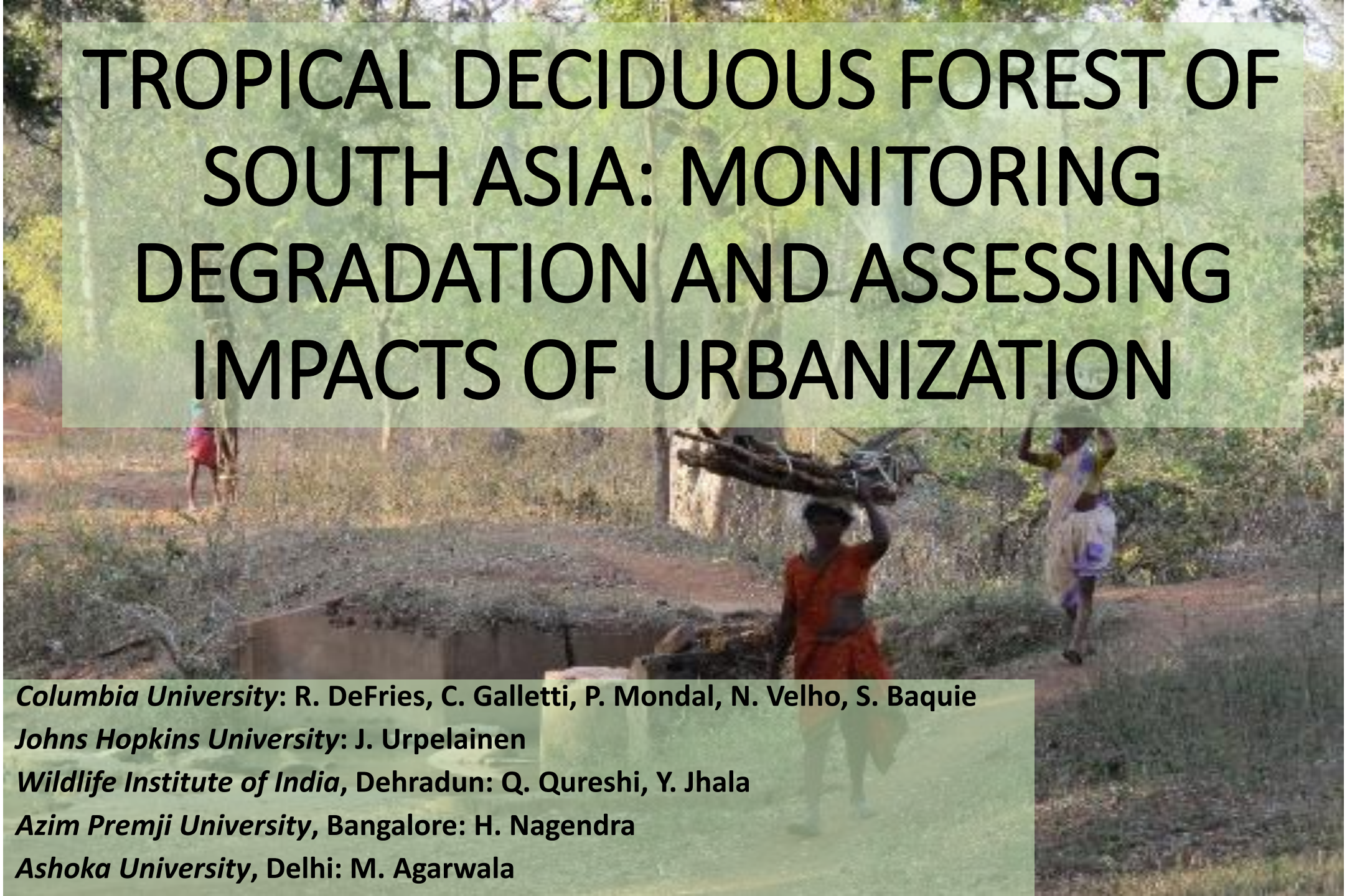
TROPICAL DECIDUOUS FOREST OF SOUTH ASIA: MONITORING DEGRADATION AND ASSESSING IMPACTS OF URBANIZATION



***Columbia University*: R. DeFries, C. Galletti, P. Mondal, N. Velho, S. Baquie**

***Johns Hopkins University*: J. Urpelainen**

***Wildlife Institute of India*, Dehradun: Q. Qureshi, Y. Jhala**

***Azim Premji University*, Bangalore: H. Nagendra**

***Ashoka University*, Delhi: M. Agarwala**

"The tendency of people to move to cities, either out of desire or perceived necessity, creates a great opportunity."

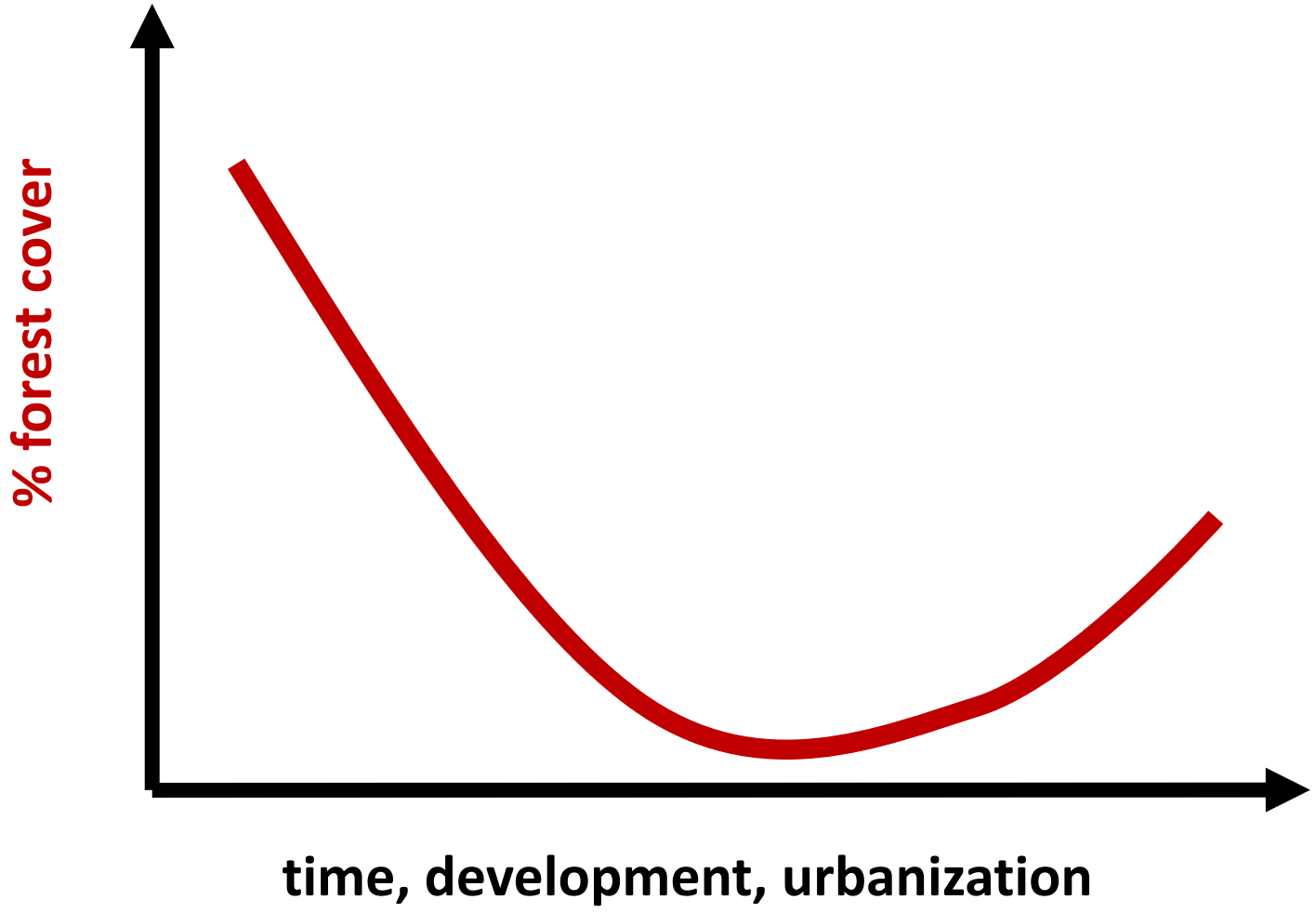
US edition
The Guardian

Empty half the Earth of its humans. It's the only way to save the planet

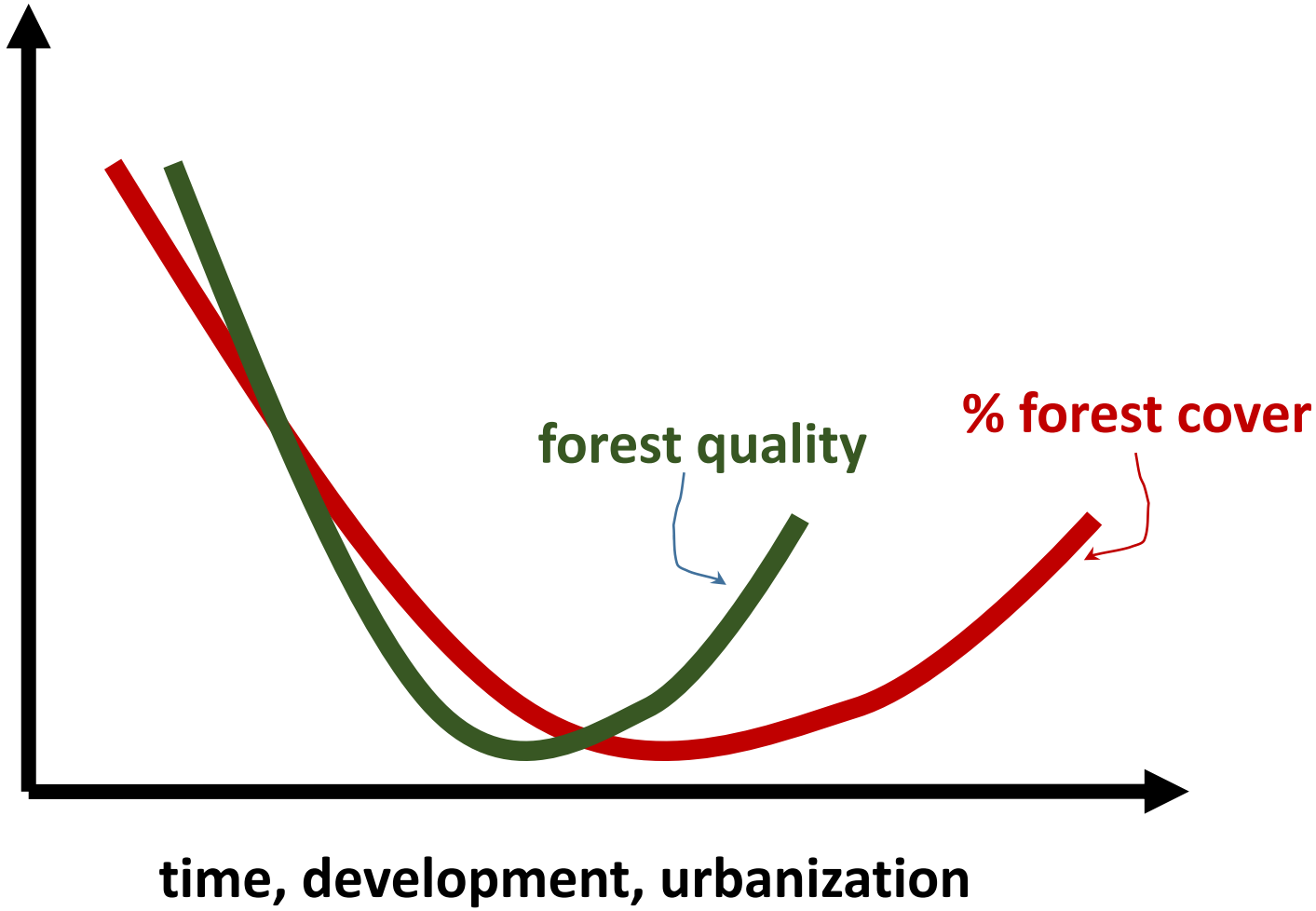
Kim Stanley Robinson

There are now twice as many people as 50 years ago. But, as EO Wilson has argued, they can all survive – in cities

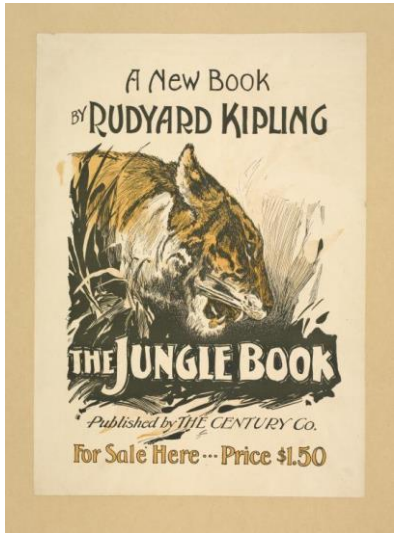
FOREST TRANSITION



FOREST TRANSITION IN HUMAN-DOMINATED, FOREST-DEPENDENT LANDSCAPES



Will a forest transition occur here?



