

# **Deforestation Research in the United States: Evidence To Inform the Avoided Deforestation Discussion**

Ralph J. Alig  
USDA Forest Service  
PNW Research Station  
Corvallis, Oregon  
[ralig@fs.fed.us](mailto:ralig@fs.fed.us)

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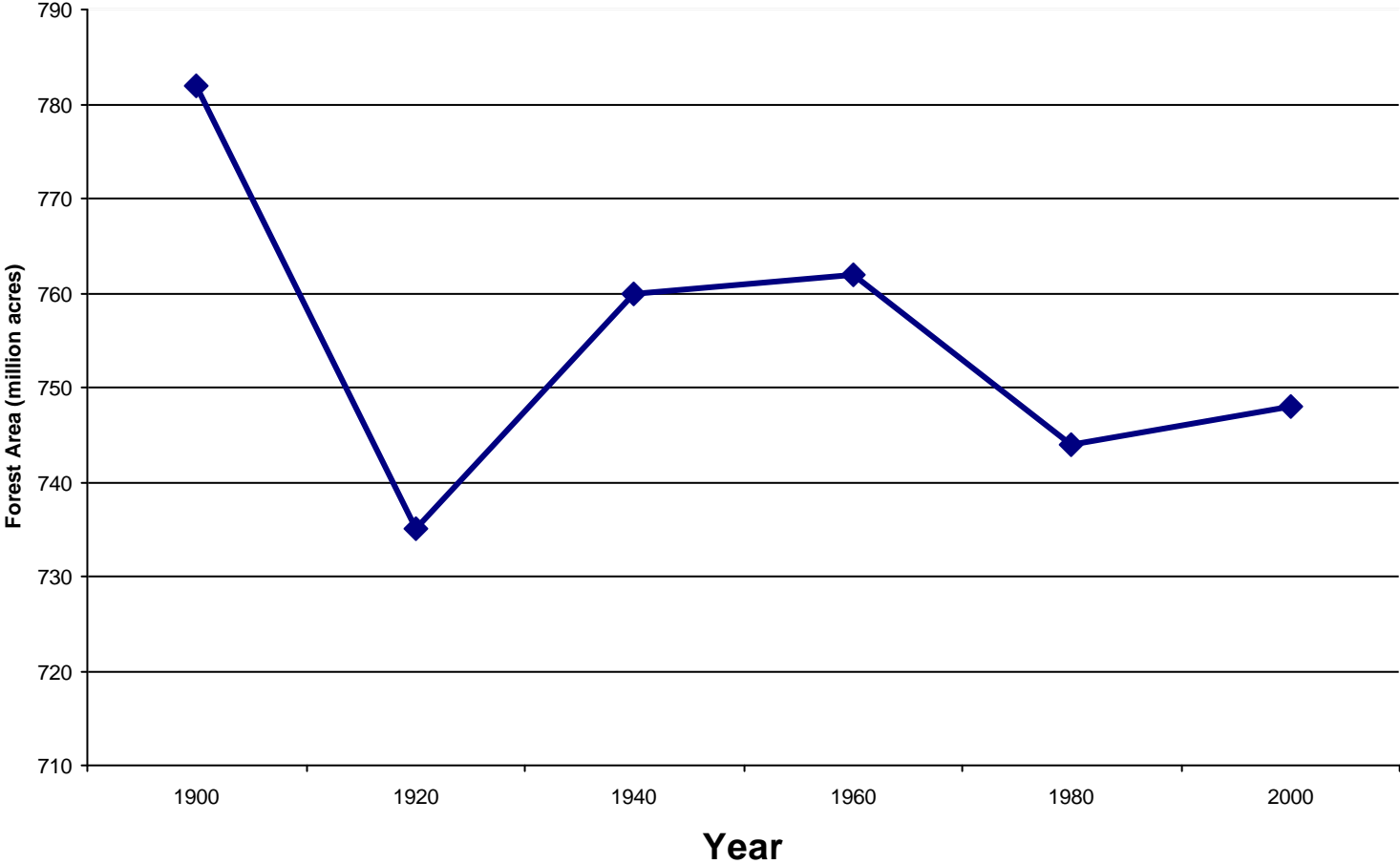
# Outline of Talk

- Recent Trend: Two million acres of U.S. nonfederal rural land converted annually to developed uses
- Largest source is forest of land converted to developed uses
- Approximately one million acres per year of deforestation (roughly 8-10 times amount in Canada)
- Projections for >50 million acres of deforestation by 2050
- Competition for Rural Land Affected by Demands for Developed Land: Study in Progress with FASOM-GHG Model
- Impact on costs for GHG offsets, including biofuel
- Insights for deforestation incentives and disincentives question in developing countries

