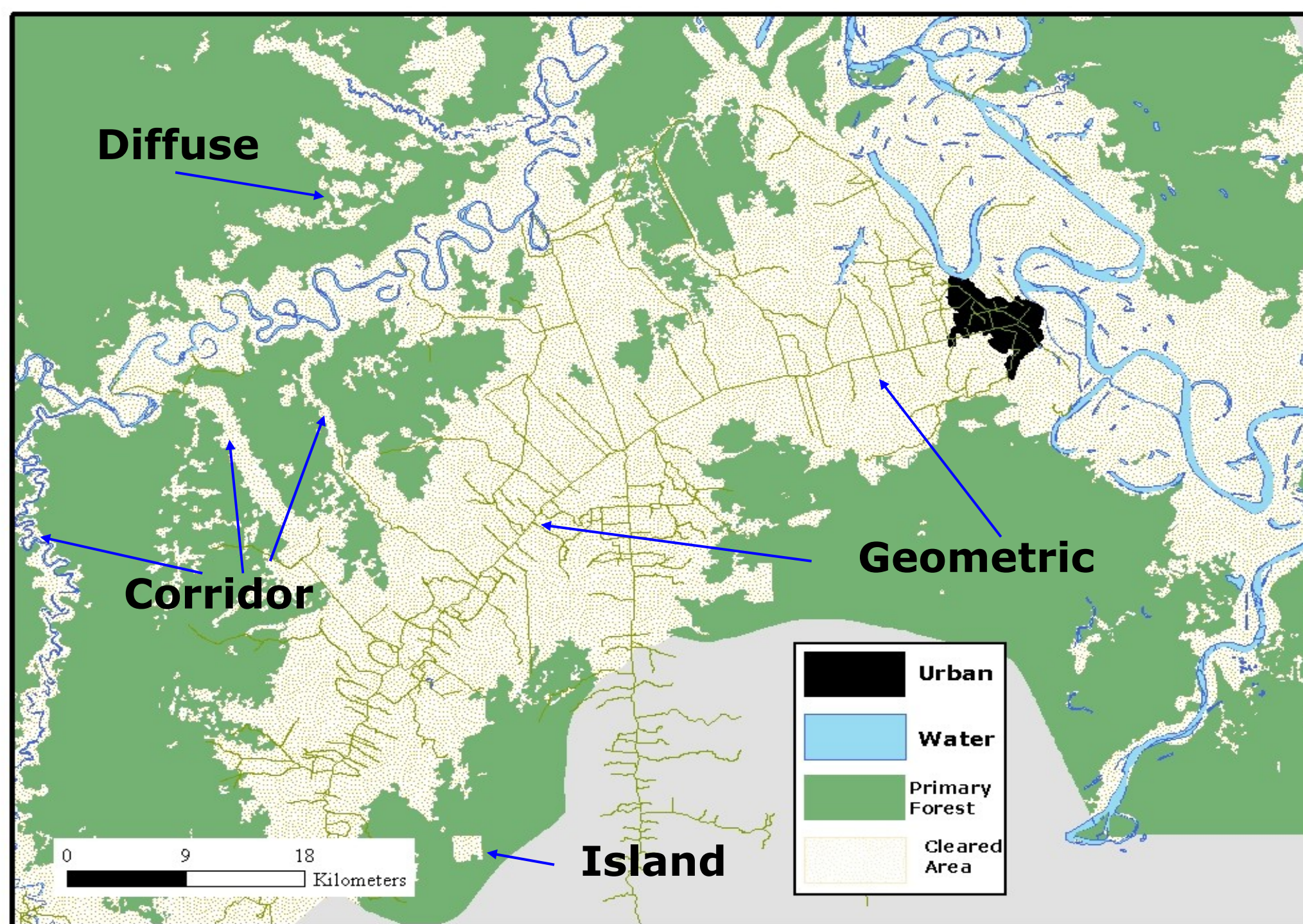# Roads and deforestation in the Central Peruvian Amazon