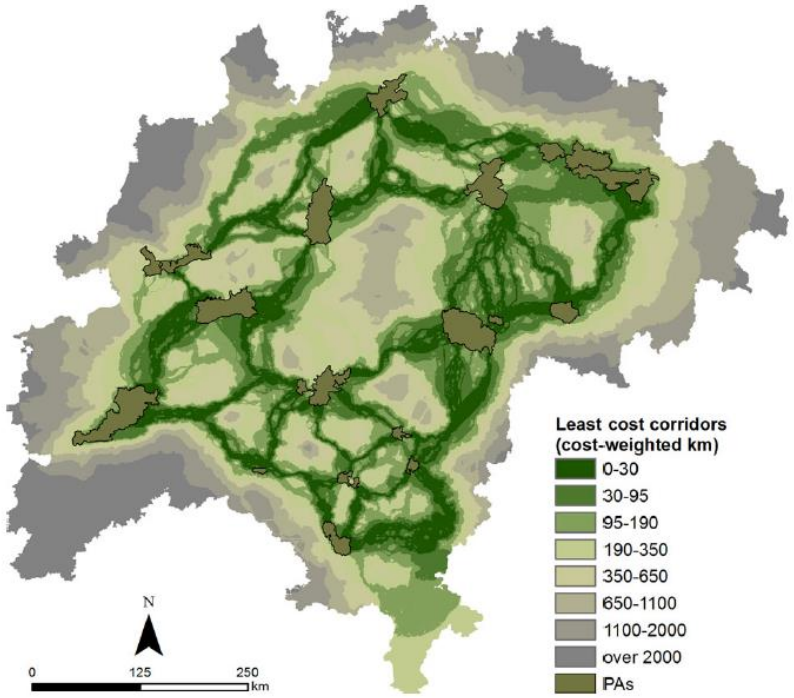
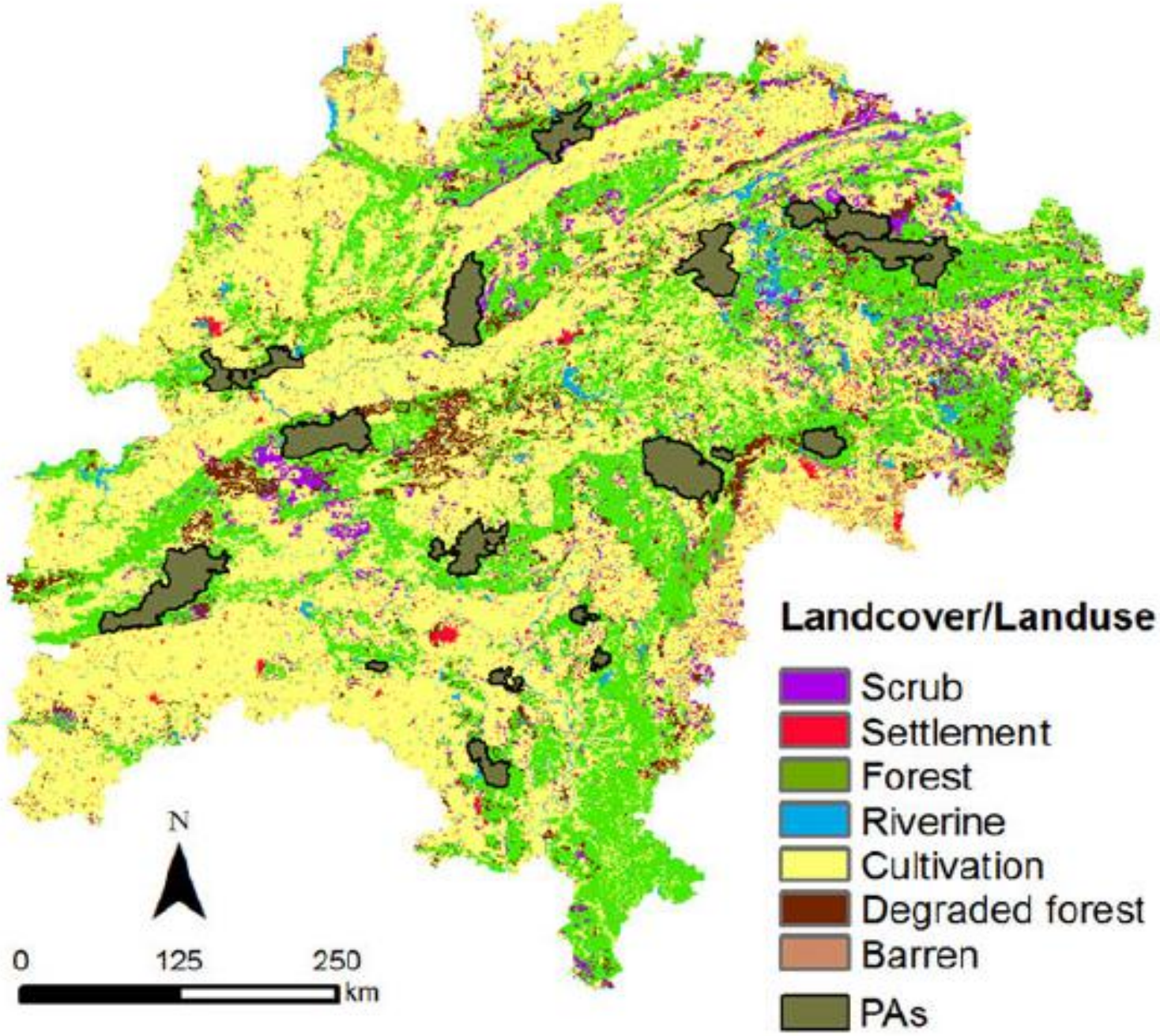


Fig. 3 Map showing least-cost corridors in the landscape. Lower resistance paths are shown in *green,* and *gray areas* represent higher cost-weighted distance (color figure online)

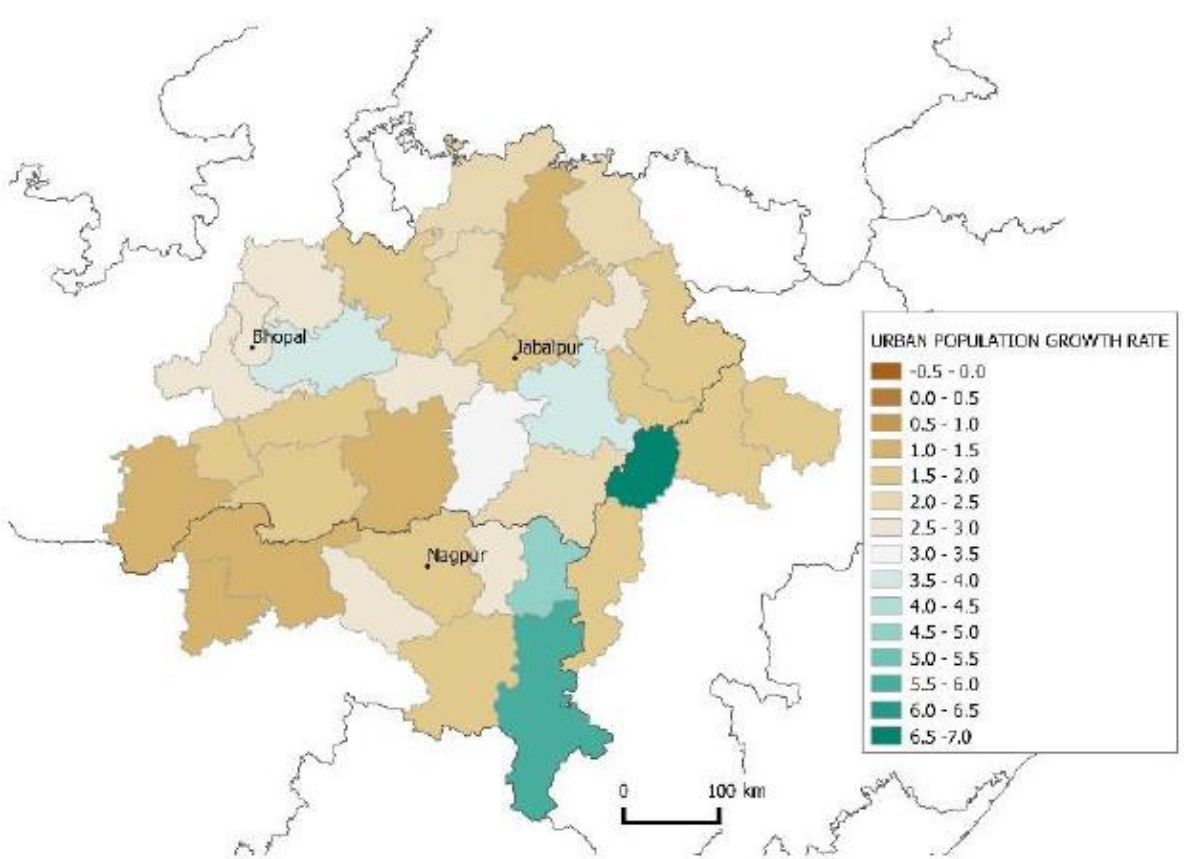


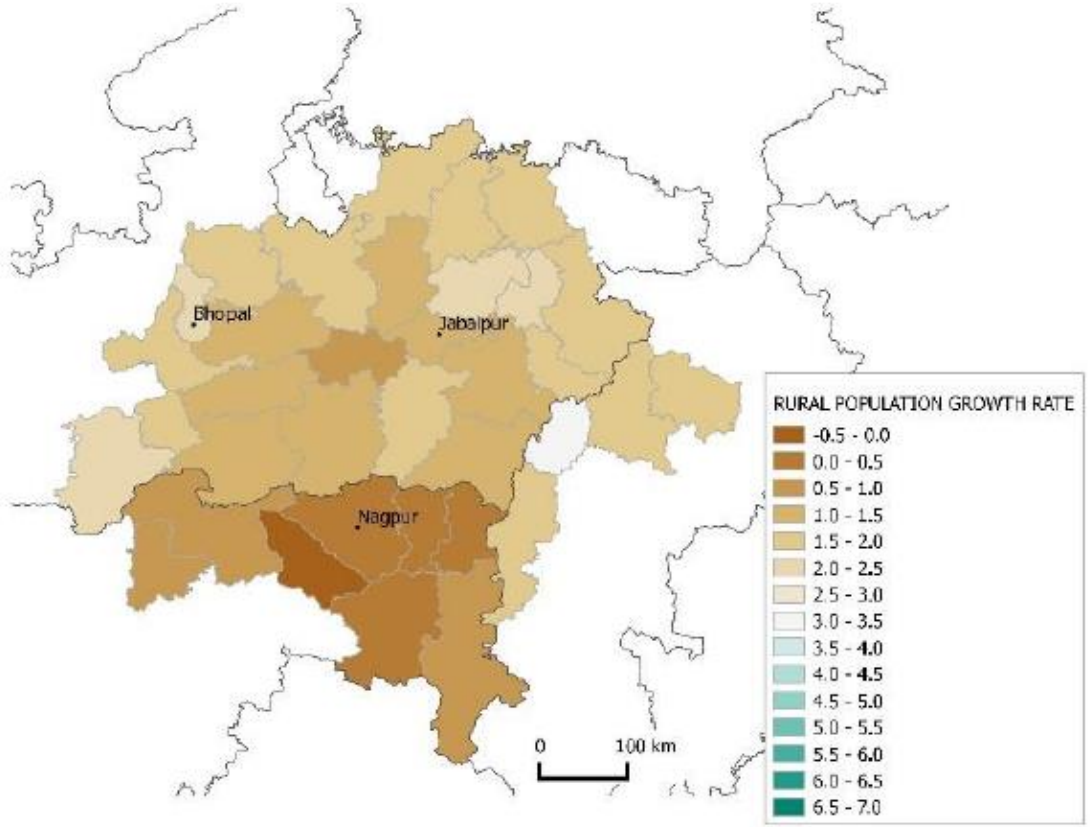
Connecting the dots: mapping habitat connectivity for tigers in central India

Trishna Dutta[1] · Sandeep Sharma[2] · Brad H. McRae[3] · Parth Sarathi Roy[4] · Ruth DeFries[1]

Reg Environ Change
DOI 10.1007/s10113-015-0877-z

URBANIZATION OF LANDSCAPE (2001-2011)





Source: India district-level census

GOALS

- **Identify remote sensing methods to monitor forest degradation and regeneration in tropical deciduous forests**

- **Understand how rapid urbanization is altering pressures on forests**

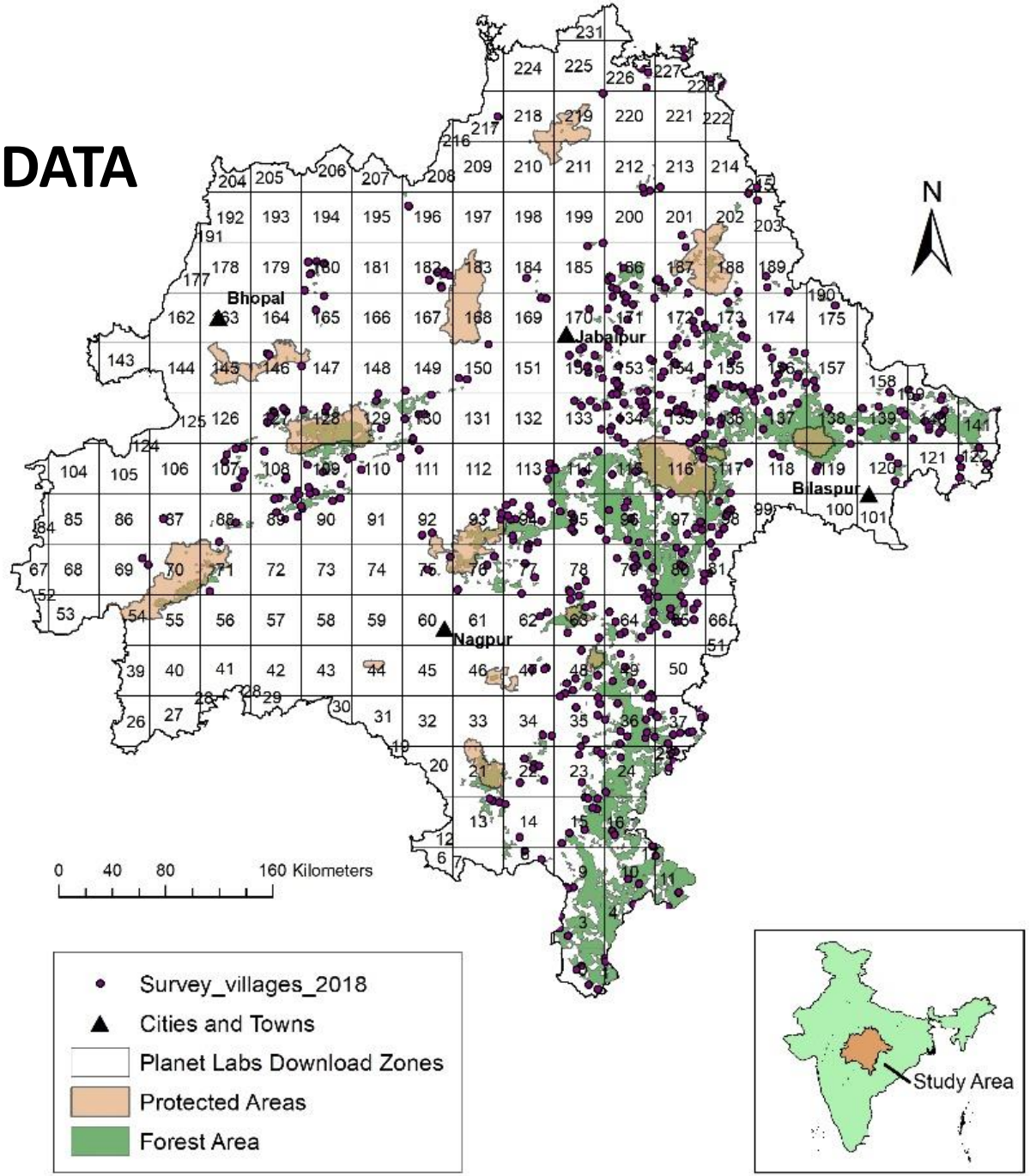
GOALS

- **Identify remote sensing methods to monitor forest degradation and regeneration in tropical deciduous forests**