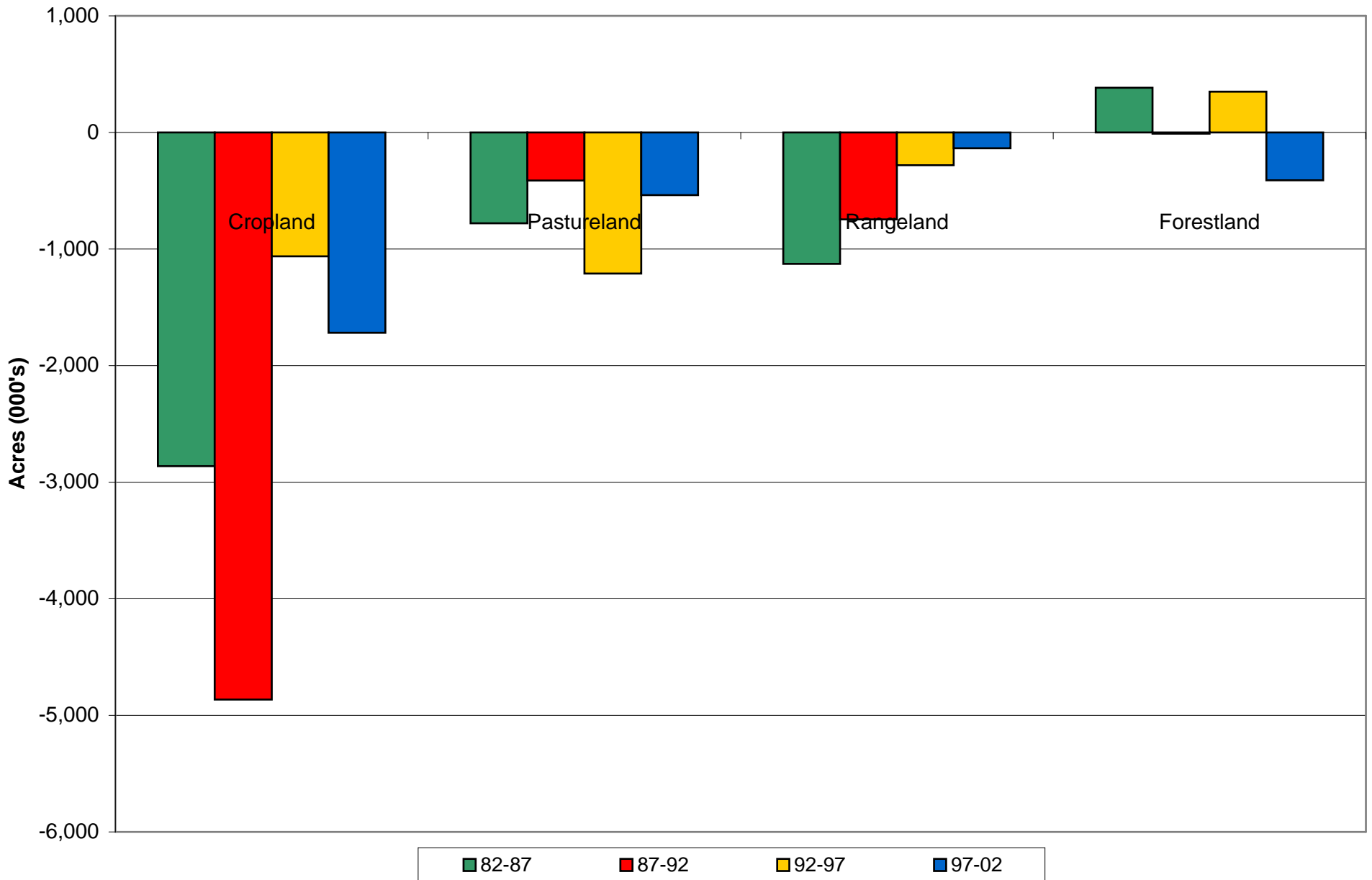
# Definition

- **Deforestation:** The conversion of forest to another land use, such that the long-term reduction of the tree canopy cover is below a 10 percent threshold. Deforestation implies transformation into another land use, vs. timber harvesting where the site is likely to revert back to tree cover.