Glenn Hyman and Elizabeth Barona, International Center for Tropical Agriculture (CIAT), Cali, Colombia
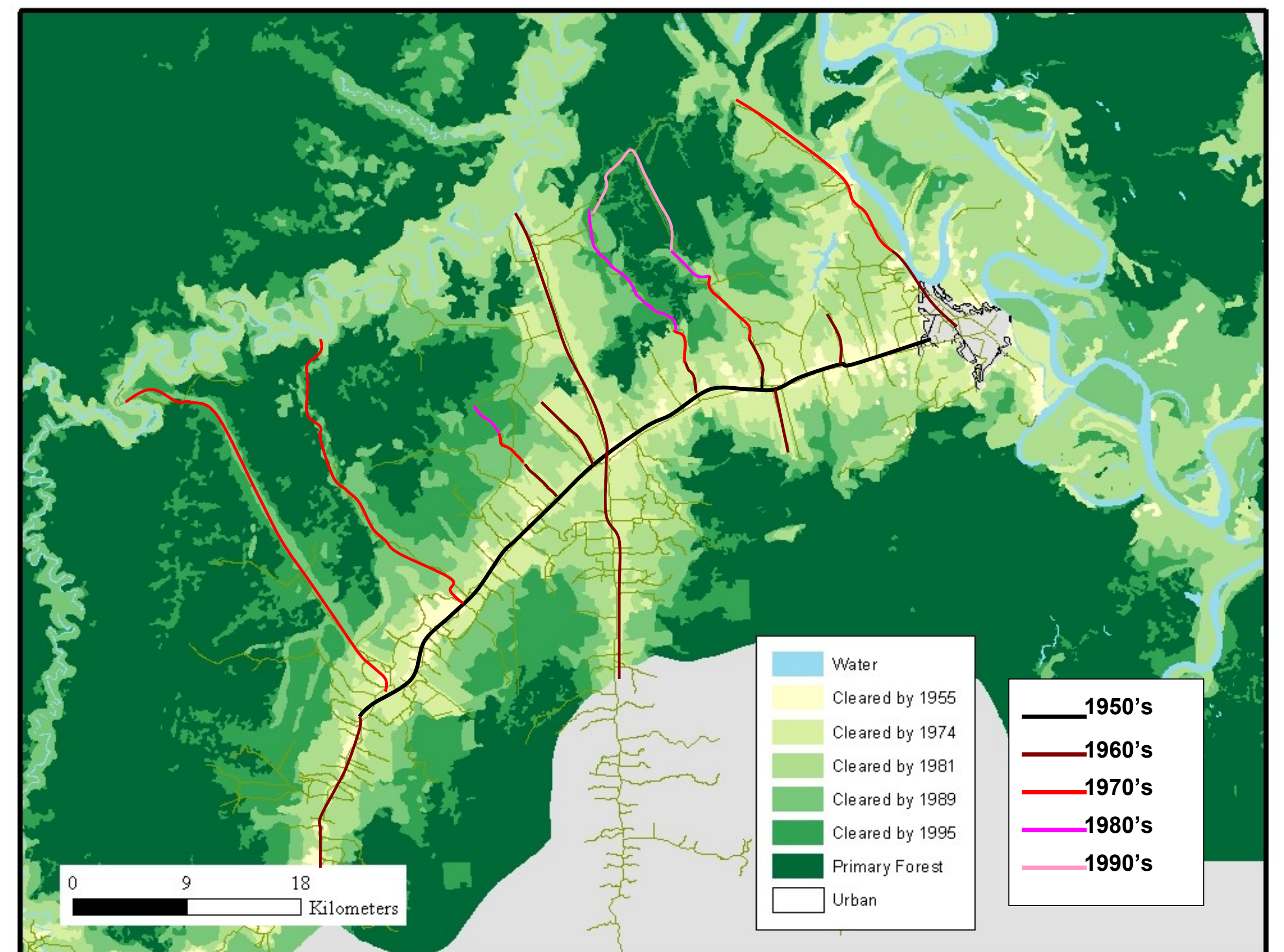
Since the middle of the last century road development has been a key proximate cause of deforestation in the Central Peruvian Amazon. Less clear are the underlying causes of deforestation and how they vary over time and across the landscape. This study reconstructed the development of the road network in the Aguaytia watershed and nearby Ucayali River floodplain since 1950. The study uses remote sensing imagery, censuses and other secondary data to reveal the proximate and underlying causes of deforestation. Road development, shifting cultivation, cattle ranching, migration, population growth and government policies all feature prominently in deforestation dynamics in the region. The study showed that the proximate and underlying drivers of deforestation vary substantially across the landscape and over the last 60 years. This case study links the spatial and temporal pattern of deforestation to the development of the road network and the underlying causes of deforestation in the region.

