

**2013 Esri International User Conference**

July 8–12, 2013 | San Diego, California

# **Changes in the Brazilian Semiarid: Analysis Supported by GIS Technology**

Iana Rufino

Universidade Federal de Campina Grande. Brazil

Kevin Mulligan

Texas Tech University. USA

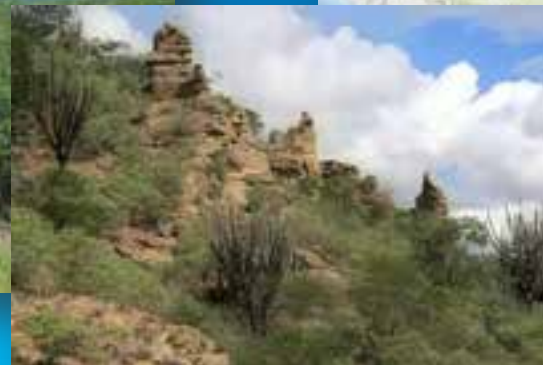
# The Brazilian Semi-arid

## Physical Environment

- the northeastern part of Brazil is a semi-arid environment
- most populated semi-arid region in the world (22 million / 12%)
- physical environment
  - characterized by seasonal drought
  - few opportunities for irrigated agriculture



Caatinga



# The Brazilian Semi-arid

## Criteria Used to Define the Semi-arid Boundary

- the semi-arid region is a legal geographic designation
  - used to administer federal government programs
- defined by at least one of three criteria:
  - 1) Aridity Index  $< 0.50$  (Thornthwaite, 1941)
  - 2) Annual Precipitation  $< 800\text{mm}$  (1961-1990)
  - 3) Drought Risk  $> 60\%$  (days under drought)



Semi-arid Boundary Criteria

# Land Use / Land Cover Change

## Potential Impacts of Climate Change and Population Growth

- to manage natural and agriculture resources, it is important to understand the potential impacts of climate change and population growth on land use (and watershed hydrology)

### Drivers of Land Use / Land Cover Change

#### 1) Climate Change

- increased temperature (evapotranspiration)
- decrease in annual precipitation
- increased length of the dry season

#### 2) Population Growth

- spatial distribution of the current population
- future population trends (population change)

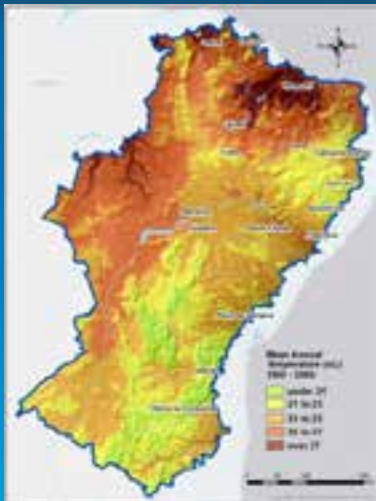
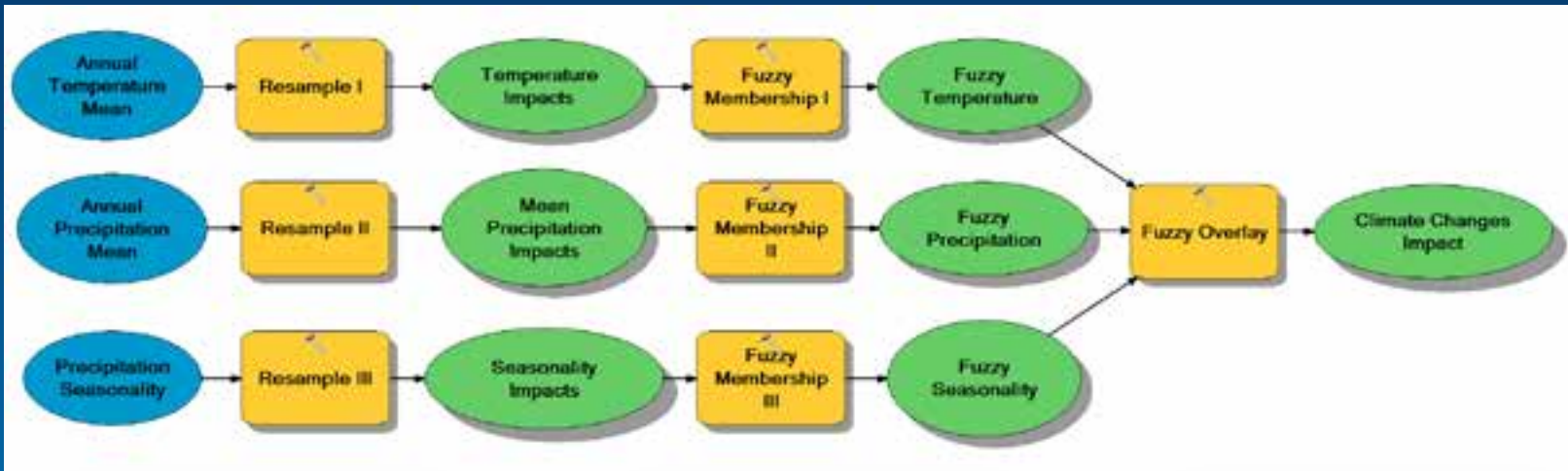