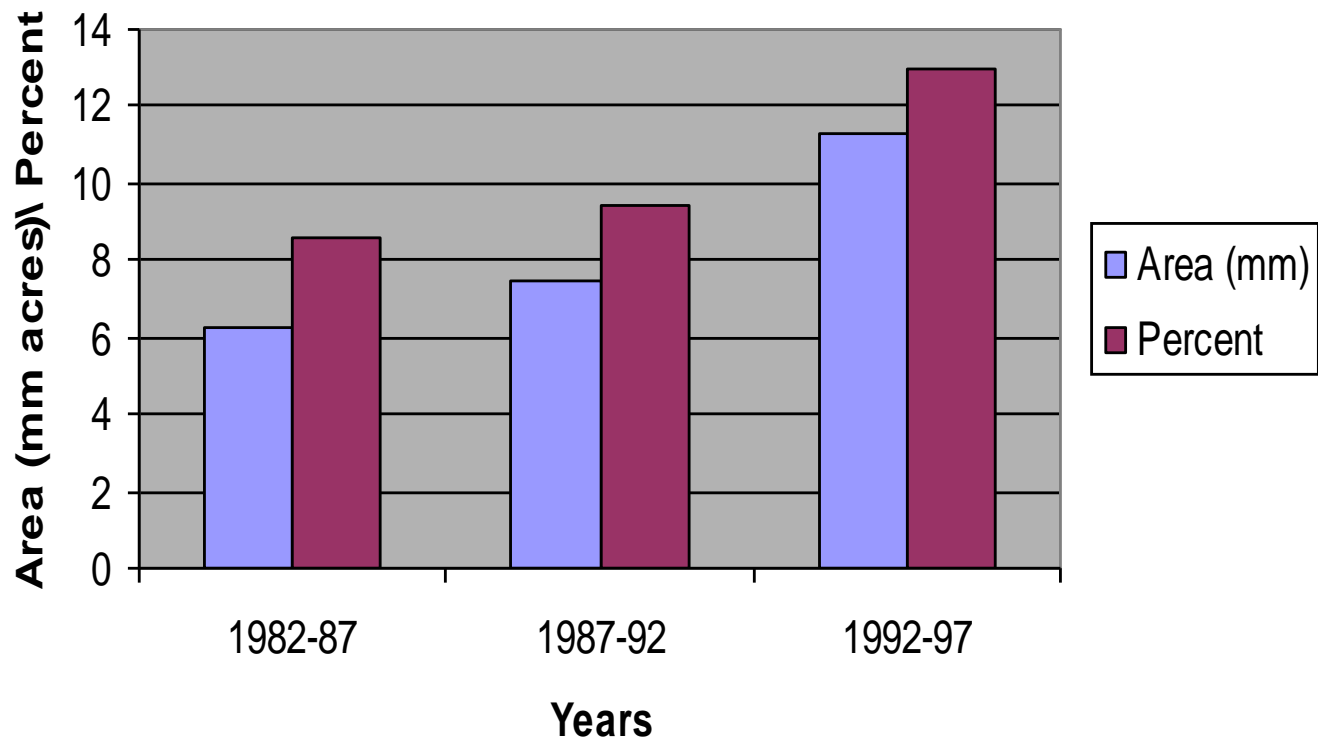
**Trends in U.S. Forest Area, 1900-2000 (source: RPA\FIA)**