## Deforestation patterns

Central Peruvian Amazon Study Area

•Watershed and Floodplain area of 16, 970 km2
•Floodplain area is 3,264 km2
•Approximately 300,000 people live in city of Pucallpa
•75,000 people live in rural areas around the city

Patterns of deforestation in the central Peruvian Amazon suggest several different processes and driving forces. Diffuse patches suggest selective logging and possibly illegal crop production. The island pattern also suggests the possibility of illegal production of coca plants.The corridor pattern shows government efforts to link a major road to an important river in the region. The most prominent pattern is the large geometric shapes that are associated with most of the land-use change in the area.

Conceptual Model of Settlement Over Time
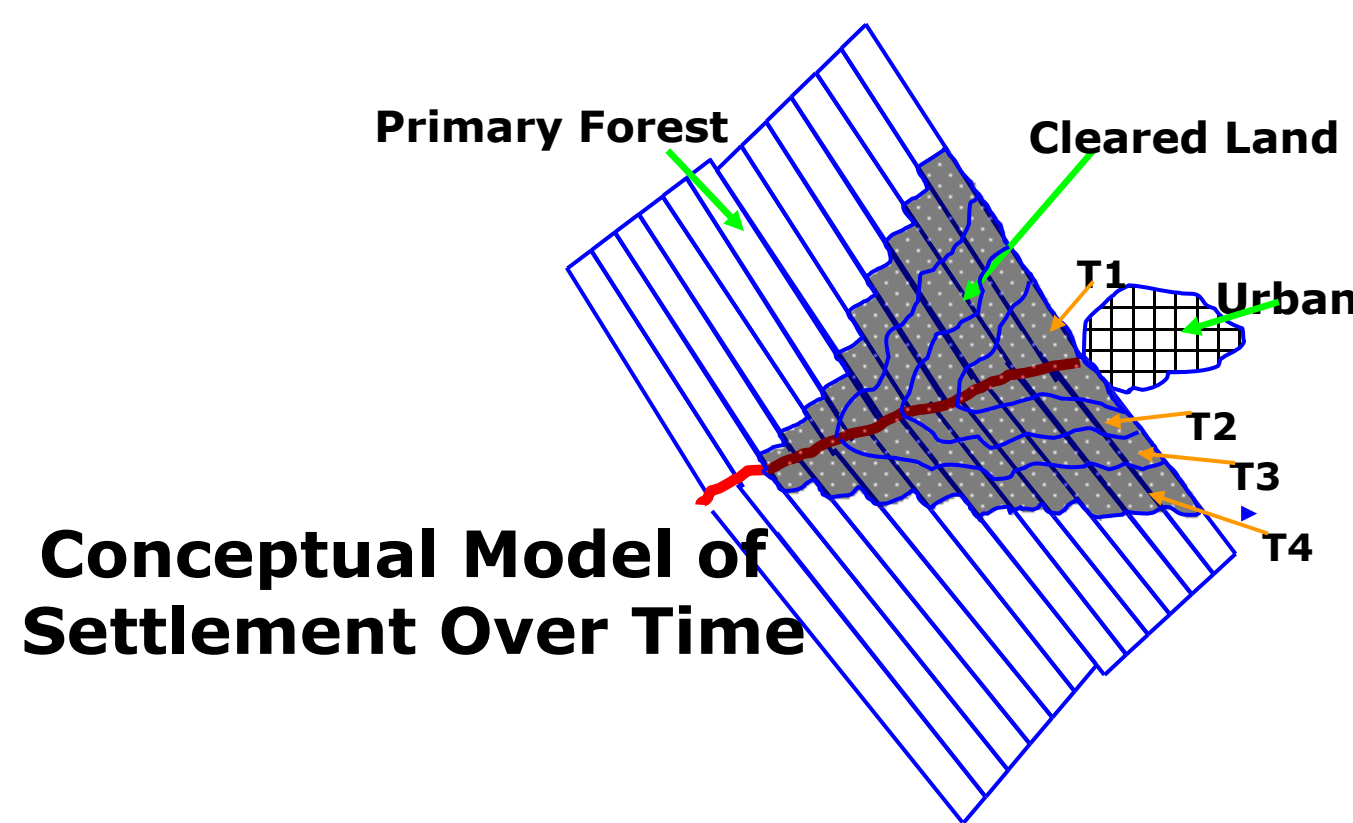
The geometric patterns described above suggest a conceptual model of land use change. The government established land parcels for distribution to colonists in their larger efforts to settle the Amazon. The first arrivals settled in the lots closest to cities or towns. Subsequent colonists settled progressively further from the urban area.