Major Watersheds

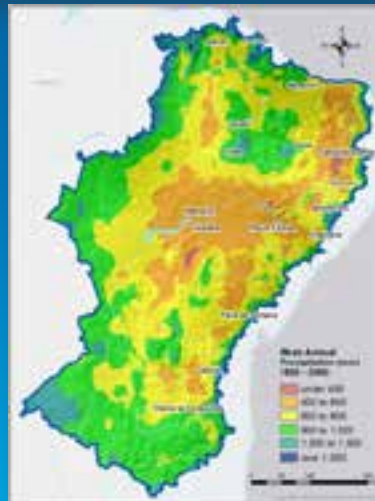


# Climate Change

## Development of a Climate Change Impact Model



Mean Annual Temperature



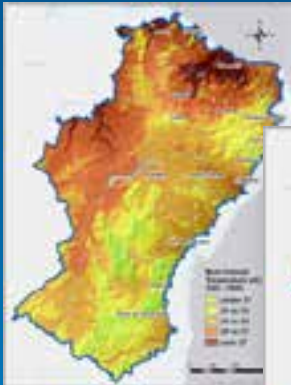
Mean Annual Precipitation



Precipitation Seasonality

# Climate Change

Results: Climate Impact Model



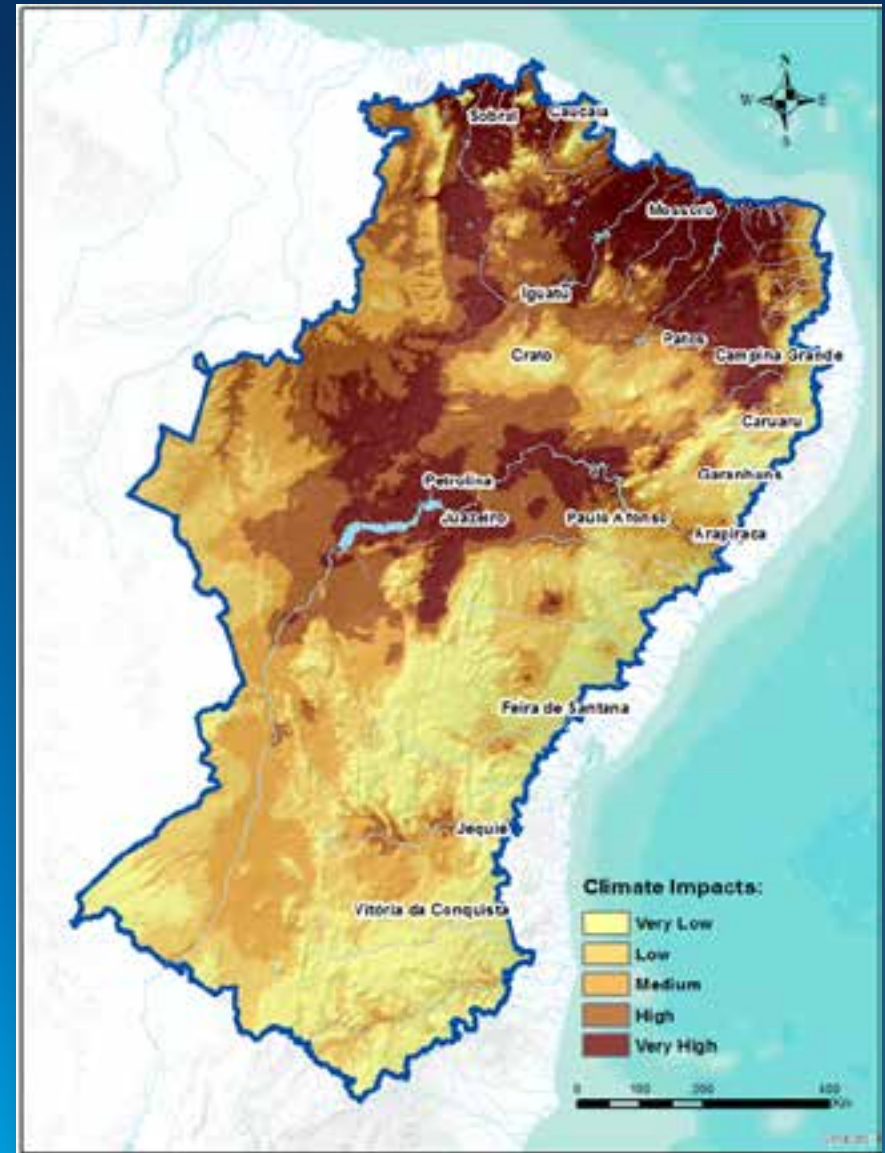
Mean Annual Temperature



Mean Annual Precipitation

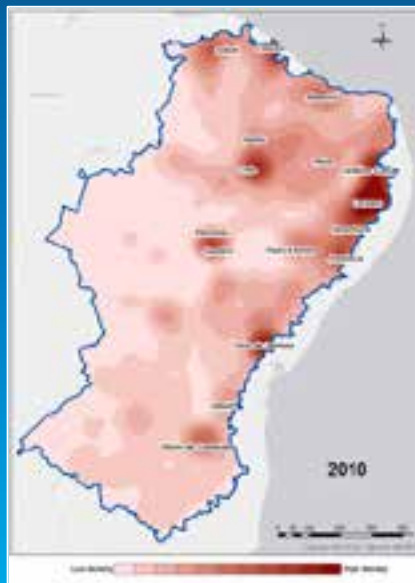
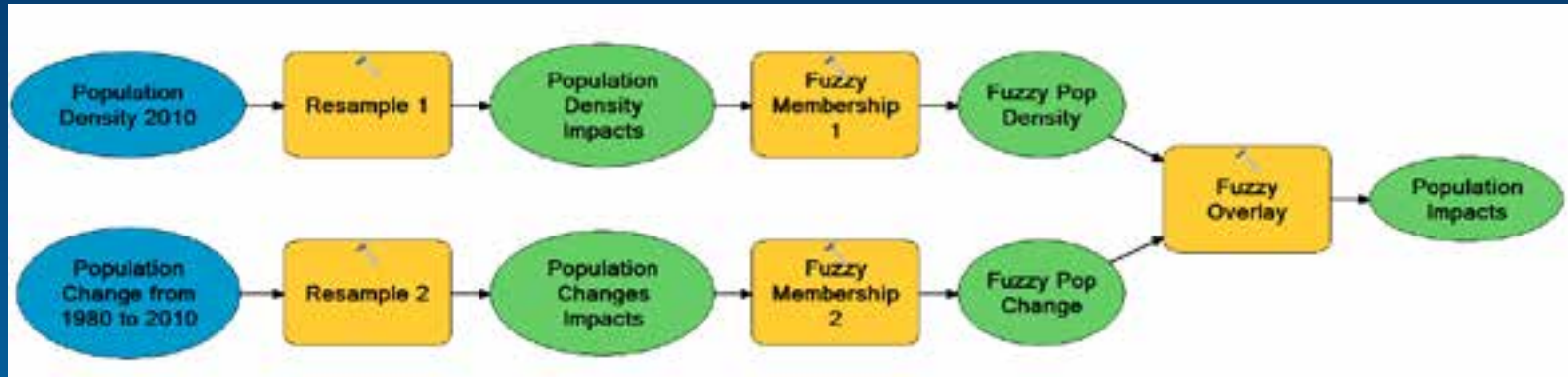