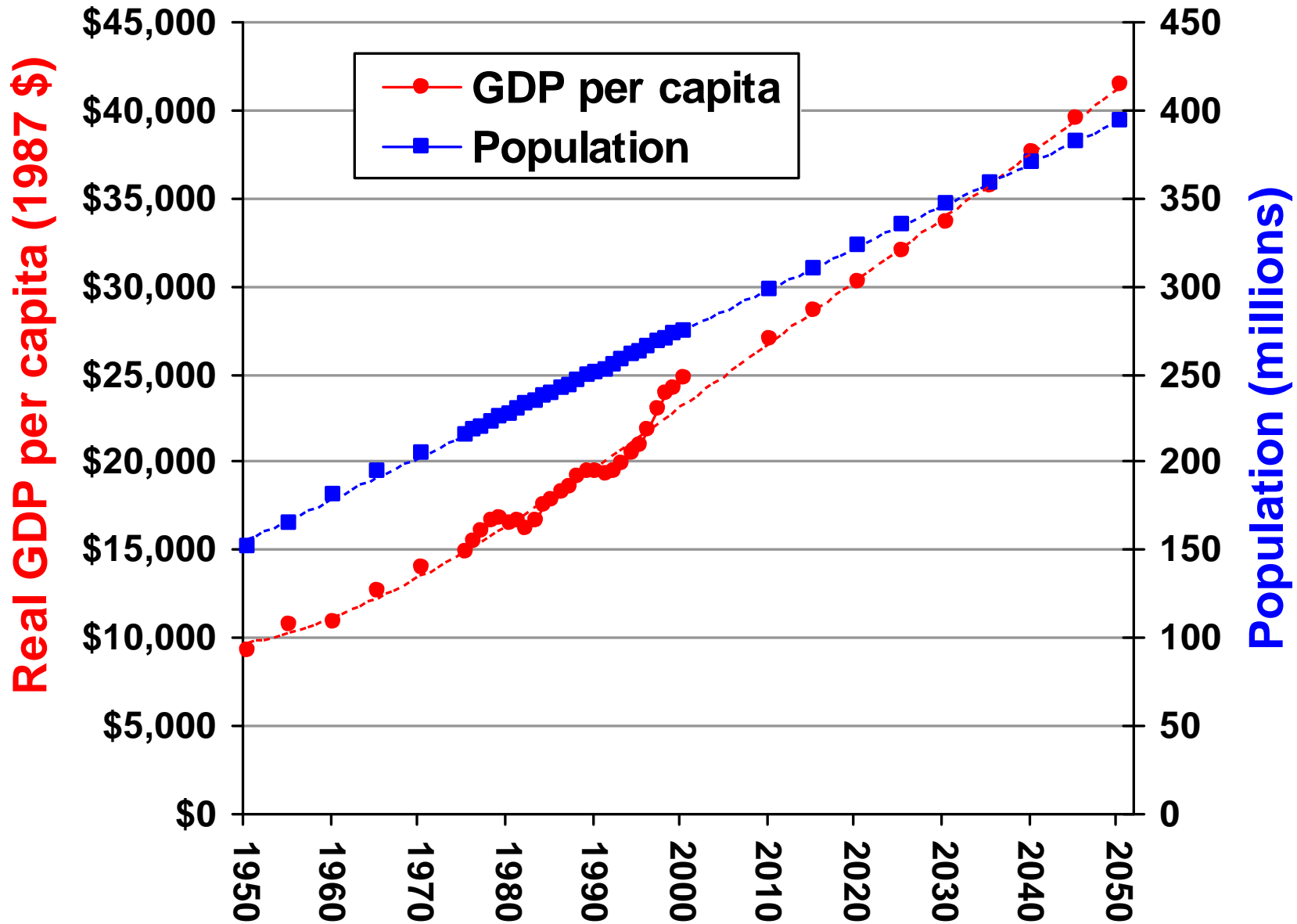
Average Annual Changes in Open Space by NRI Data Cycle (1982-2002)