Land clearing advanced at a steady pace perpendicular to the road. Because both settlement and land clearing advanced within a similar time frame, the resulting deforestation pattern resembles a triangle or pyramid.
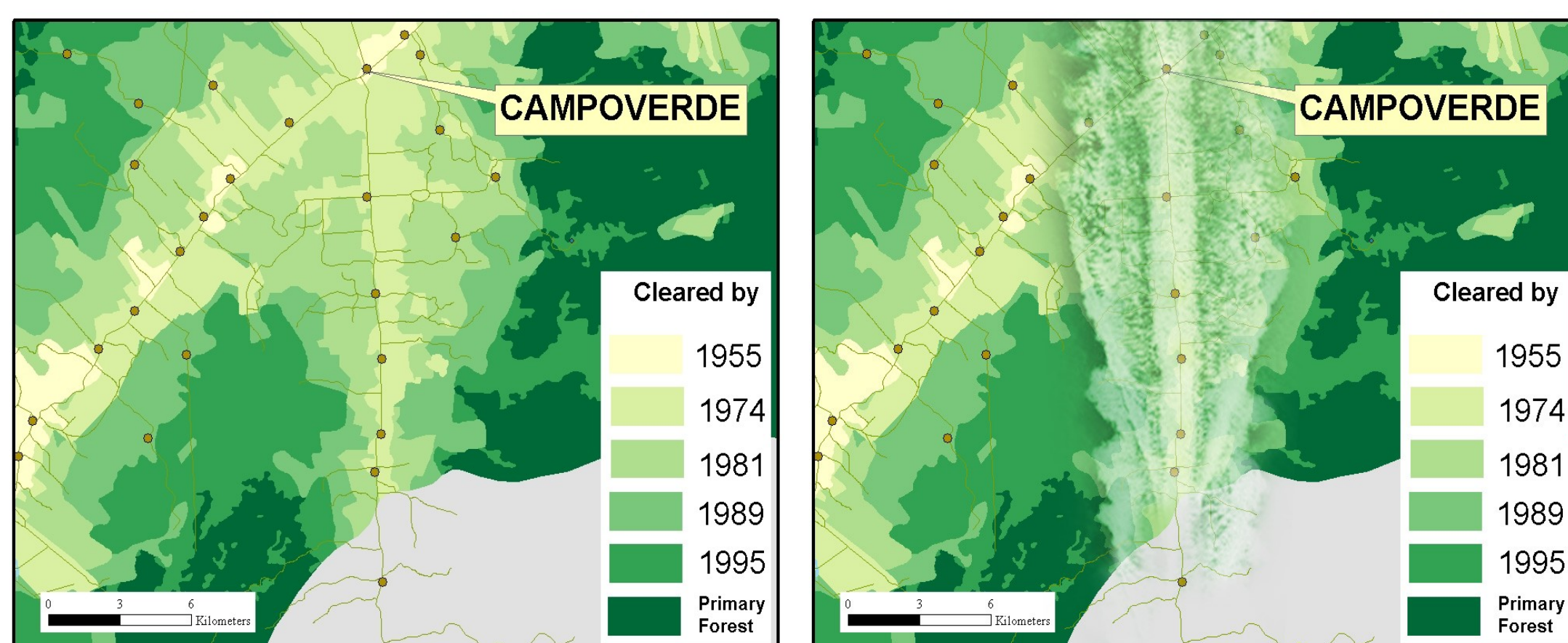
Represented dynamically, the deforestation pattern is similar to a boat's bow wave. As settlement extends away from cities or towns deforestation advances perpendicular to roads. Our research shows substantial differences in demographic characteristics, living standards, livelihood activities and other characteristics depending on where a village or household is situated along the spatial and temporal land-use continuum.

The photographs on the left shows some typical road landscapes in the central Peruvian Amazon. Even the main road connecting Lima to Pucallpa has substantial sections that have not yet been paved. Most of the roads in the region are gravel or improved dirt. Many of the roads end at the site of activities such as timber extraction.