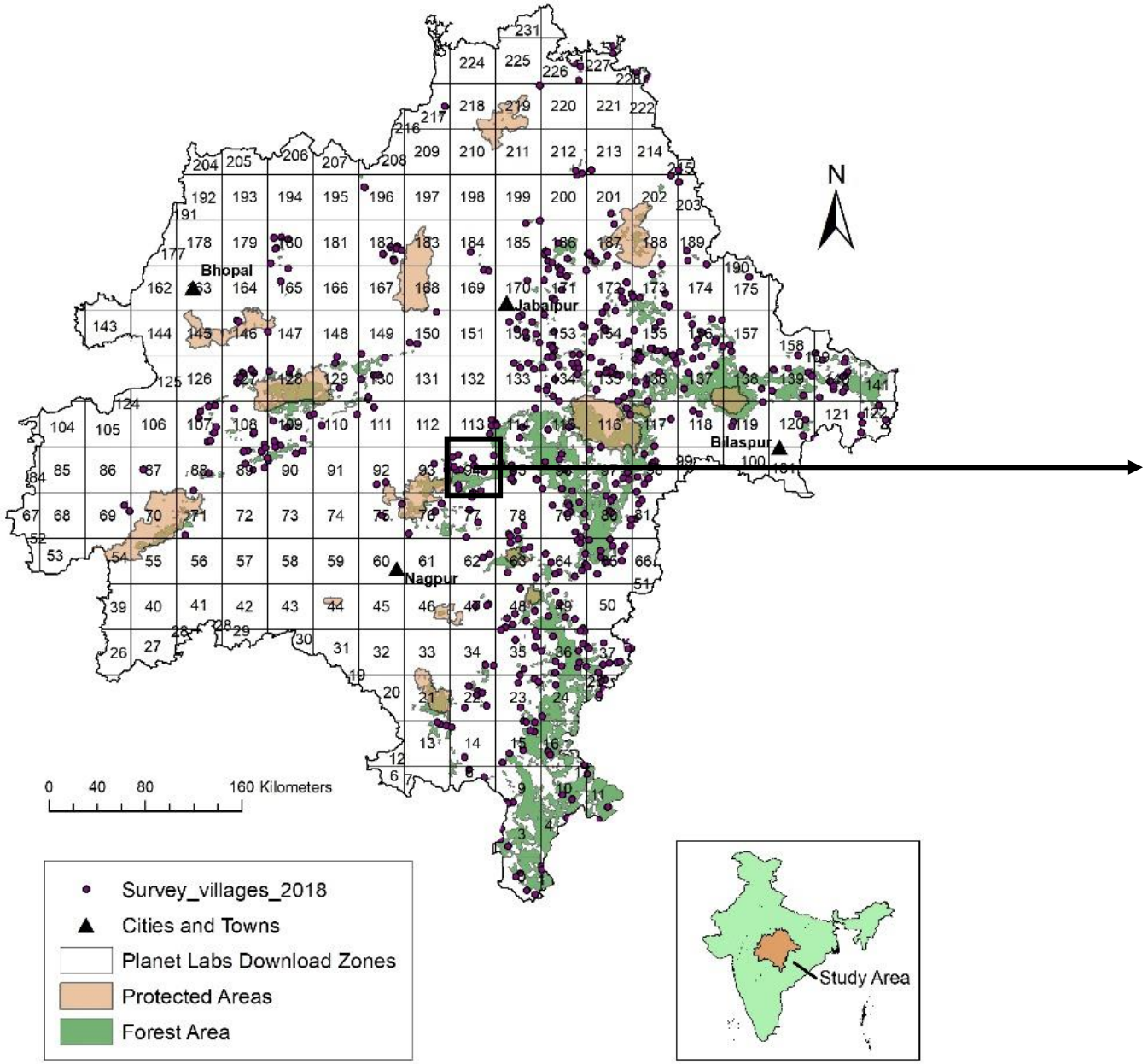
- **Understand how rapid urbanization is altering pressures on forests**

HIGH RESOLUTION PLANET LABS DATA

5000 HOUSEHOLD SURVEYS

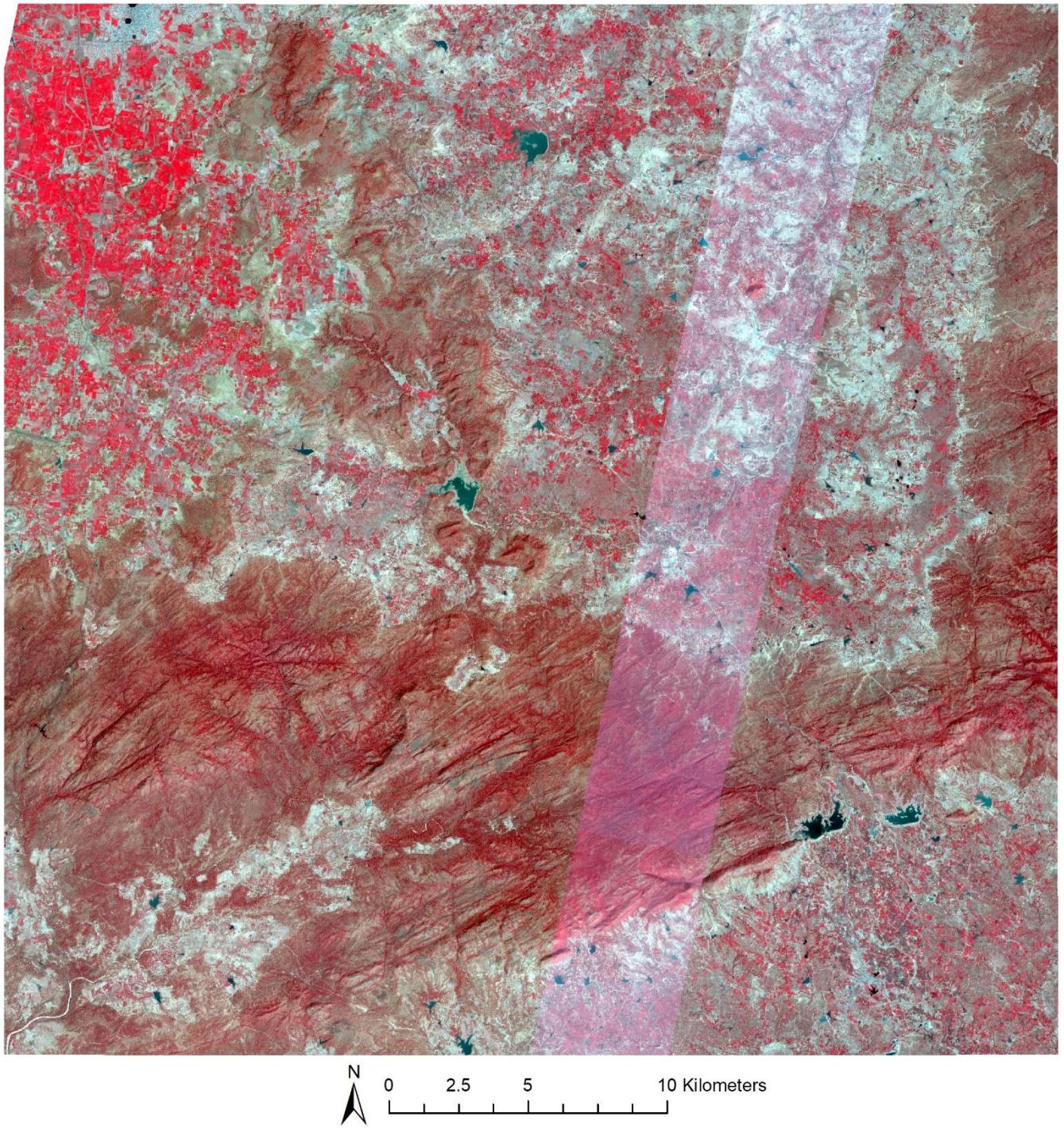


PLANET LABS

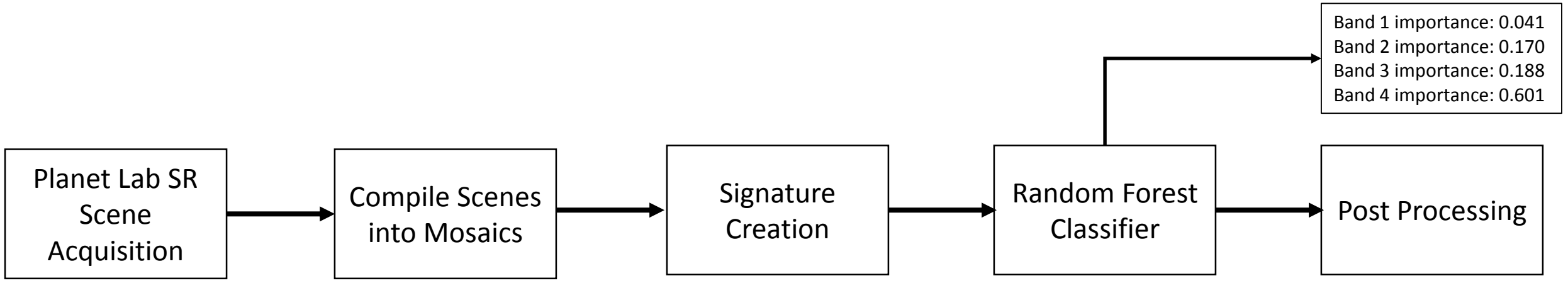

N
Bhopal
Jabalpur
Bilaspur
Nagpur
0 40 80 160 Kilometers
Survey_villages_2018
Cities and Towns
Planet Labs Download Zones
Protected Areas
Forest Area
Study Area

Mosaic of Planet Lab Scenes

- 22,141 by 22,141 pixels (~490 million pixels)
- 4 bands (R, G, B, NIR)



Classification Methodology

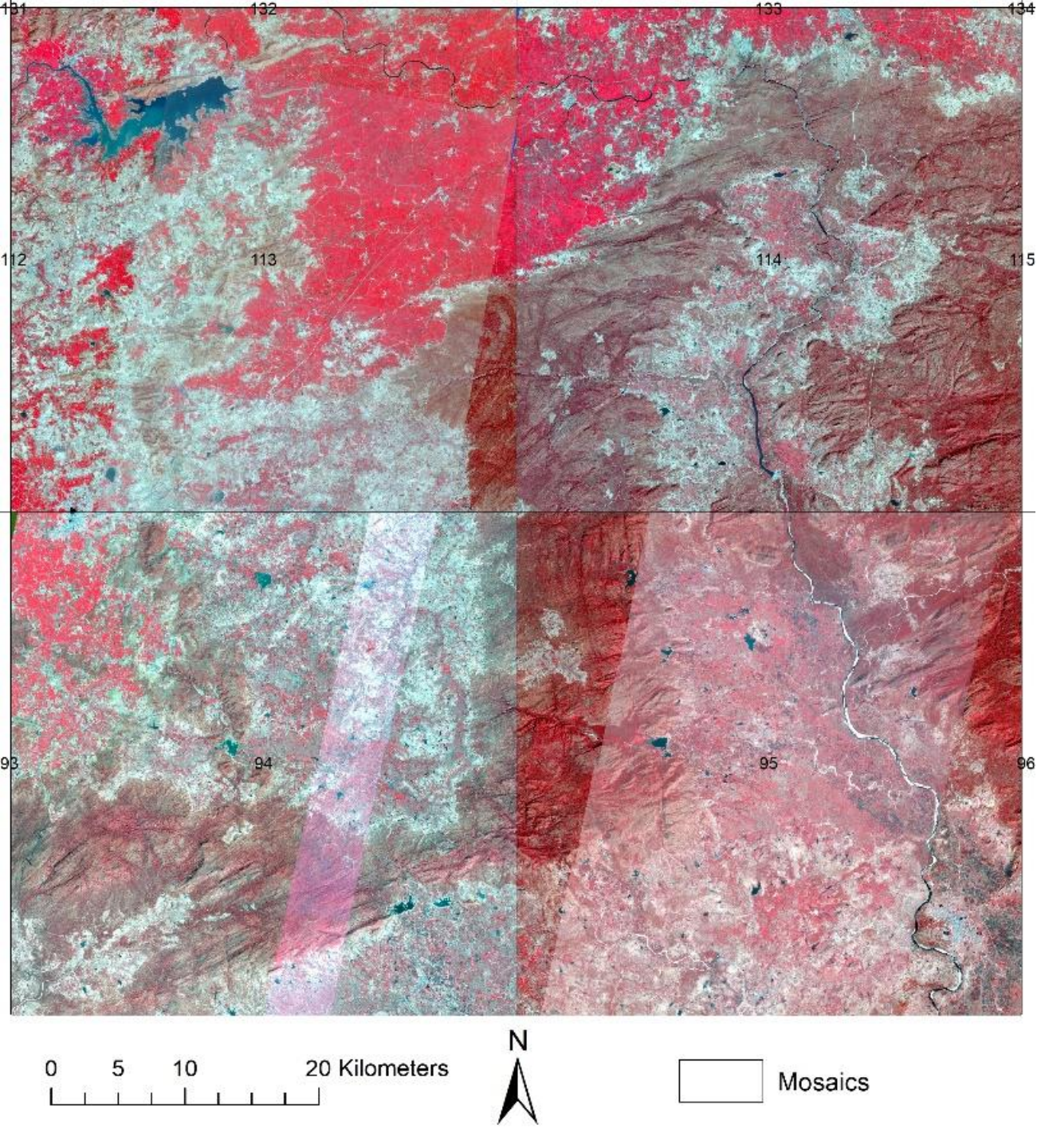


Development Environment:

- Mosaics and Signatures: ArcGIS
- Random Forest: Python
- Post Processing: Google Earth Engine and Roy et al. 2015 dataset

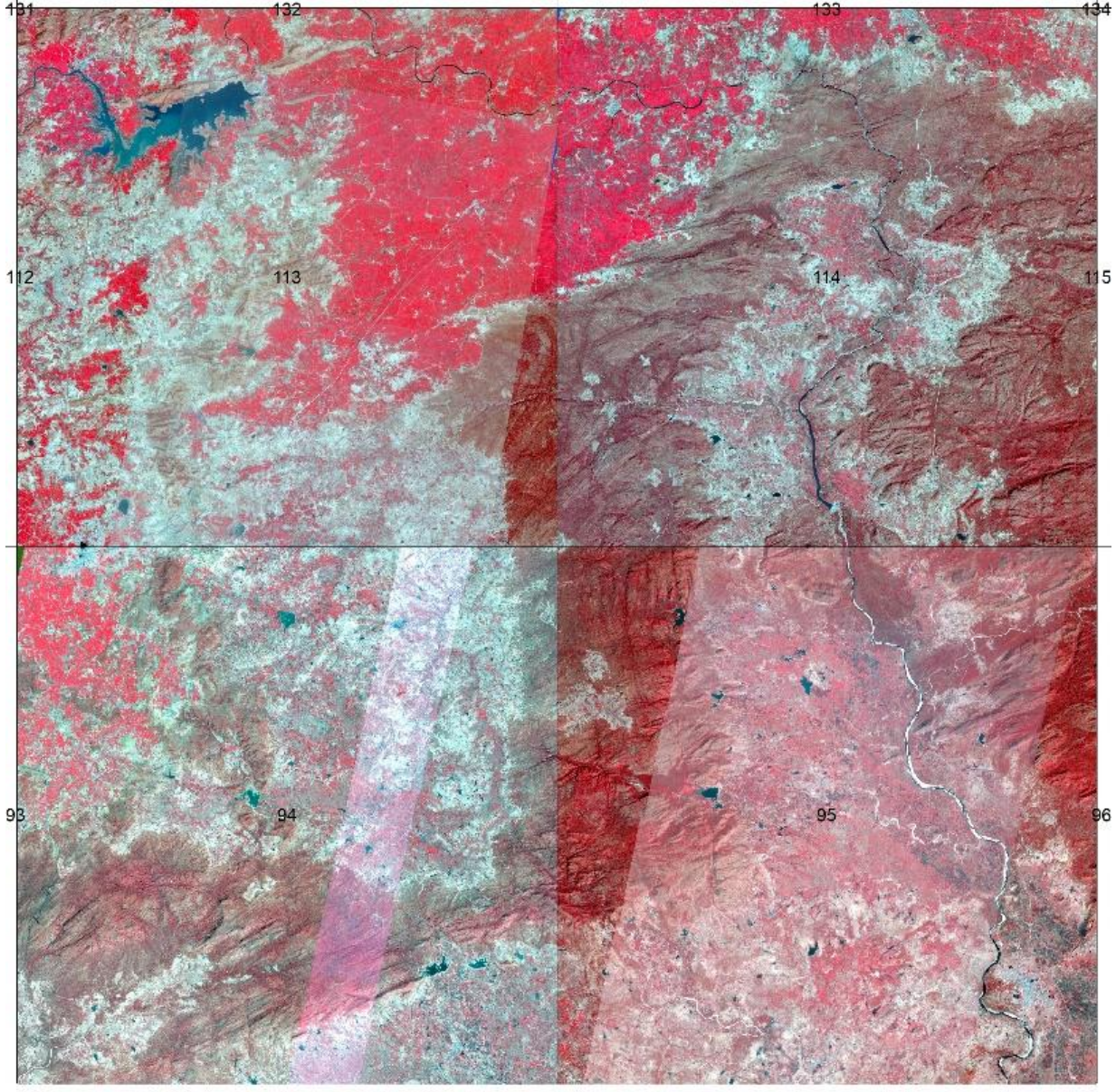
The plan is to transition all processes to Python

```
# Import GDAL, NumPy, and matplotlib
from osgeo import gdal, gdal_array
from osgeo.gdalconst import *
import sys
import numpy as np
import matplotlib.pyplot as plt

#%matplotlib inline

# Tell GDAL to throw Python exceptions, and register all drivers
gdal.UseExceptions()
gdal.AllRegister()

# Read in our image and ROI image
img_ds = gdal.Open('D:/India/Study Area Zones/113/113_feb_mosaic_clip2.tif', gdal.GA_ReadOnly)
roi_ds = gdal.Open('D:/India/Signatures/113_v2.gtif', gdal.GA_ReadOnly)

img = np.zeros((img_ds.RasterYSize, img_ds.RasterXSize, img_ds.RasterCount),
               gdal_array.GDALTypeCodeToNumericTypeCode(img_ds.GetRasterBand(1).DataType))
for b in range(img.shape[2]):
    img[:, :, b] = img_ds.GetRasterBand(b + 1).ReadAsArray()

roi = roi_ds.GetRasterBand(1).ReadAsArray().astype(np.uint8)

```



Kanha-Pench Corridor

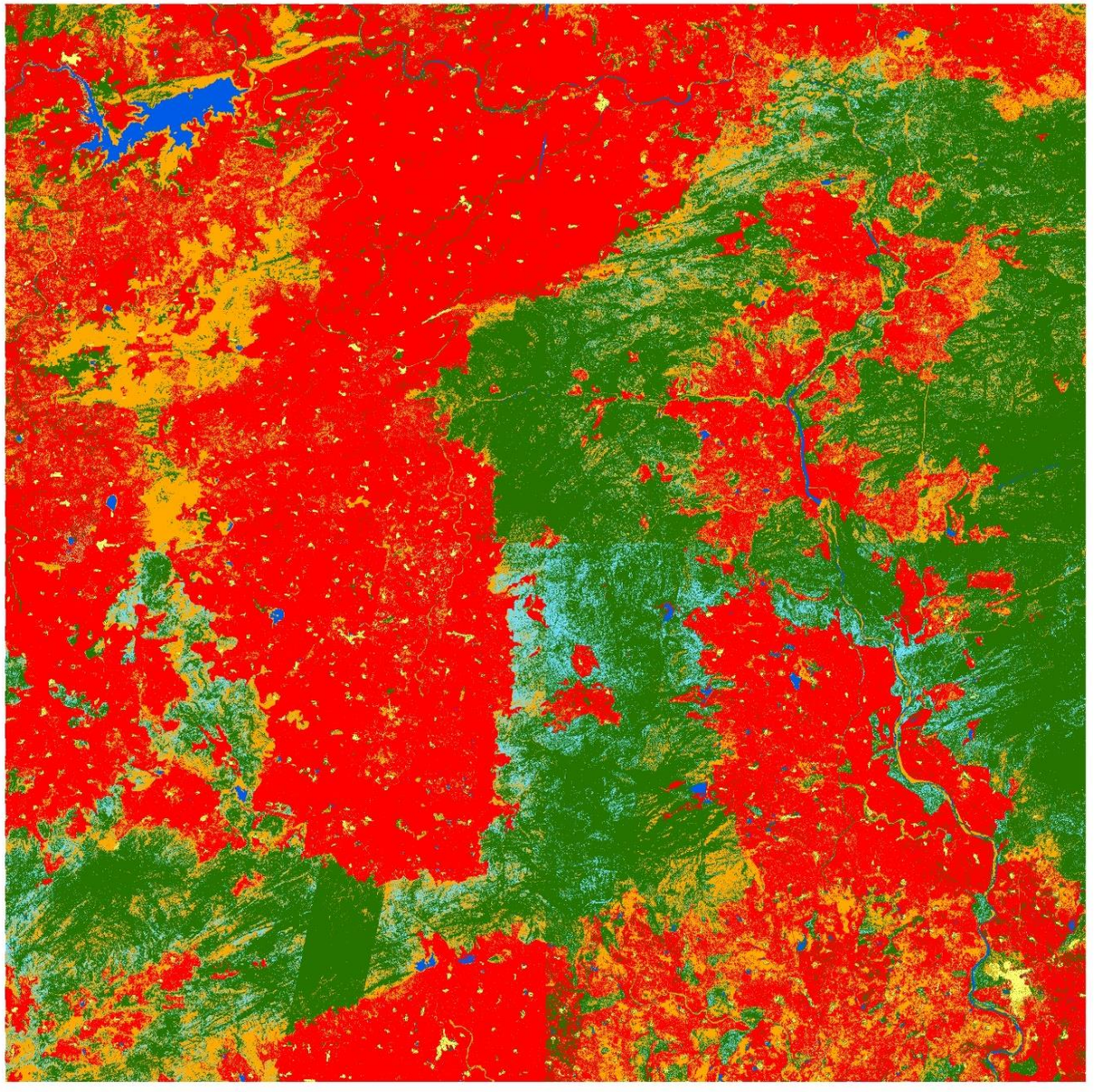
- Four mosaics
- Each mosaic is approximately 38 x 38 km
- The four mosaics together have ~1.96 billion pixels