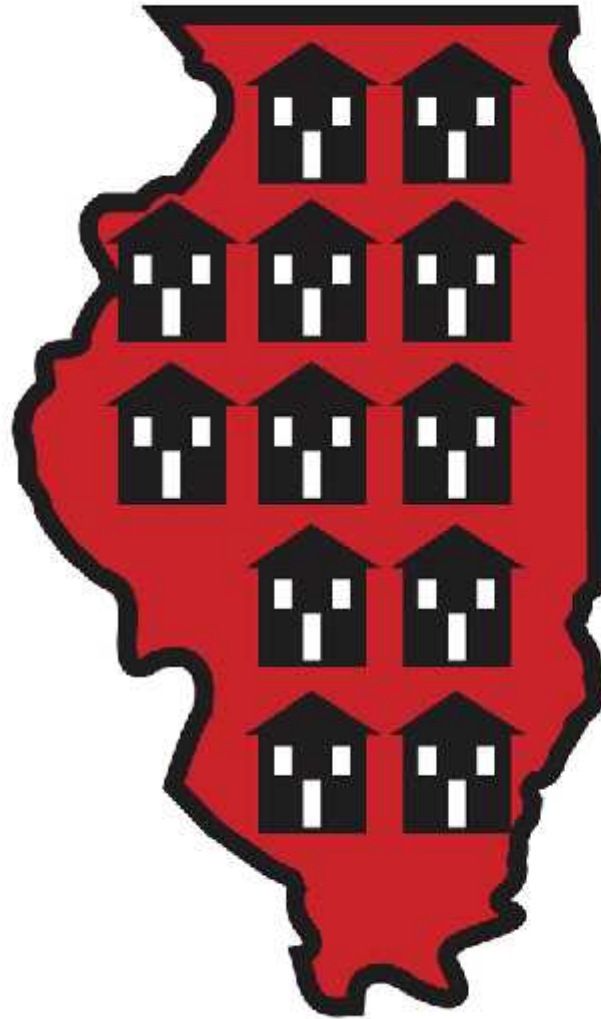


## Change in U.S. Developed Area



# U.S. Population and real GDP per capita





## SHRINKING SPACES

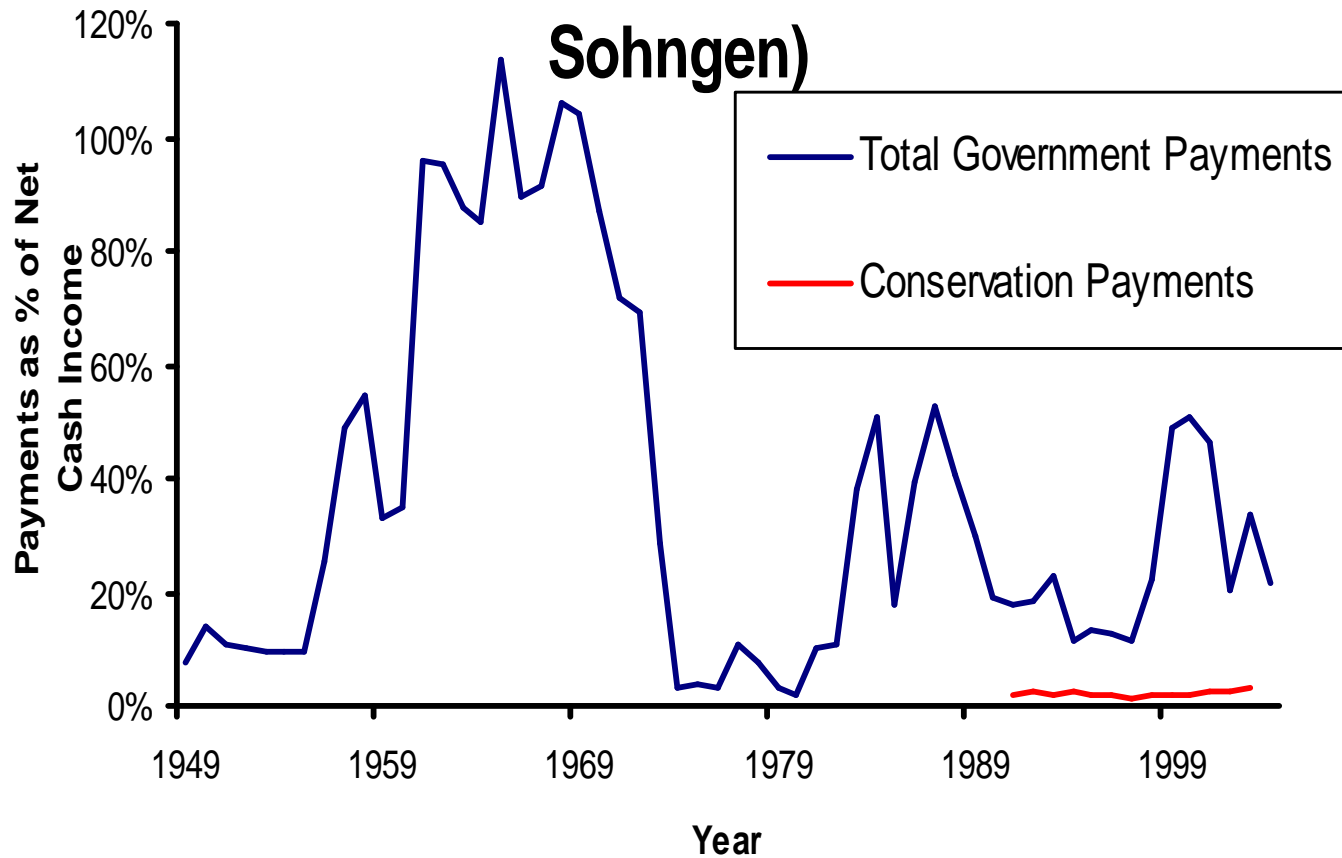
From 1982 to 2001, 34 million acres of open space were converted to development. That's equivalent to the state of Illinois.