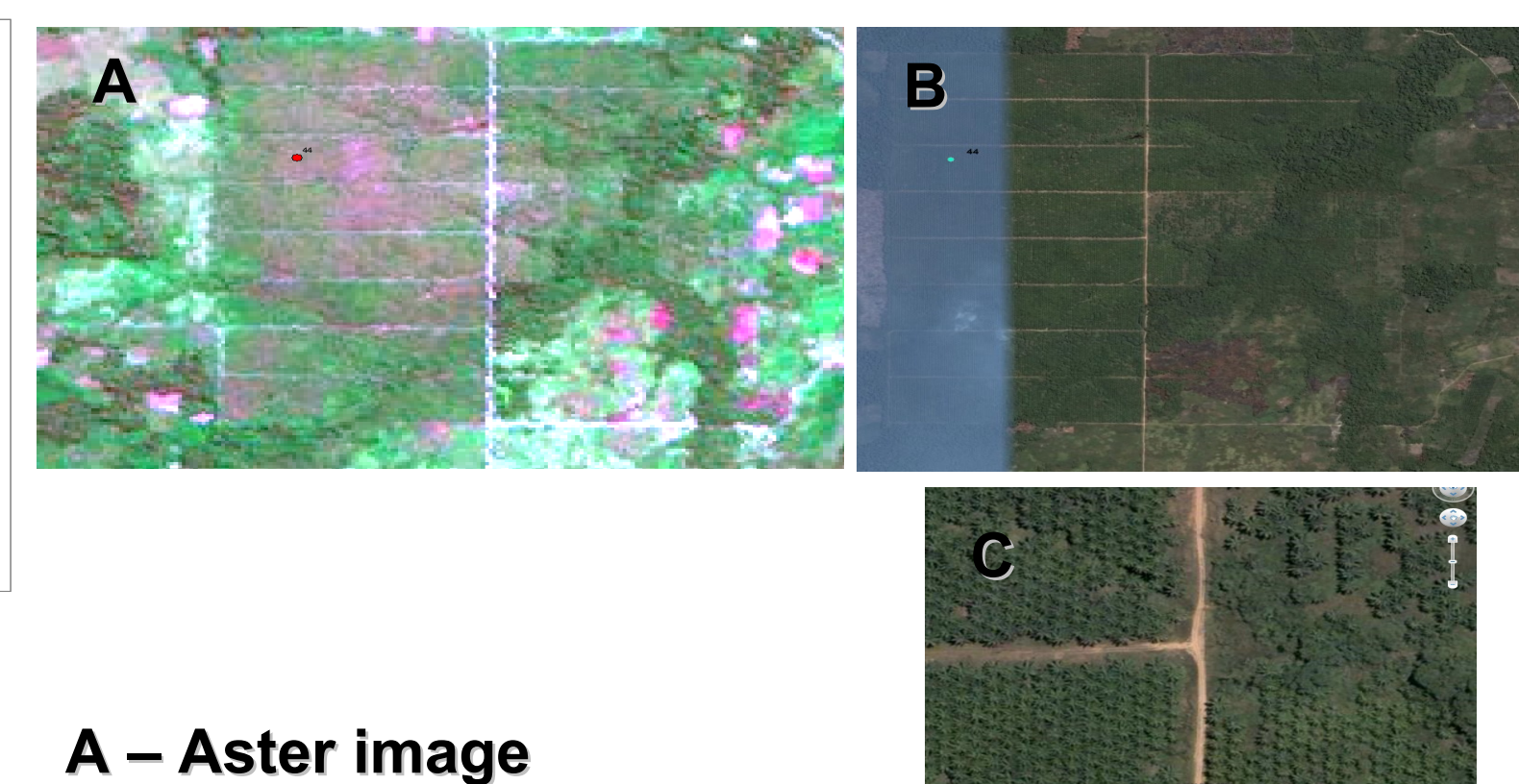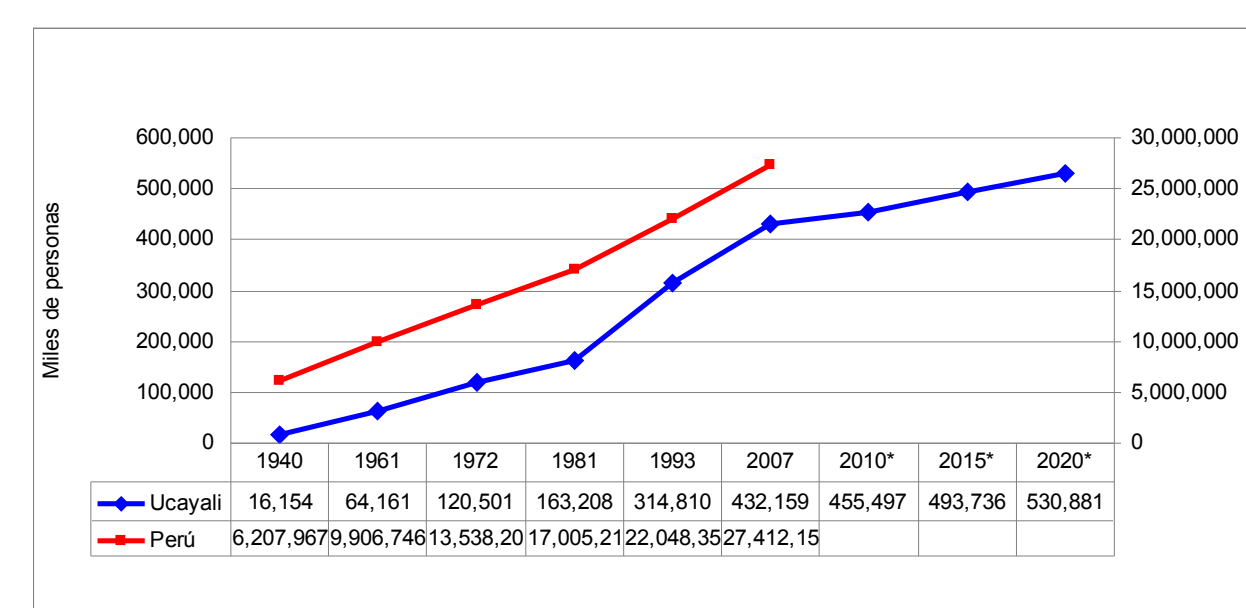|	
Water	
Cleared by 1955	1950's
Cleared by 1974	1960's
Cleared by 1981	1970's
Cleared by 1989	1980's
Cleared by 1995	1990's
Primary Forest	
Urban	