Precipitation Seasonality

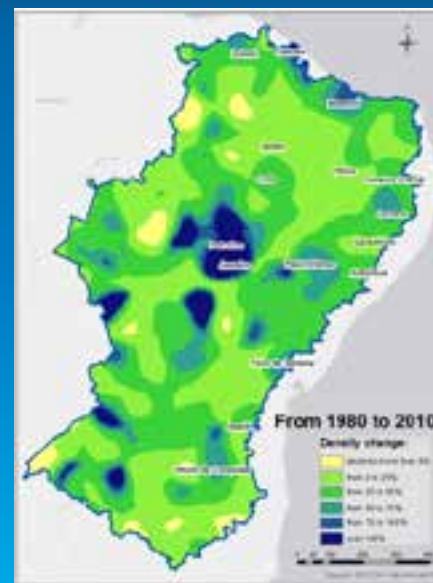


# Population Growth

## Development of a Population Impact Model



Population Density

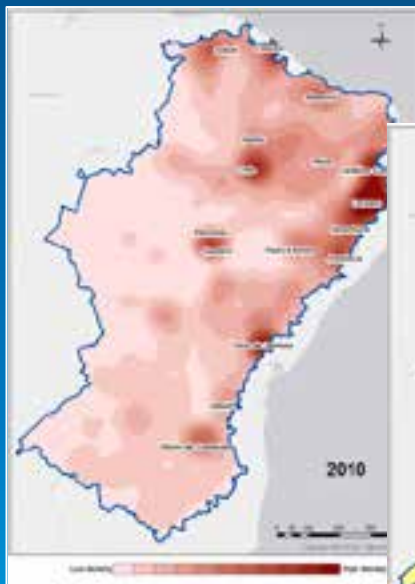


Population Change (%)