# Forestry Intertwined with Cycles Involving Agriculture

- Soil Bank Program example
- World Demand for Agricultural Crops
- Conservation Reserve Program (nation's largest tree planting program)
- Freedom to Farm legislation/Record spending on farm programs

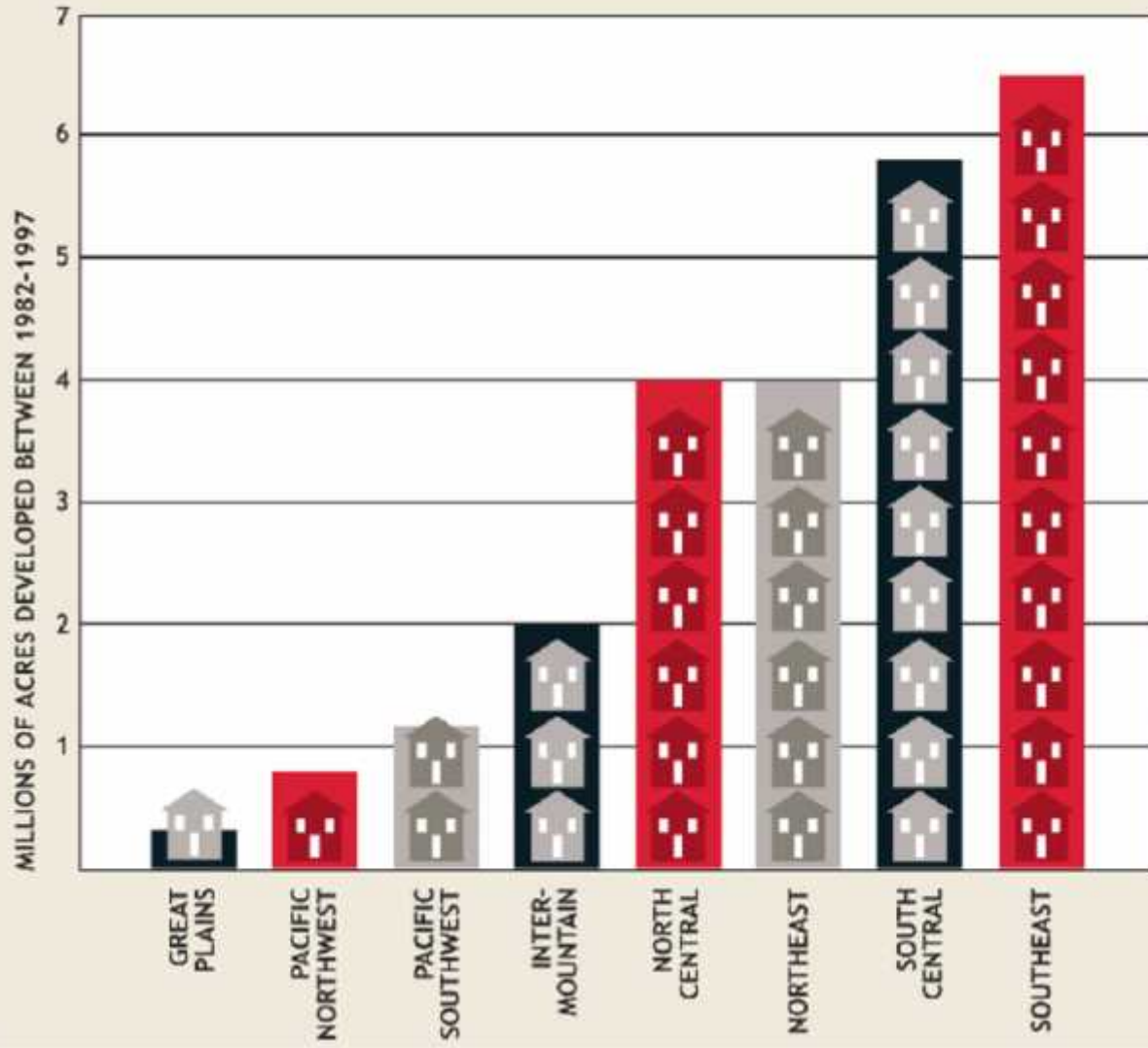
# Farm Program Payments Can Reduce Forest Area (slide from Brent Sohngen)