Road development

1. Long trajectories connecting to rivers: the most important road connection in the region is the Federico Basadre road connecting the Ucayali port town of Pucallpa to the Andes and to Lima. In the 1960s, the government built connector roads between this main road and the Aguaytia River to the north and the Ucayali to the South. Govenrment initiatives developed more recent connections between the Federico Basadre highway and the Aguaytia River to the North in the 1970s.

2. Incremental extension over decades: several roads extending perpendicular to the Federico Basdre highway have developed in an incremental manner over the decades.

3. Logging roads in remote areas: many remote areas are marked by roads developed solely for the extraction of timber.

Proximate and underlying driving forces of deforestation in the Central Peruvian Amazon

	Proximate	Underlying
1960's	•Road expansion •Colonization •Pasture expansion	•migration
1970's	•Road expansion •Timber extraction •Colonization •Shifting cultivation •Pasture expansion	•Migration •population growth
1980's	•Road expansion •Timber extraction •Shifting cultivation •Coca production	•Agricultural credit policy •Forestry sector development •Migration •Population growth
1990's	•Oil palm development •Shifting cultivation •Coca production	•Migration •Population growth
2000's	•Oil palm development	•Migration

The table above lists the proximate and underlying driving forces of deforestation in the Central Peruvian Amazon. Road construction is clearly the dominant proximate driving force. Timber extraction, shifting cultivation and pasture expansion also predominate. Other key proximate forces are coca and oil palm production. The key underlying factors in deforestation of this region are related to population. Migrants from the Andes, who may have been pushed out by the lack of land there, have arrived to the Amazon in the hopes of taking advantage of abundant natural resources. This region of the Amazon also has one of the highest fertility rates in all of Peru. Other underlying forces include changes in national agricultural and forestry development policies.

	1940	1961	1972	1981	1993	2007	2010*	2015*	2020*
Ucayali	16,154	64,161	120,501	163,208	314,810	432,159	455,497	493,736	530,881
Peru	6,207,9679,906,746		13,538,2017,005,2122,048,3527,412,15						

A – Aster image
B – Google Earth
C – Google Earth close-up where you can see the palm plantation canopy