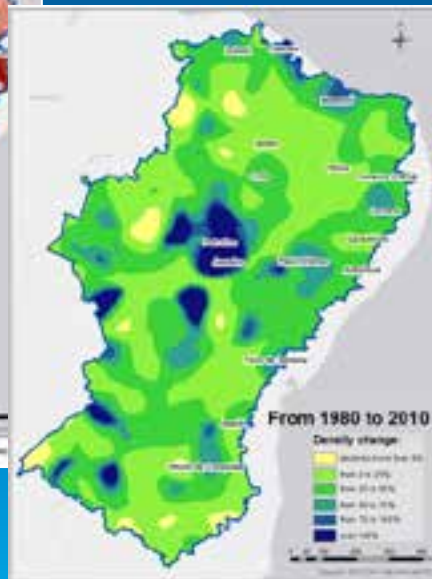


# Population Growth

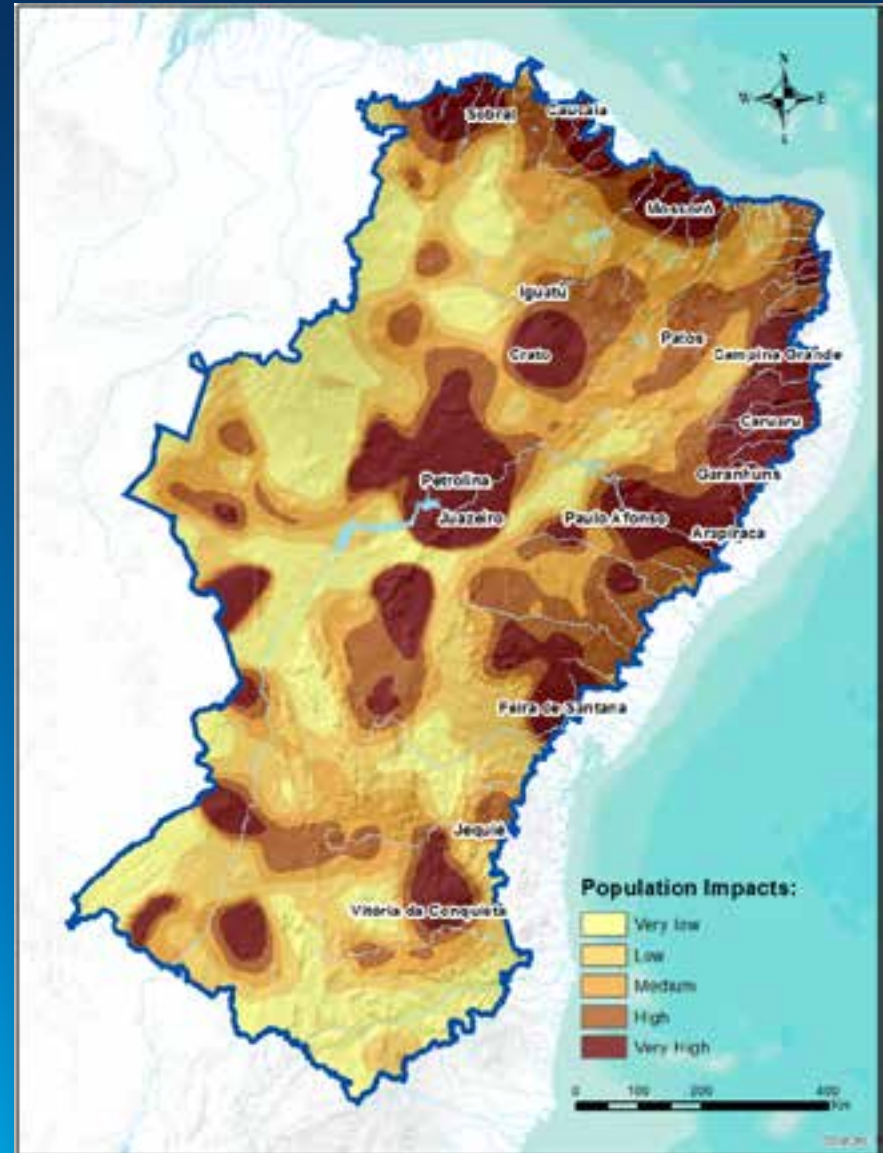
## Results: Population Impact Model



Population Density



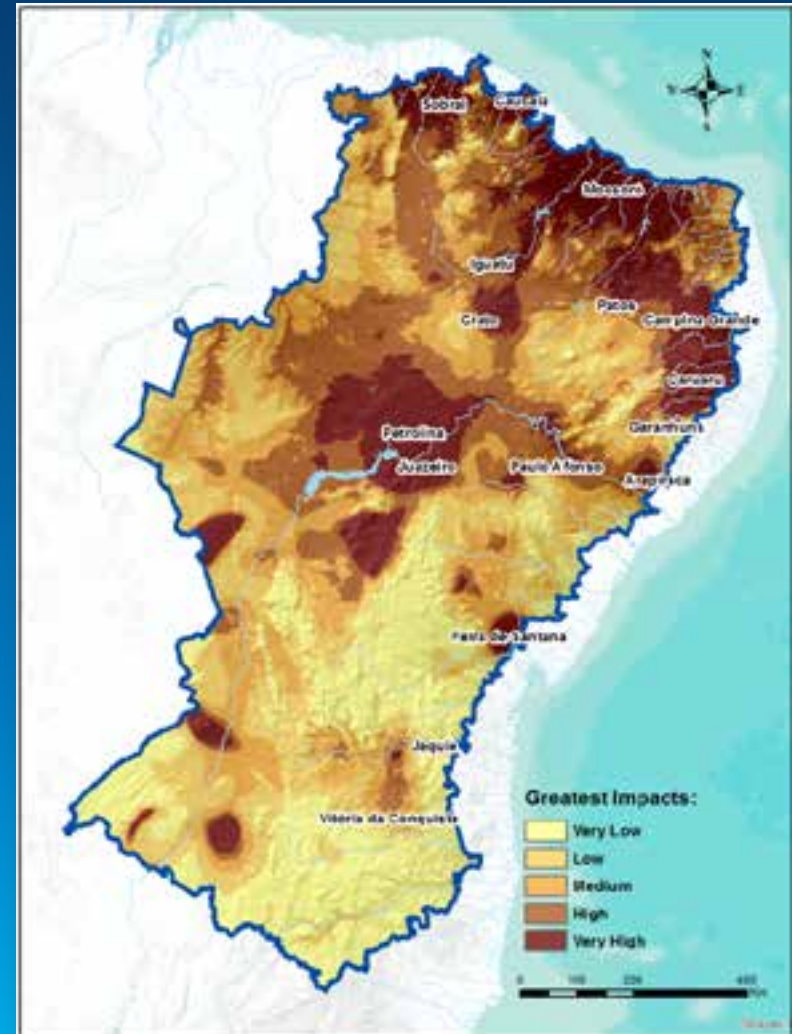
Population Change





# Final Model Results

## Combined Impact of Climate Change and Population Growth



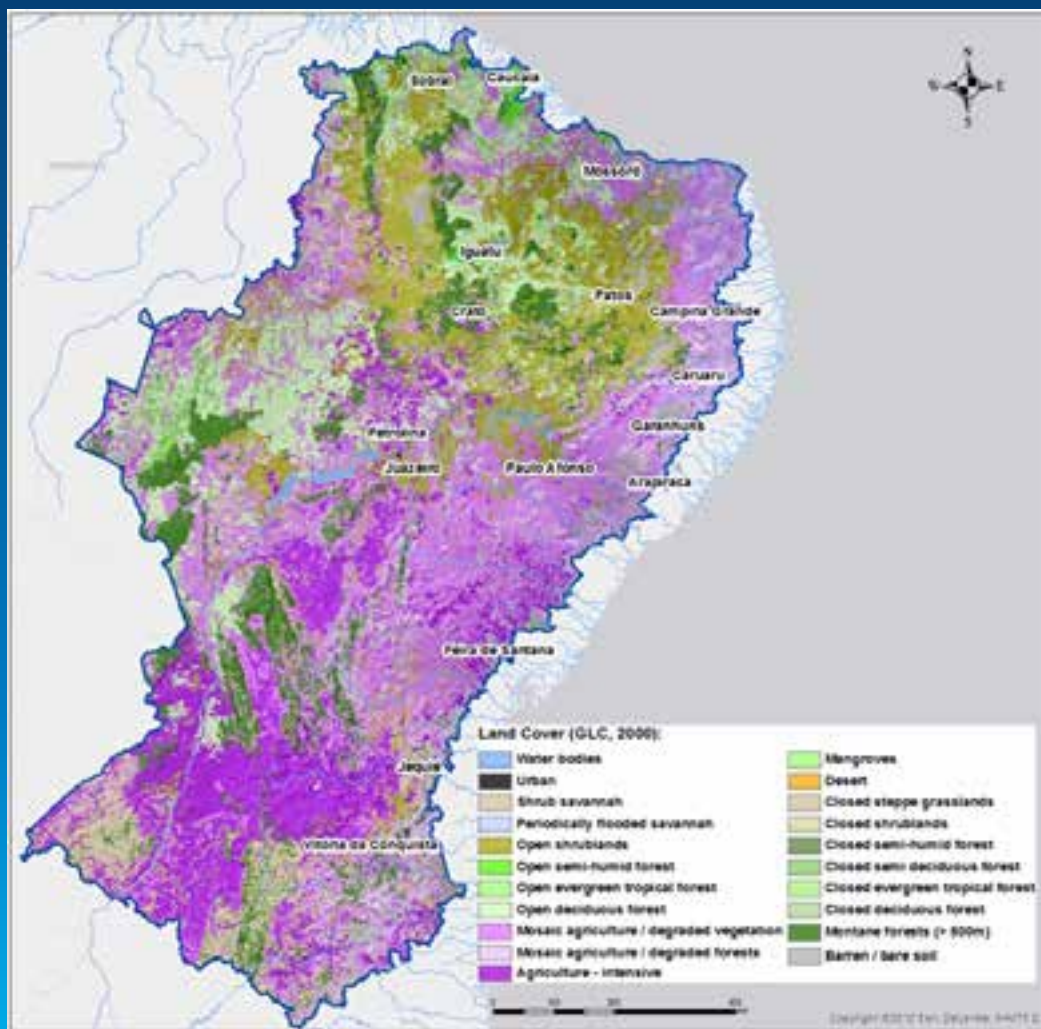
Climate Change Impacts



Population Growth Impacts

# Impact on Land Use / Land Cover

## Overlays on Land Use / Land Cover Datasets

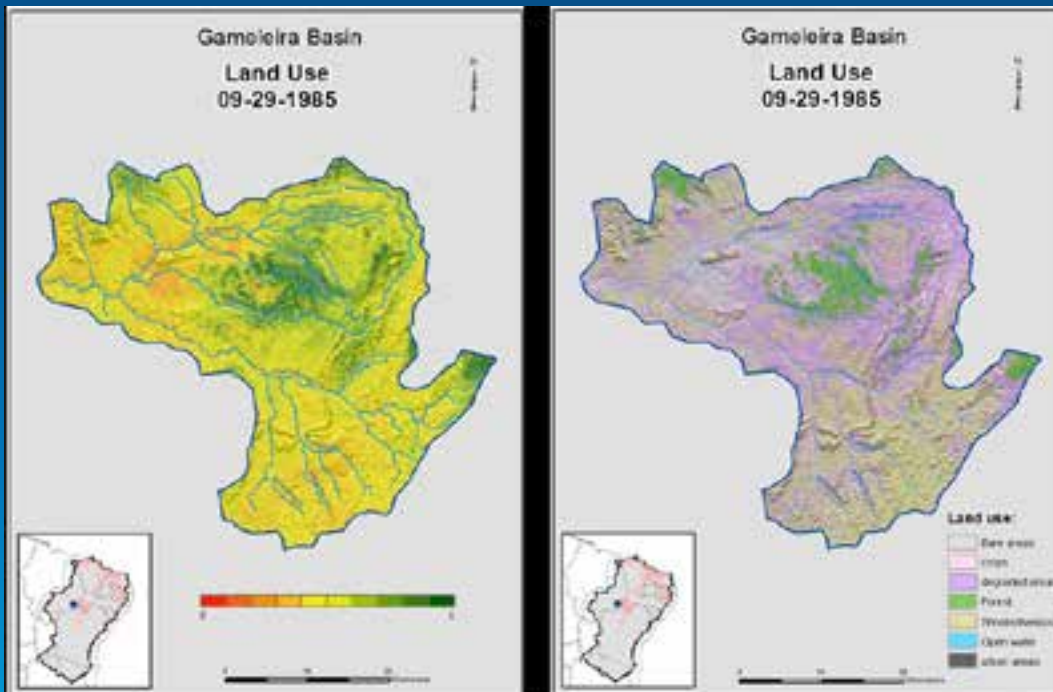


Land Cover Class	Area %