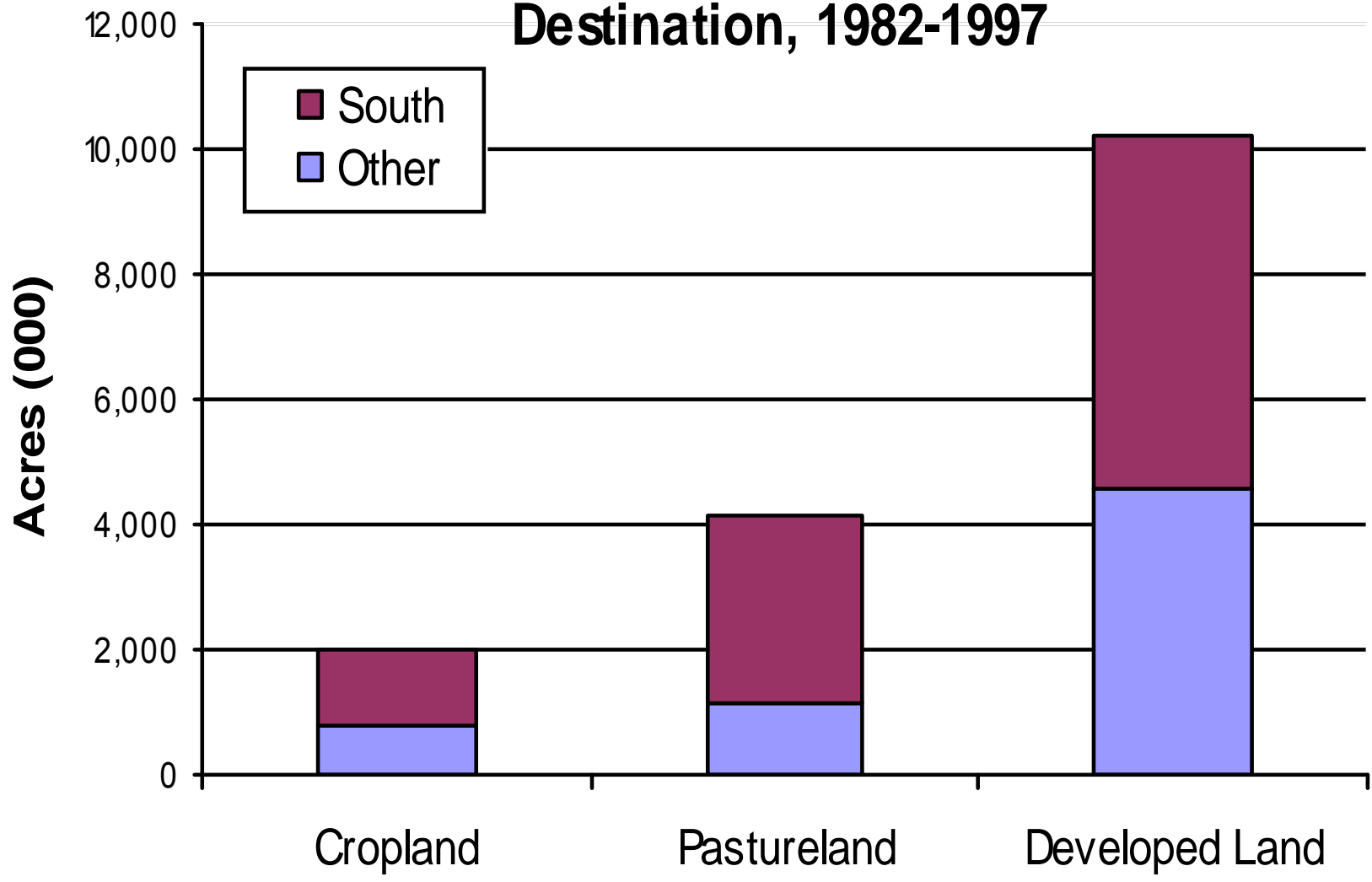
# Intersections in the South

- Region has large amount of timber harvests
- Has many acres suitable for use in either agriculture or forestry
- Had relatively large increase in developed area in recent decades
- Implications for production possibilities

## REGIONAL TRENDS



# Forest Area Conversion by Region and Destination, 1982-1997



# Demand for land: examples

- World demand for agricultural commodities
- Green revolution in agriculture and land sparing effects for forestry
- Growing population
- Technological improvements, productivity increases
- Fewer people per household

# Forest Transitions

- Naturally-regenerated forests converted to planted forests, with more capital into forest sector
- More planted forests mean less timber supply and values for natural forests dropping if one considers timber-based values
- Will other capital flow into sector for non-timber uses of forests, such as GHG goals, biodiversity, etc; e.g., conservation easements