0 5 10 20 Kilometers

N

Mosaics

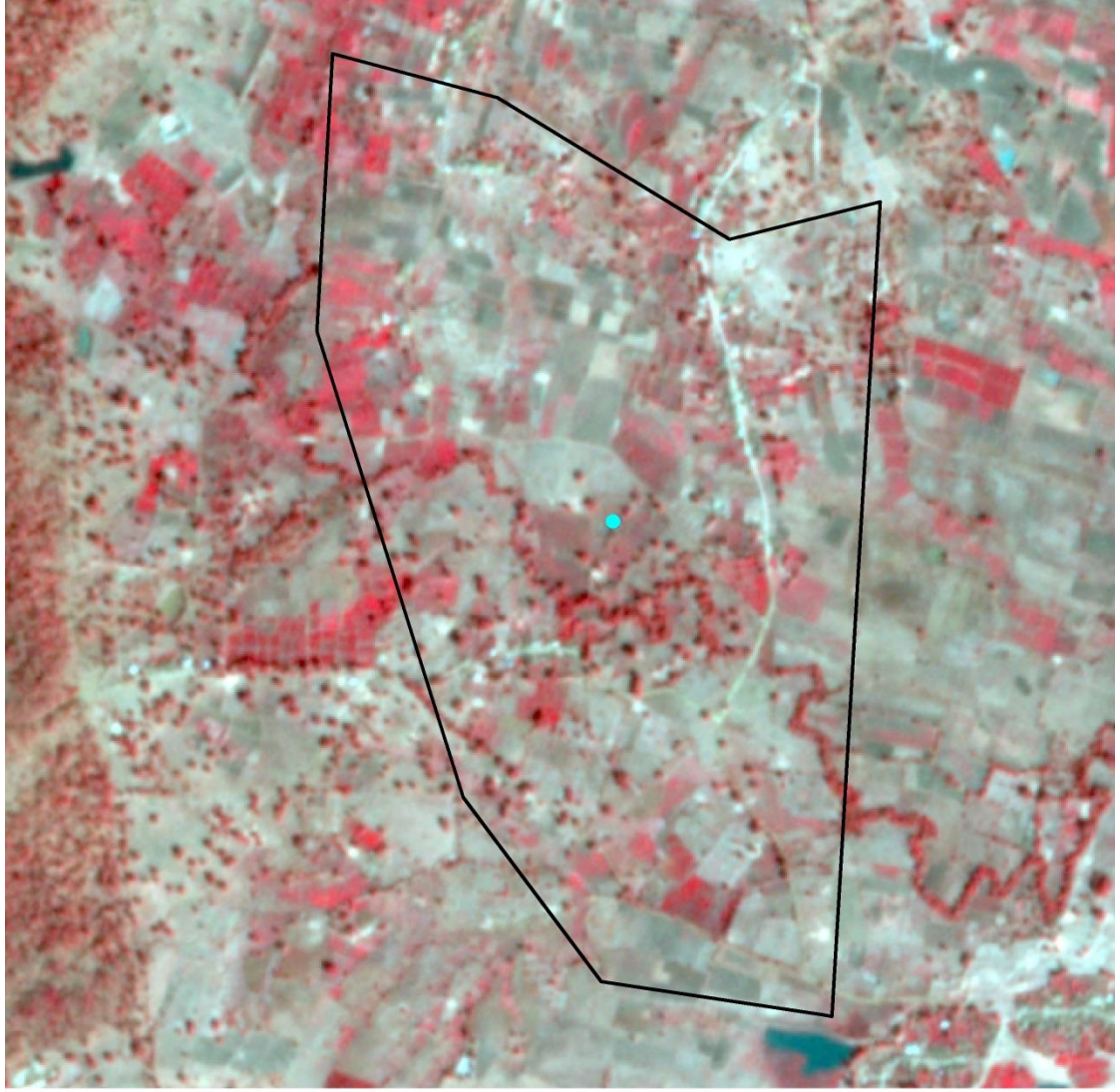


0 5 10 20 Kilometers

N

Water
Soil
Trees
Cropland
Teak
Built Environment

Overall accuracy ~98%



0 0.125 0.25 0.5 Kilometers

N

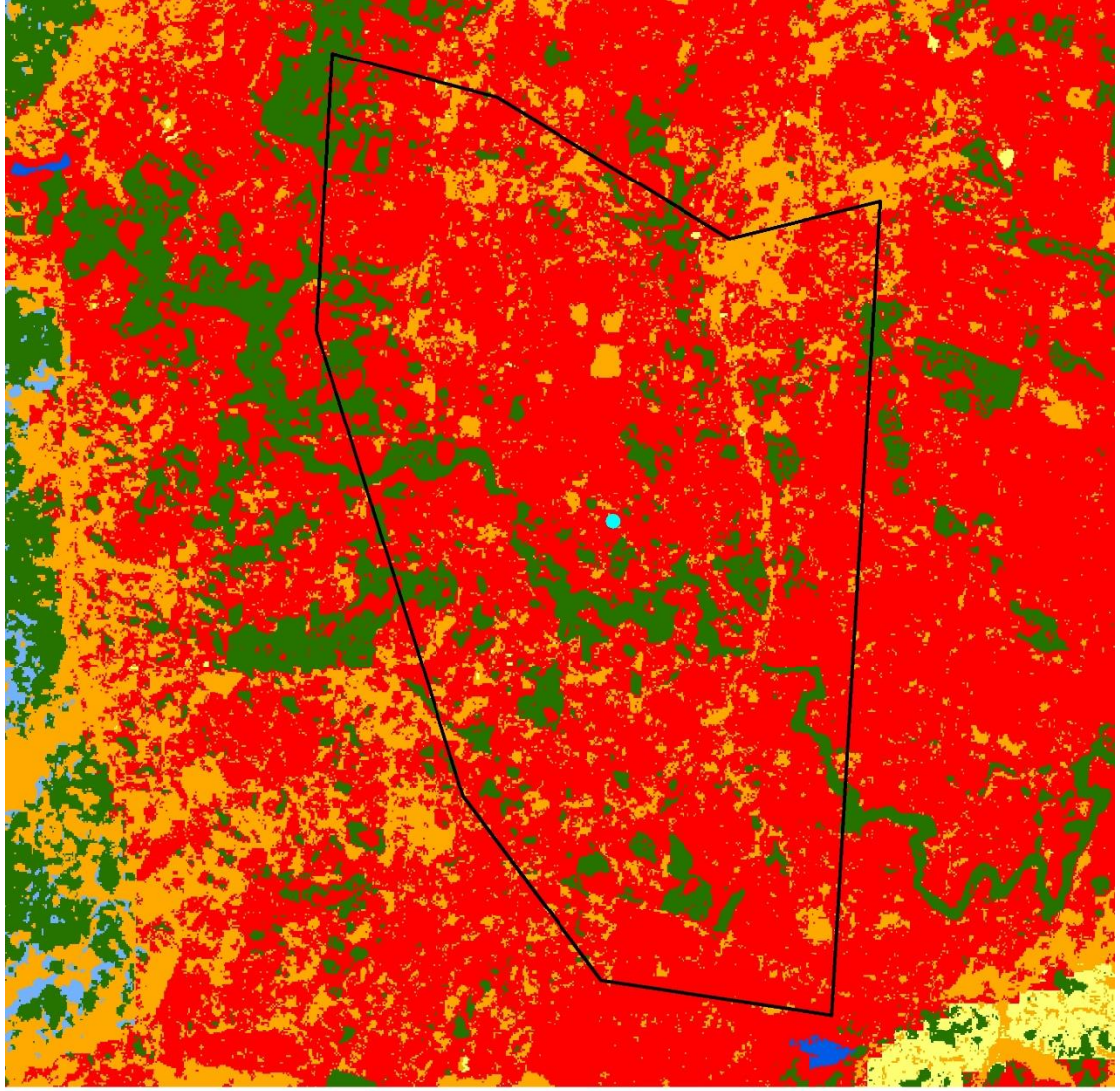
Sakhadehi

Planet Lab Scene

Red: NIR

Green: Red

Blue: Green



0 0.125 0.25 0.5 Kilometers

N

Sakhadehi

Class

Water

Trees

Teak

Soil

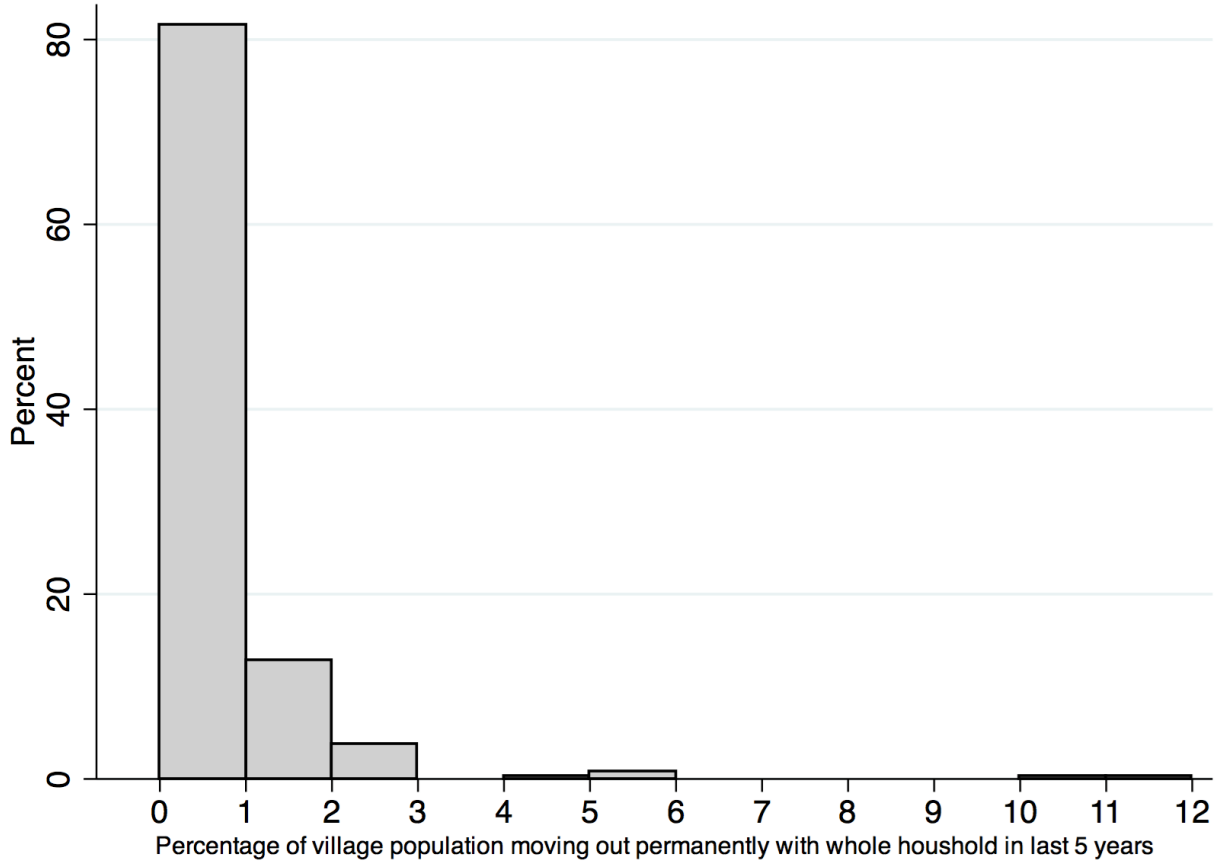
Fallow Cropland

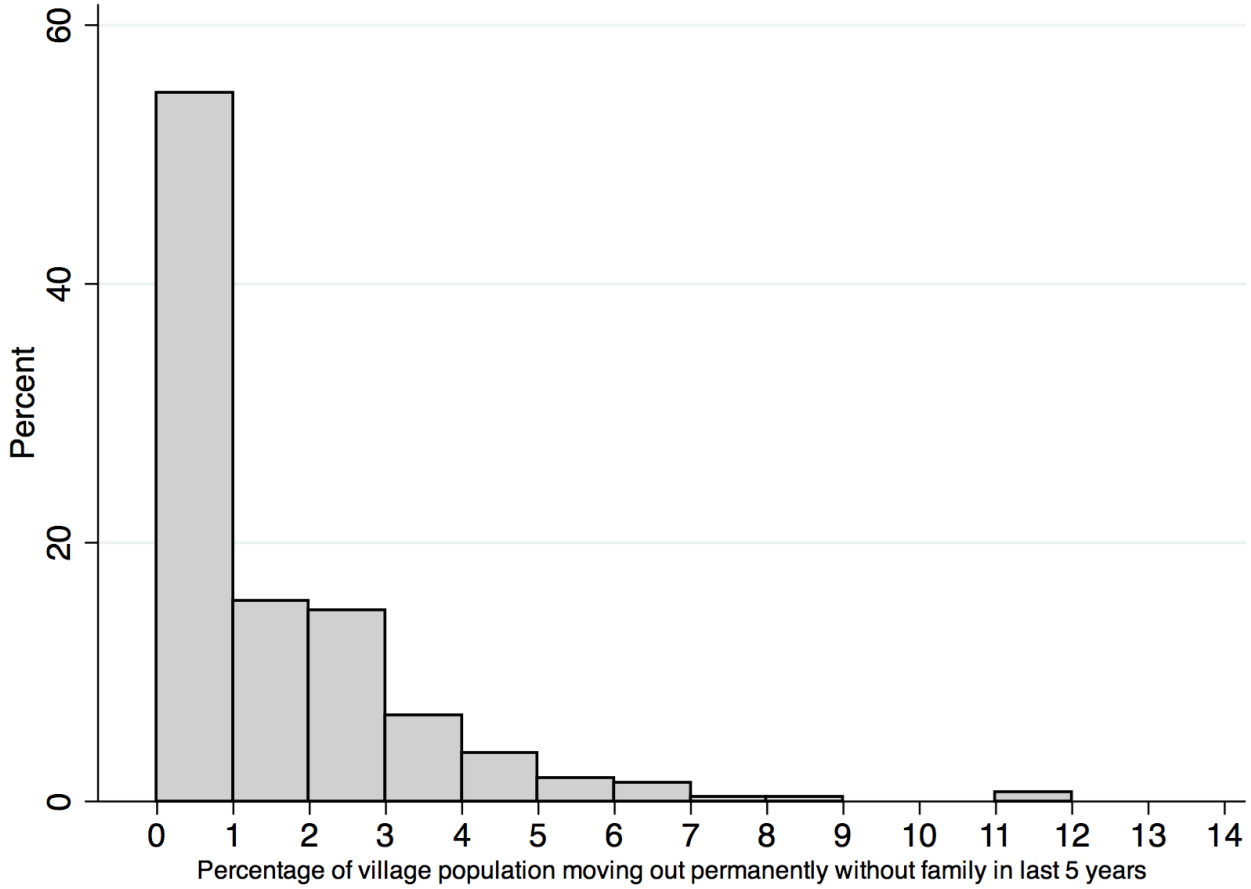
Cropland

Built Environment

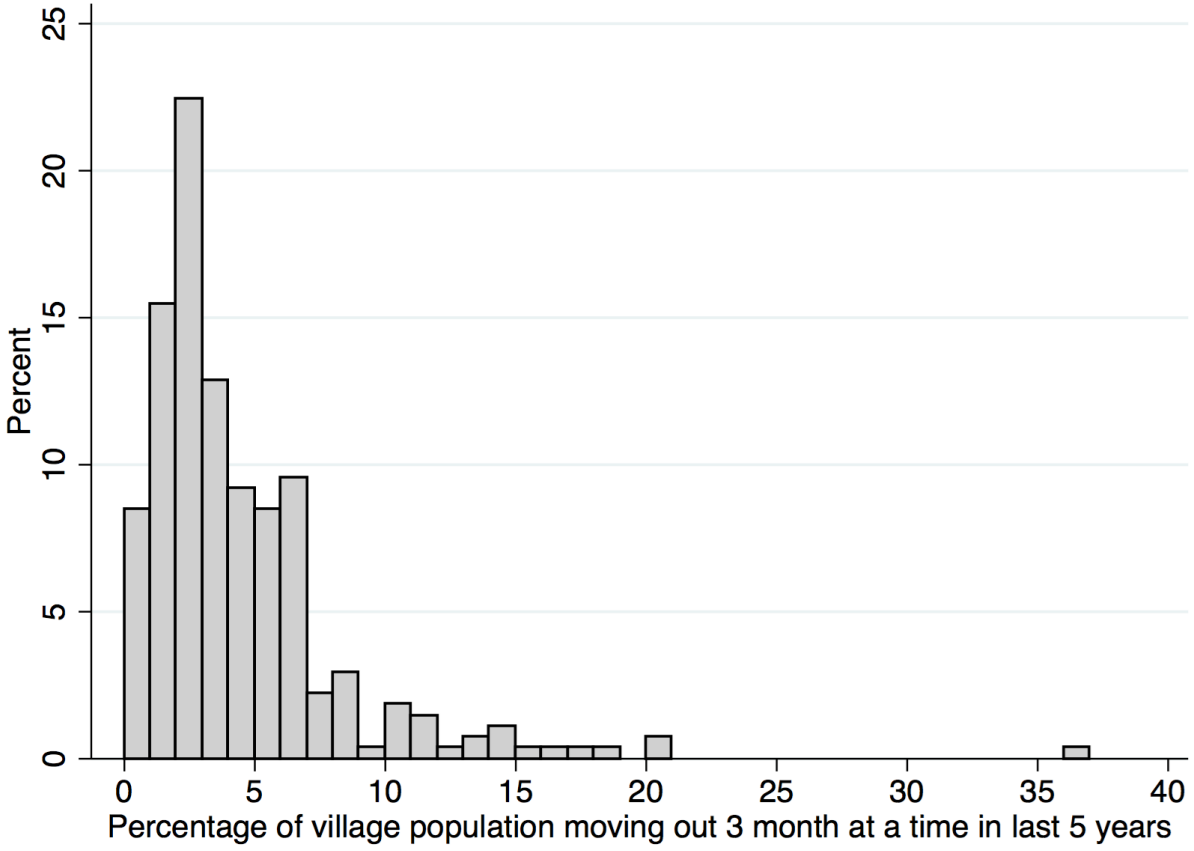
- Survey data collected January - April
- 2539/5000 observations
- 254/500 villages
- Household questions: socio-economics, migration, forest use
- Village questions: migration, history