Mosaic agriculture / degraded vegetation	24.81
Open shrublands	18.20
Open deciduous forest	17.85
Agriculture - intensive	9.61
Barren / bare soil	8.63
Mosaic agriculture / degraded forests	7.62
Montane forests (> 500m)	5.79
Closed shrublands	2.86
Open semi-humid forest	1.84
Water bodies	1.31
Shrub savannah	0.99
Urban	0.12
Closed evergreen tropical forest	0.10
Closed steppe grasslands	0.09
Closed semi deciduous forest	0.06
Mangroves	0.02
Closed semi-humid forest	0.01
Desert	0.01
Periodically flooded savannah	0.01

# Conclusions

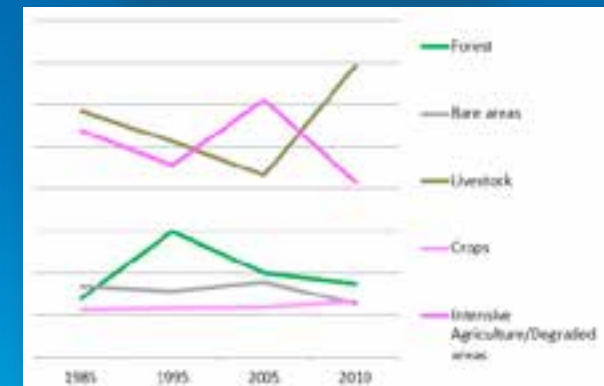
## Impact of Climate Change and Population Growth on Land Use

- In this analysis ArcGIS was used to model and map the potential impact of climate change and population growth



NDVI  
Landsat

Land Use / Land Cover  
Landsat





# Thank You!

Iana Alexandra Alves Rufino  
Center for Natural Resources and Technology  
Federal University of Campina Grande

Kevin Mulligan  
Center for Geospatial Technology  
Texas Tech University

**Acknowledgements**  
CAPES



Universidade Federal  
de Campina Grande



**TEXAS TECH**  
UNIVERSITY.



Coordenação de Aperfeiçoamento de Pessoal de Nível Superior