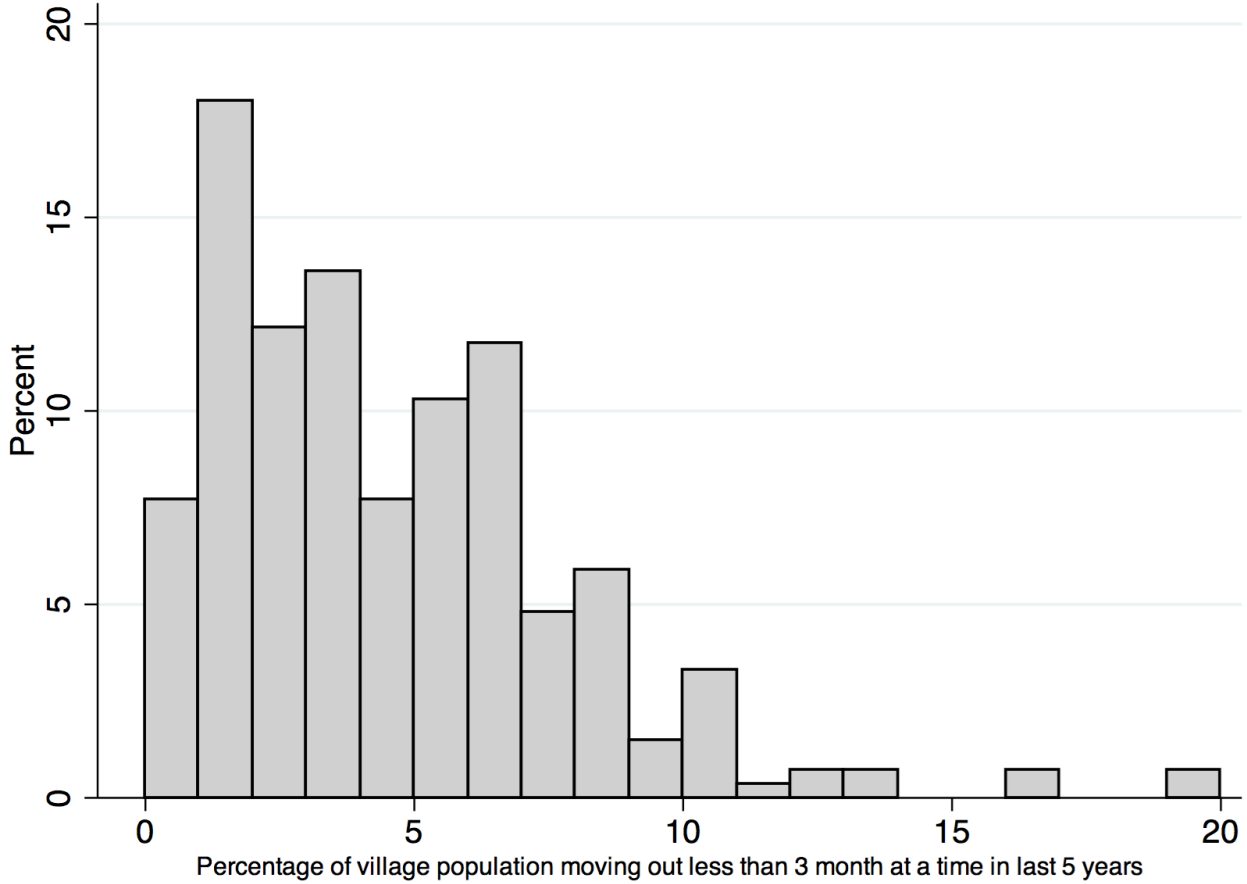
Village level: not much permanent migration



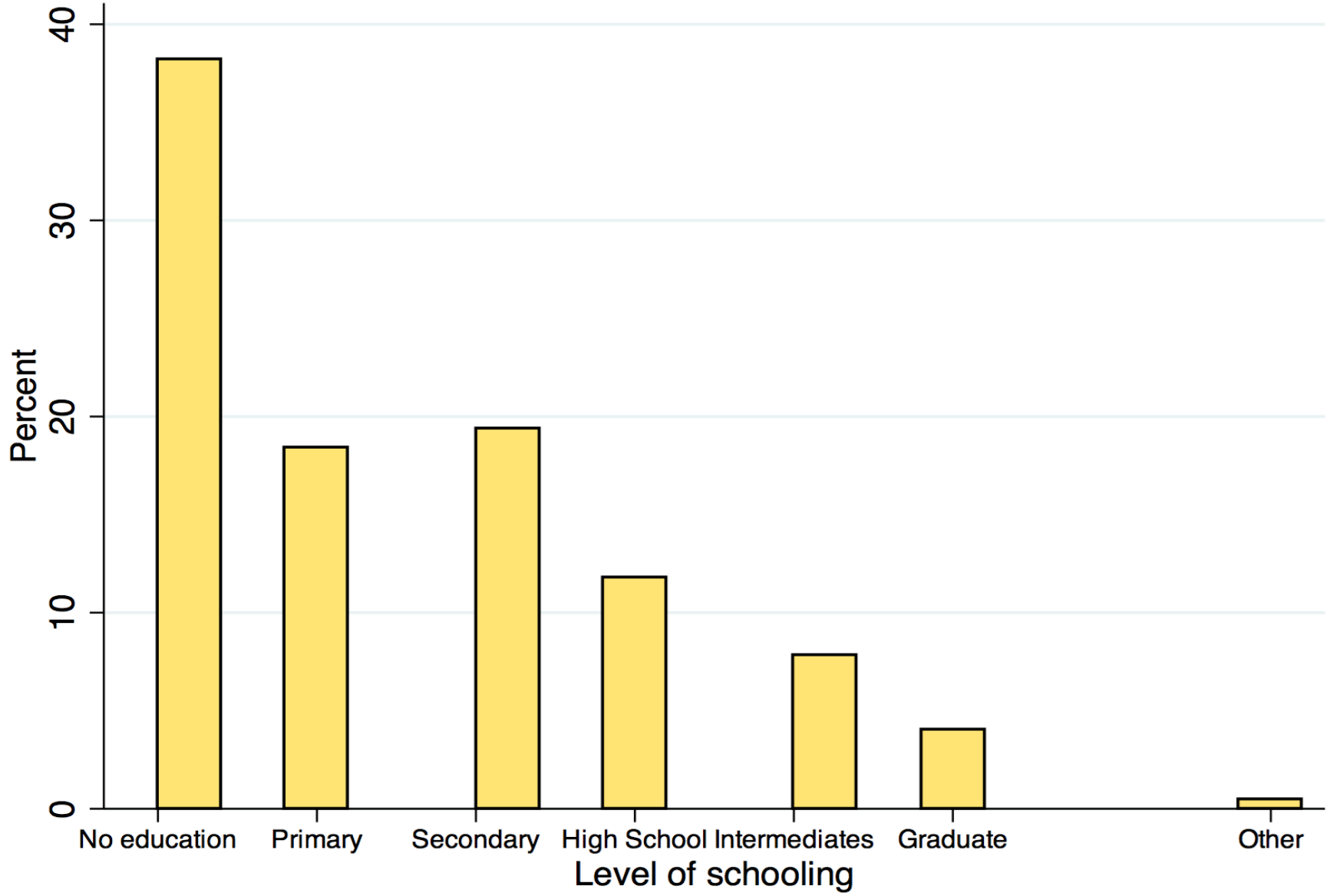


Village level: lots of seasonal migration

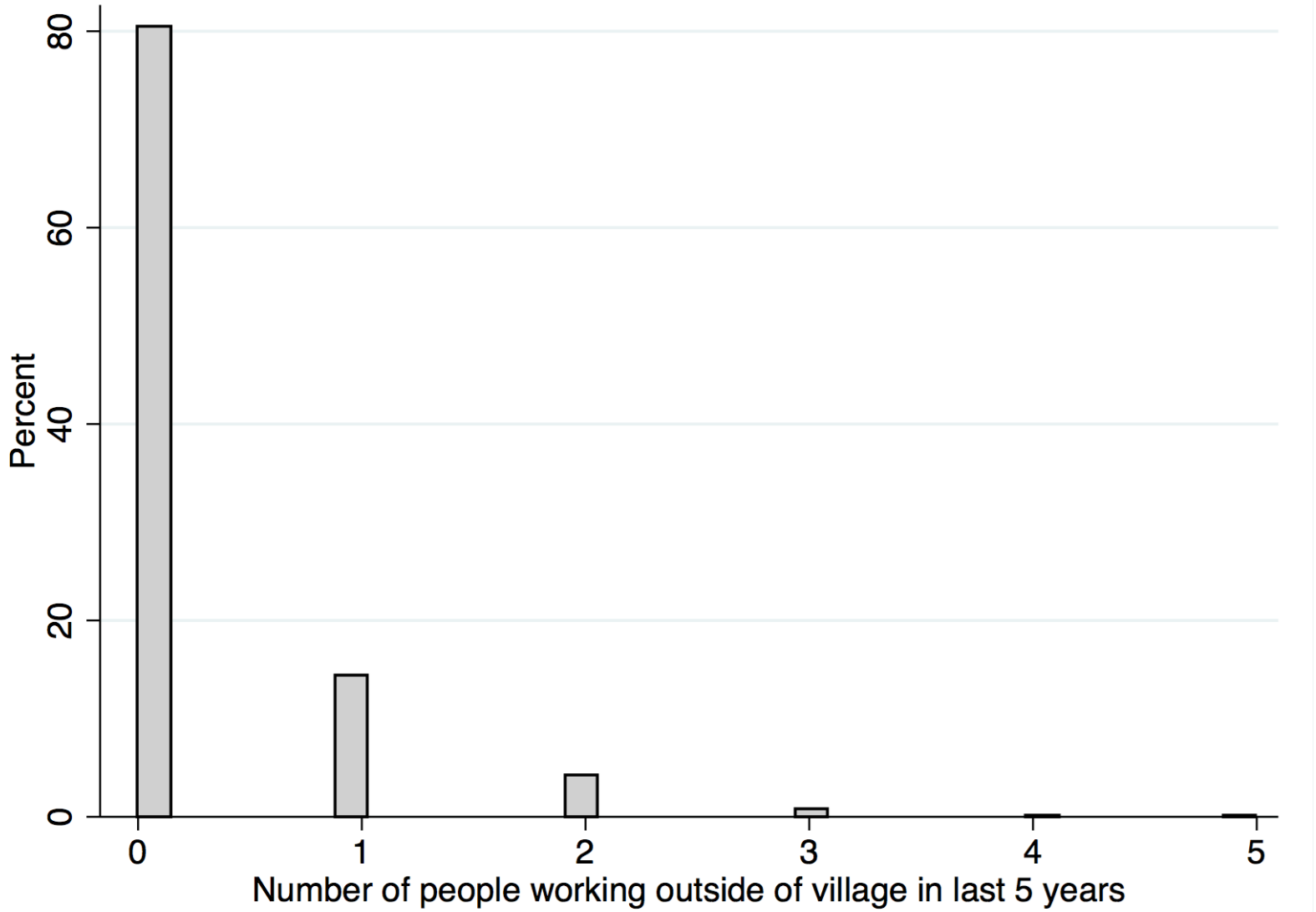




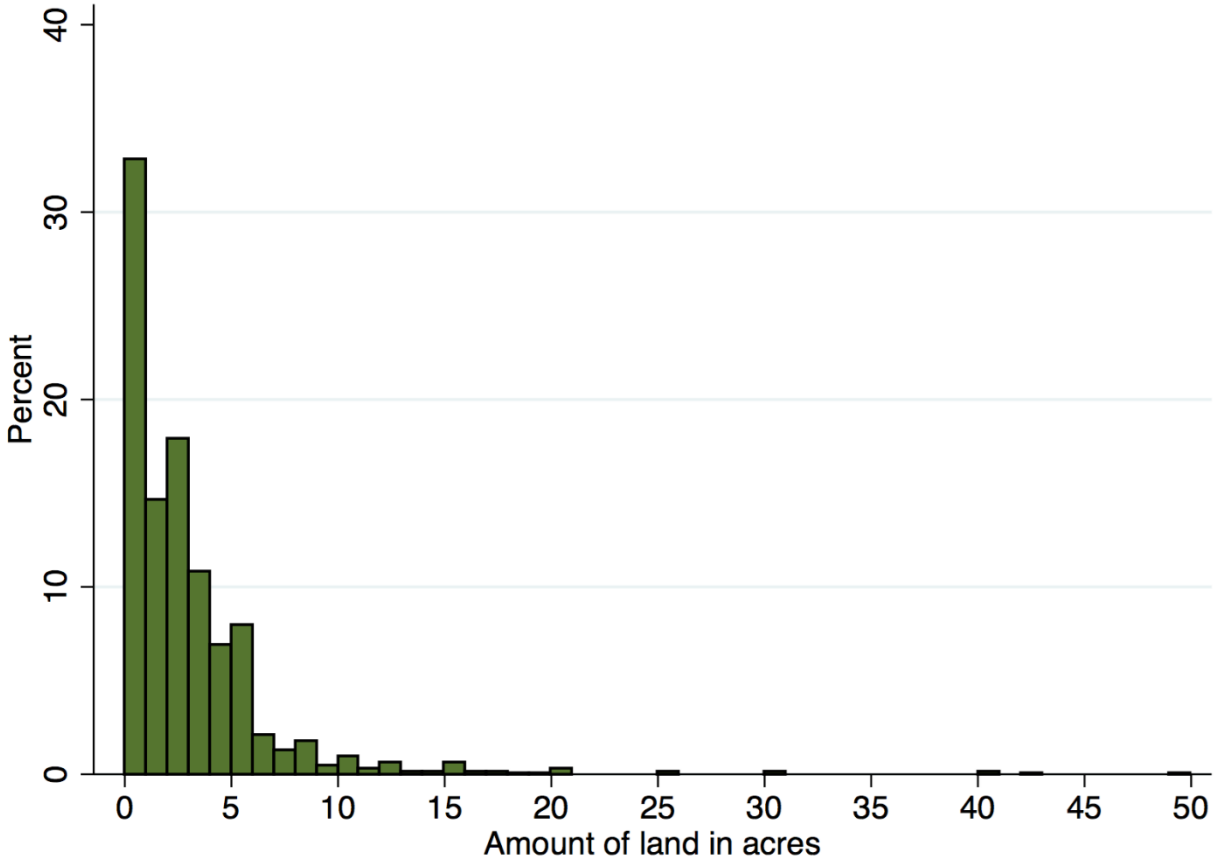
Household survey: education

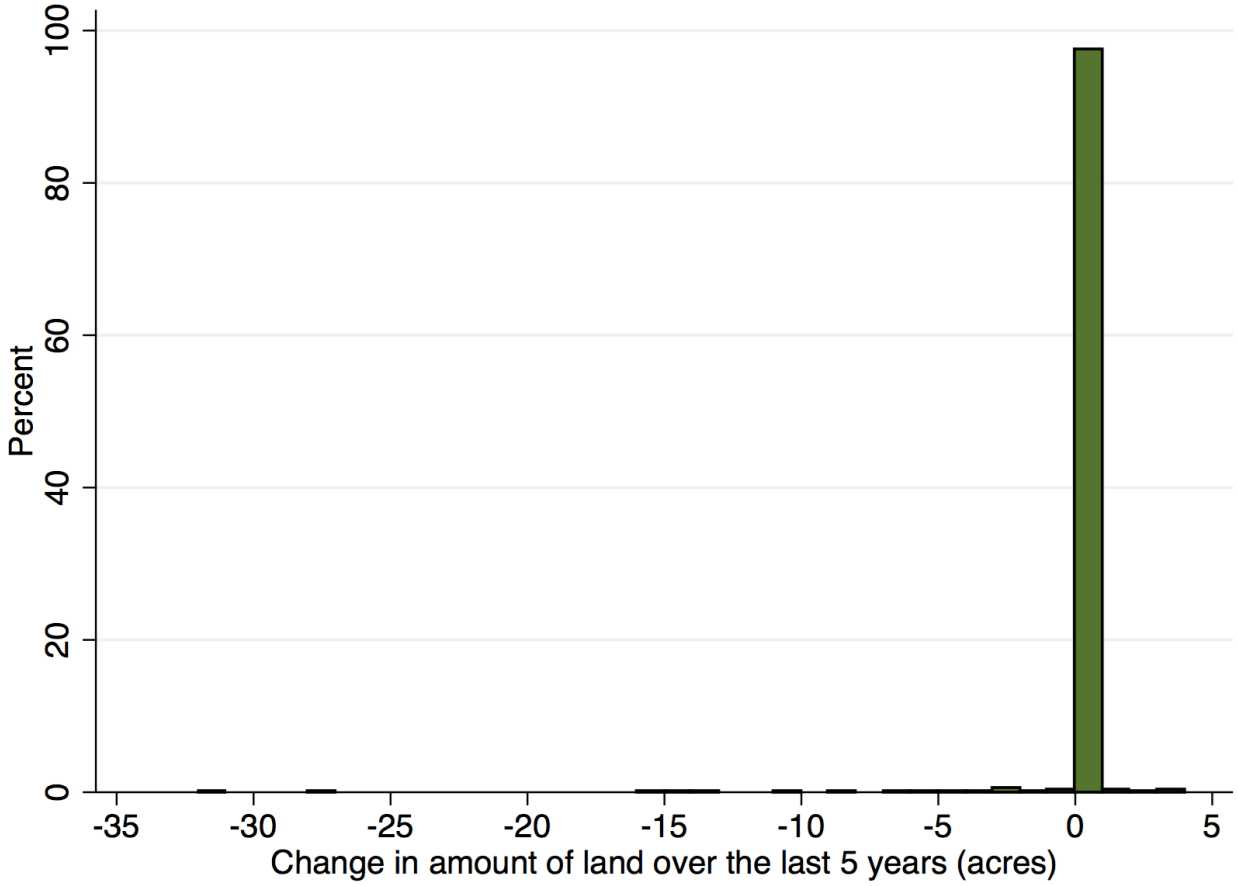


Household survey: 80% of hhs with no one working outside village

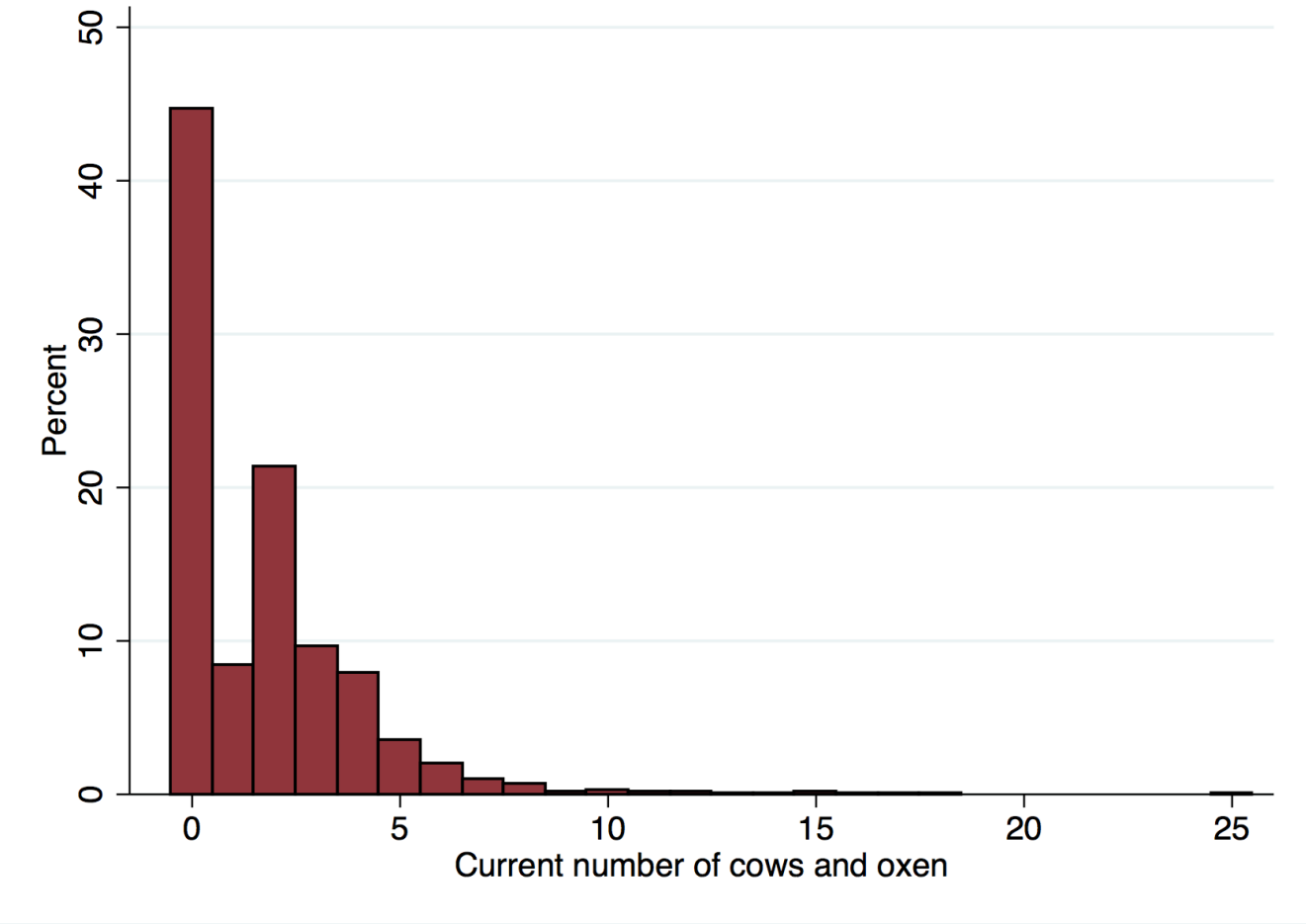


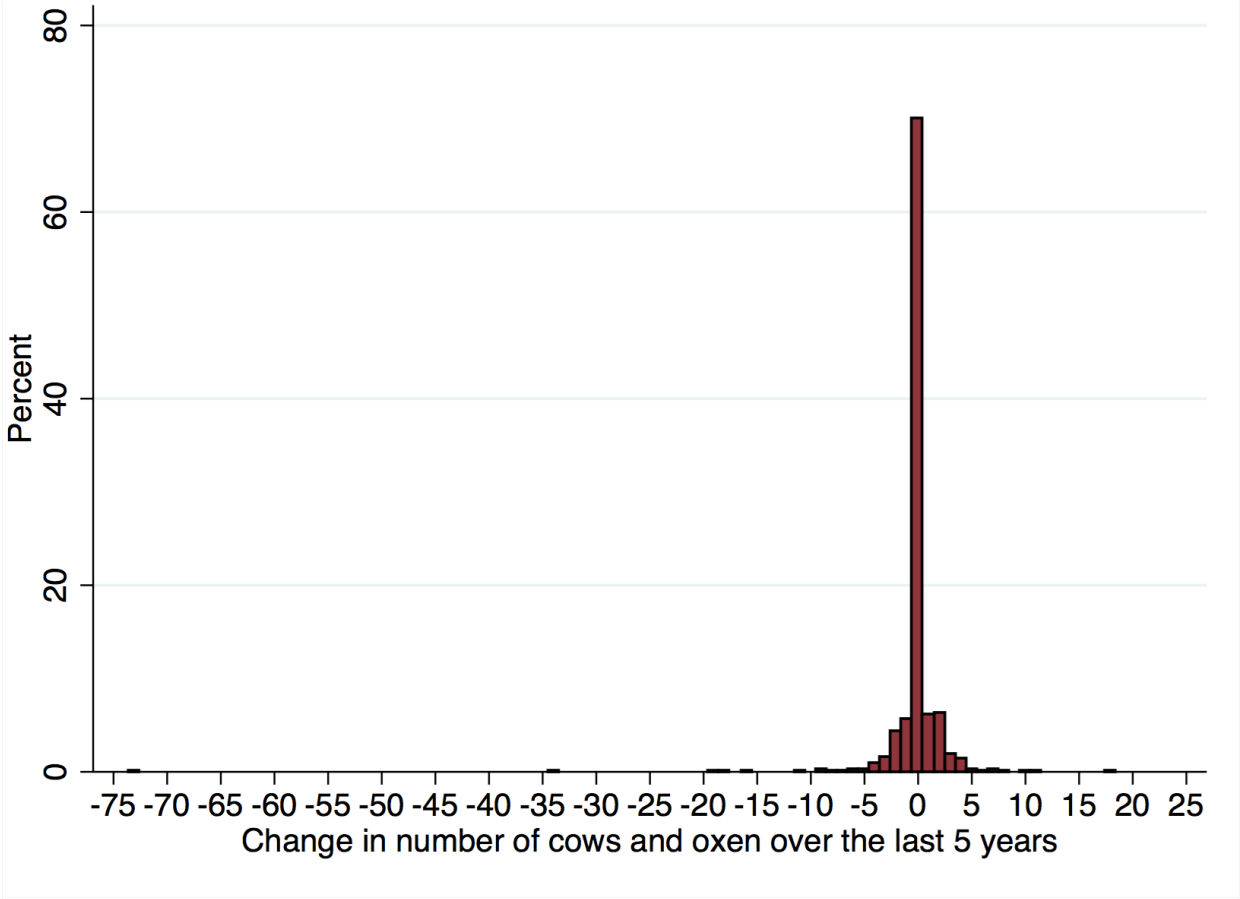
Land ownership



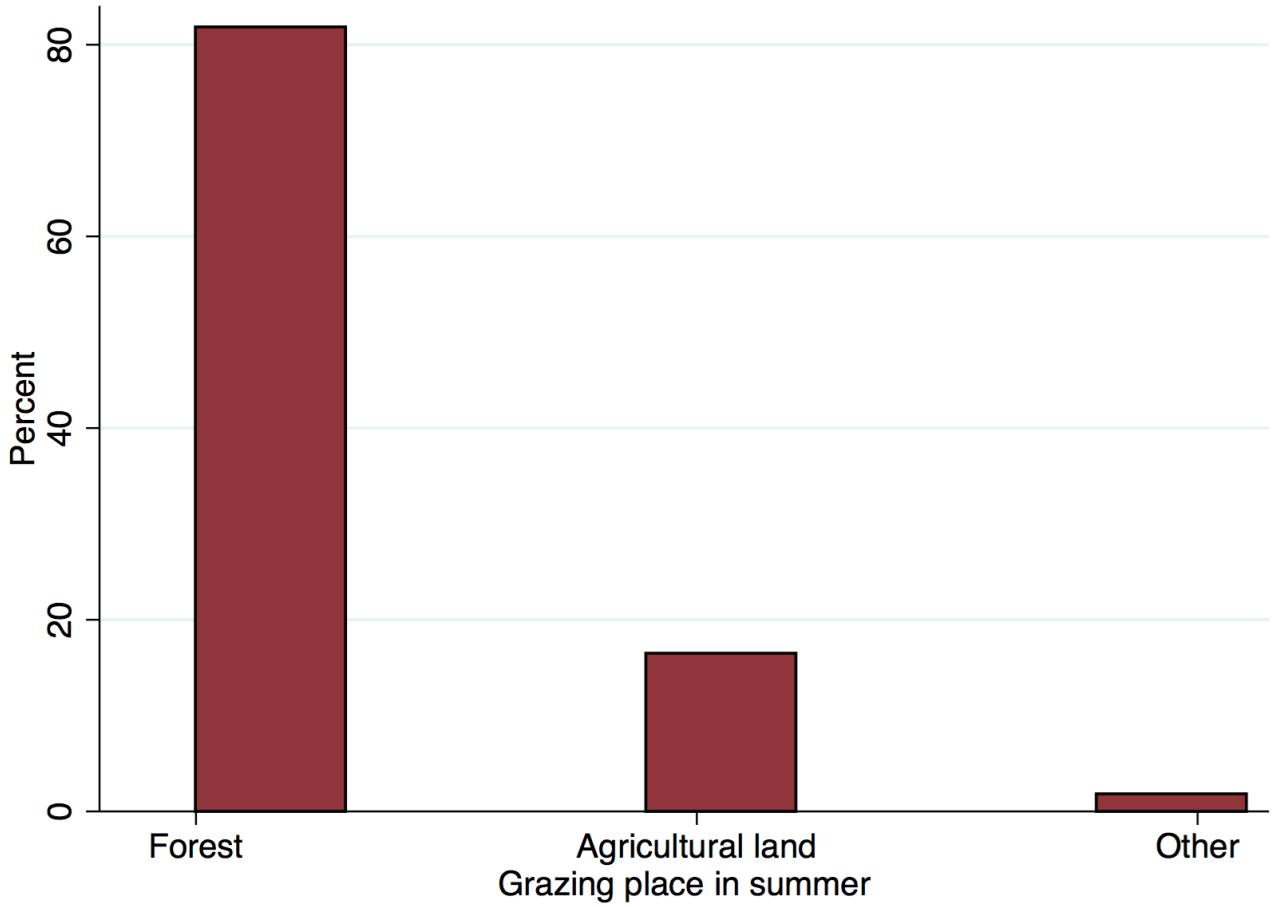


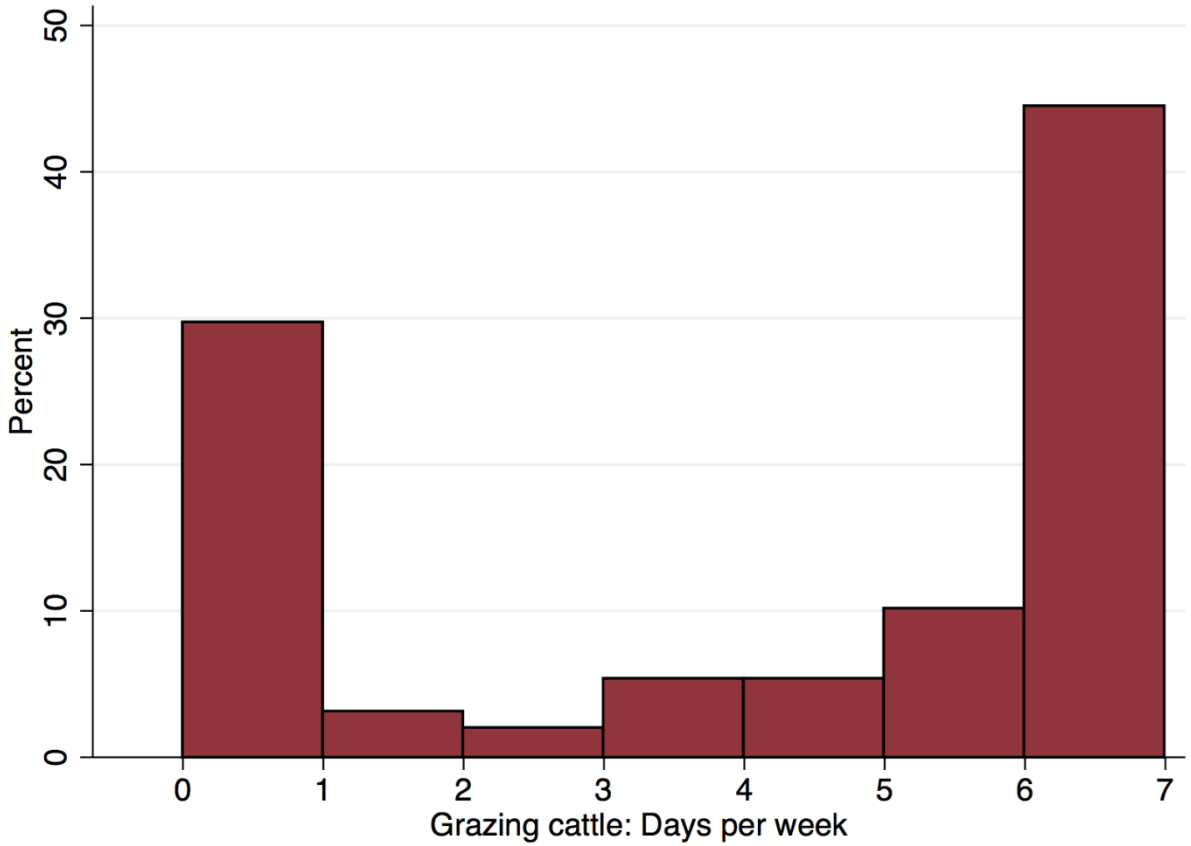
Land use: cows and oxen



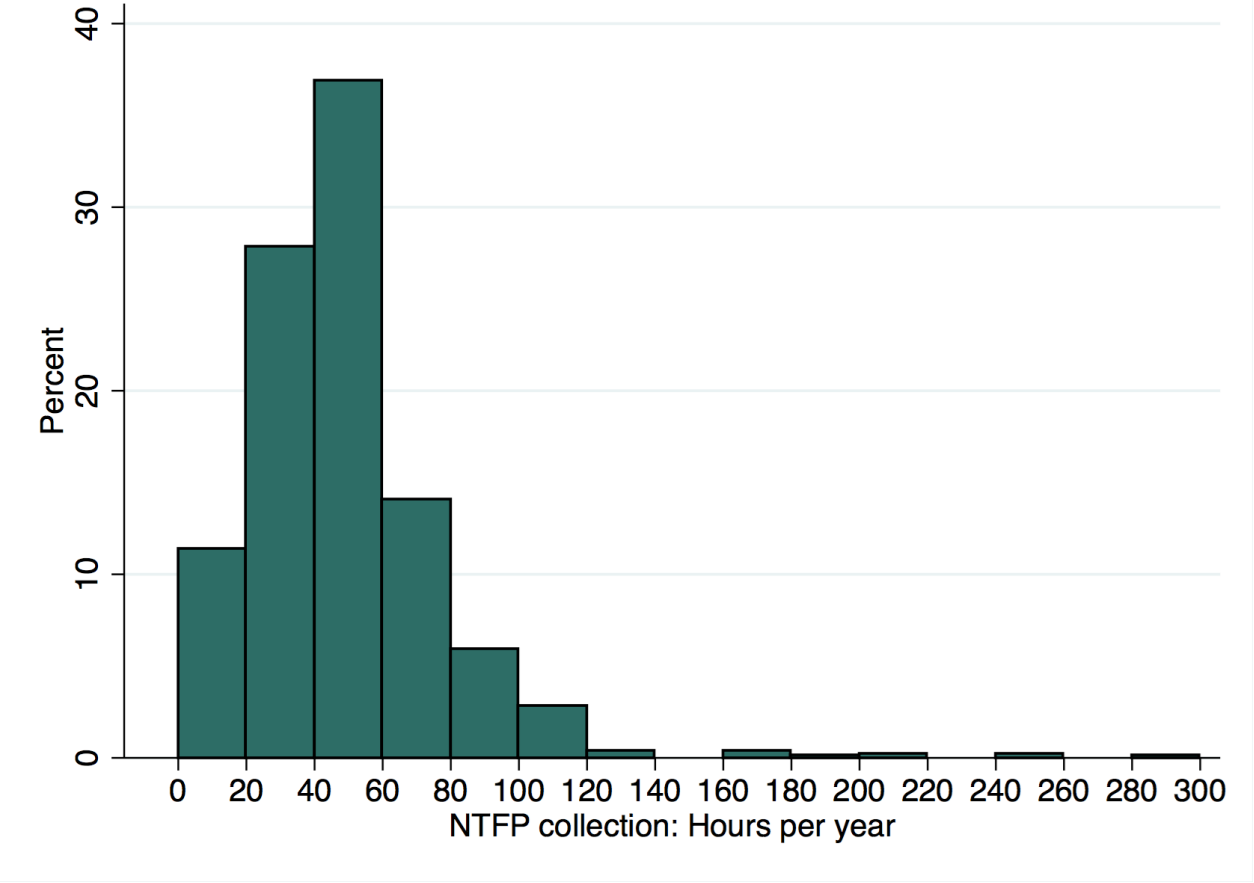


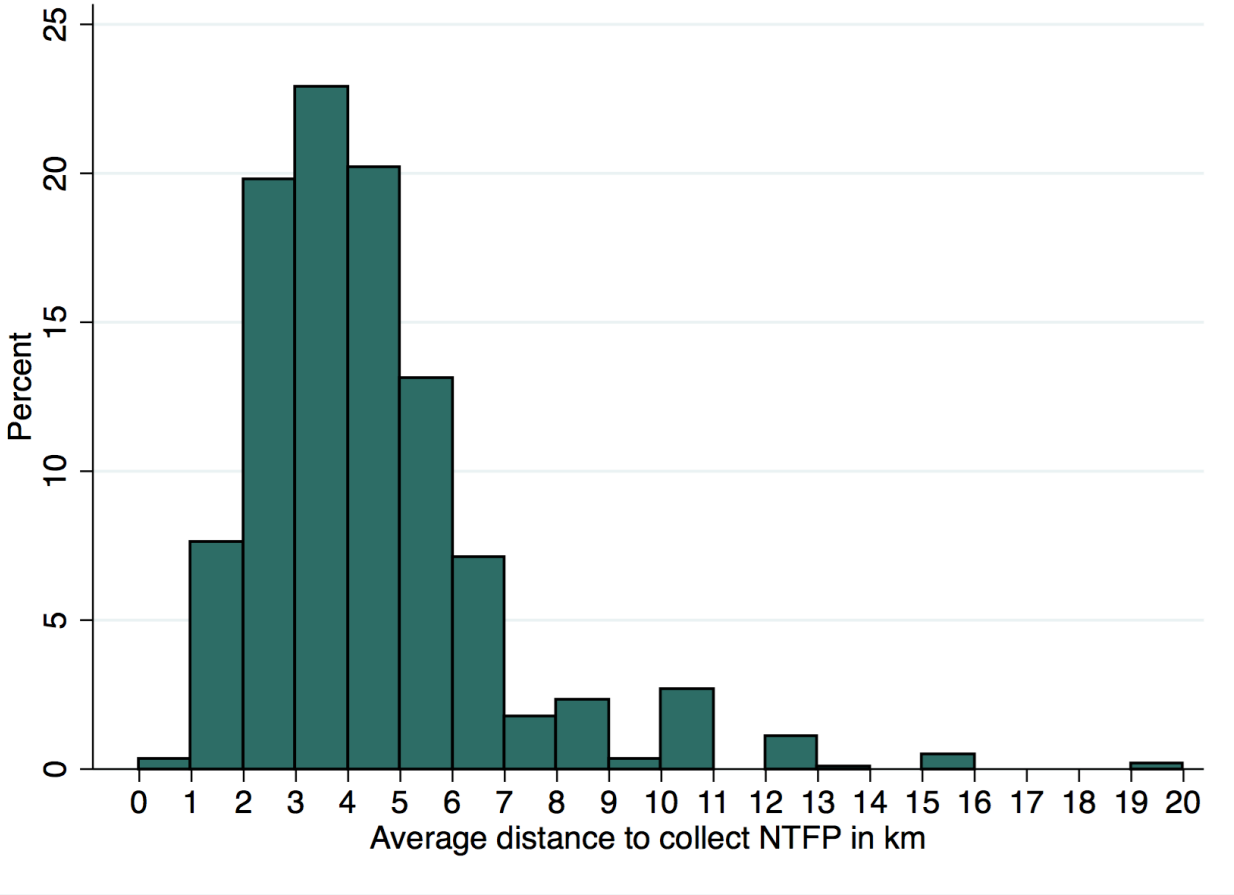
Land use: cattle



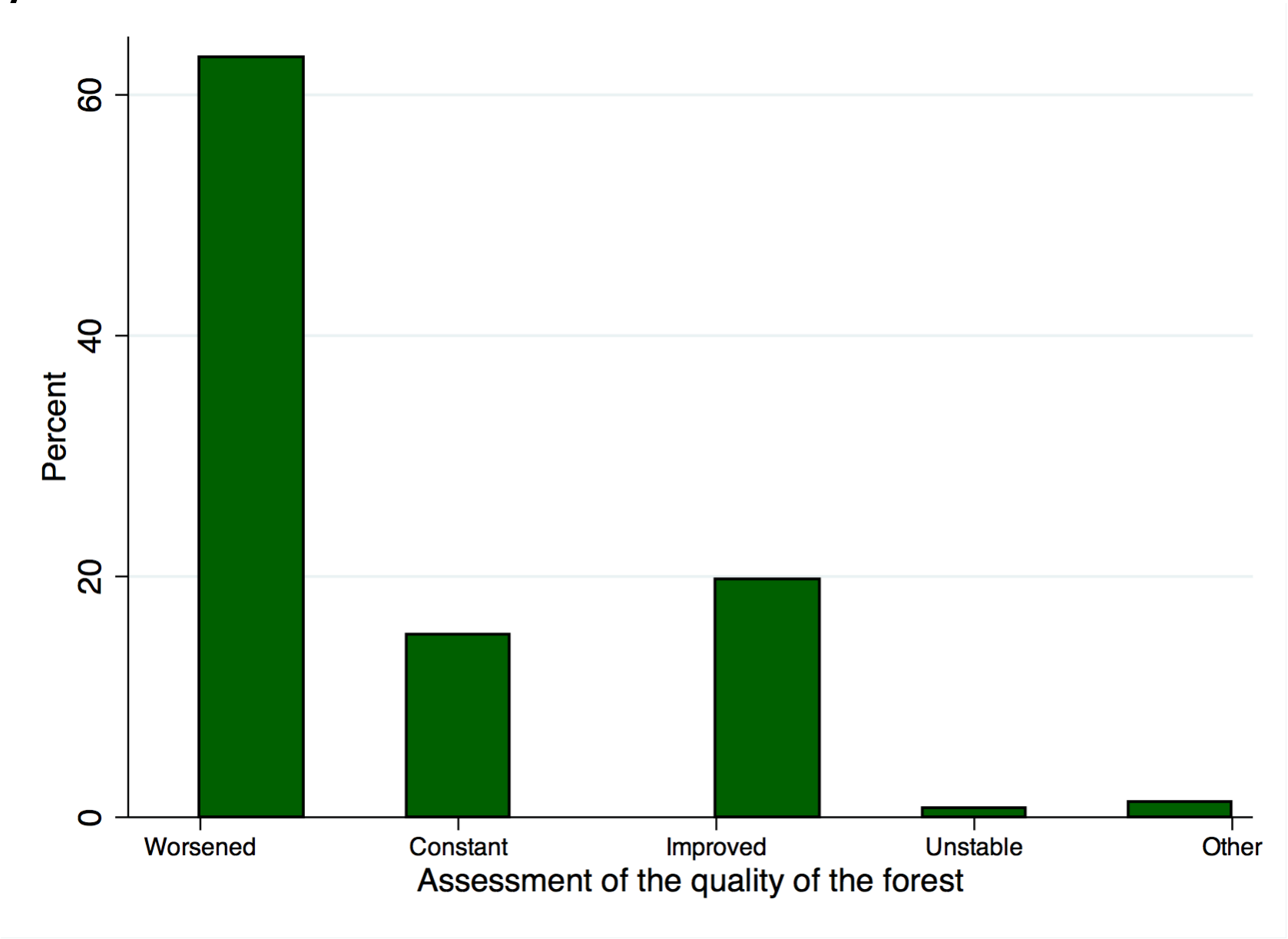


Land use: NTFP (excluding 53% not collecting)





Quality of forest



PRELIMINARY DIRECTIONS

- **Cautiously optimistic about Planet Labs data to quantify degradation as % exposed soil**
- **Survey results indicate range in migration patterns and forest use**
- **Associate off-farm employment with forest use from hh surveys and remote sensing degradation metric with village surveys**

POSSIBLE POLICY/SOCIETAL RELEVANCE???

- Should state governments promote urban migration or staying-on-the farm?
- Where to target efforts to improve forest quality in corridors?
- In-house ability to monitor changes in forest quality

THANKS