# Biofuels Discussion on Wednesday at the Forum

- “How land is used is the big environmental issue”
- “Many choices ahead of society”



# GHG Implications of Deforestation

- 22 million acres deforested between 1982 and 1997, equal to amount of forests in State of Washington
- Tens of millions tons of carbon released annually

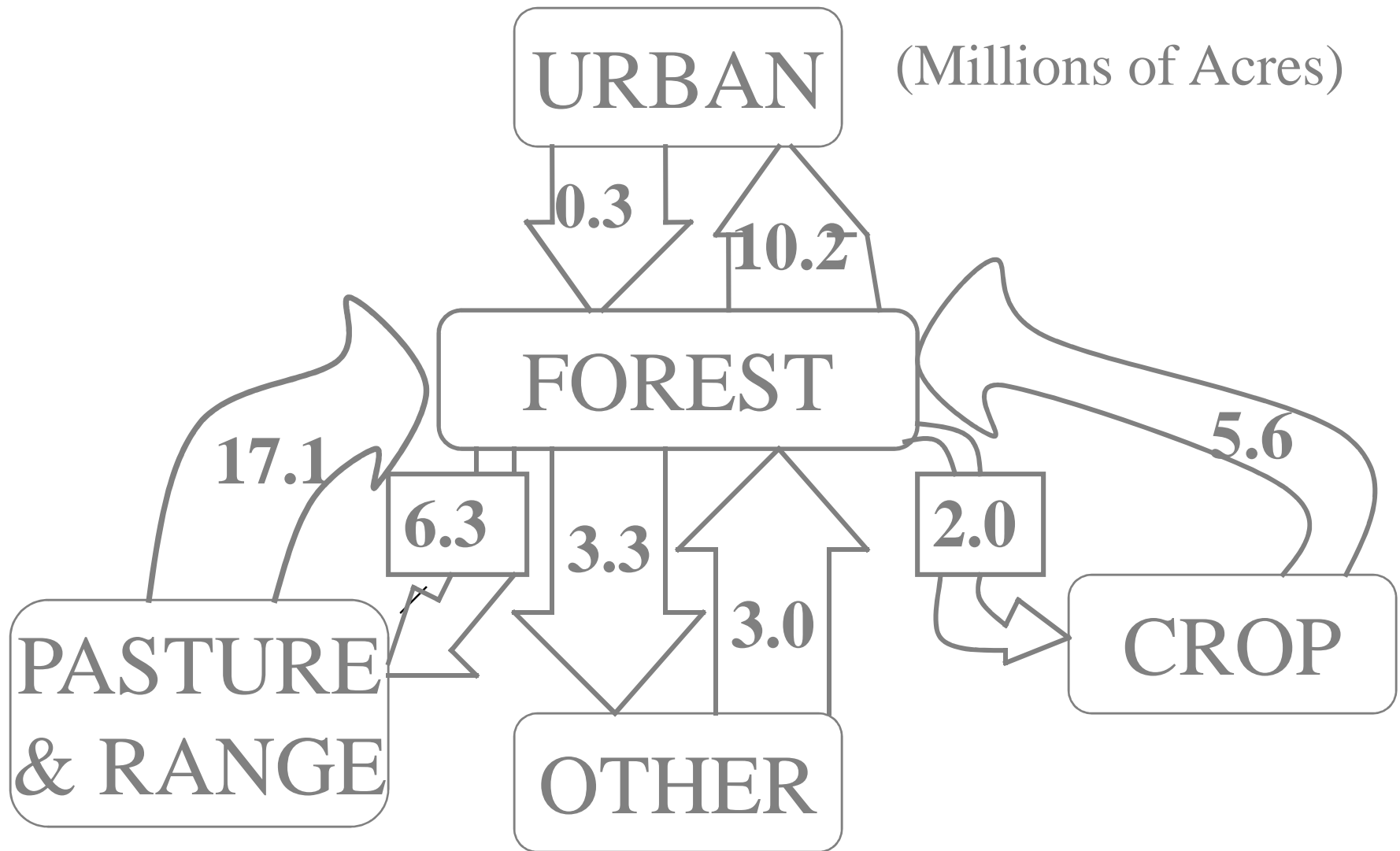
# LAND VALUES: Hierarchy

- DEVELOPED USE
- AG CROPLAND
- FOREST AND PASTURE

# Socio-Economic Drivers

- \*World population to grow from six to nine billion
- \*National population to grow by 120 million people by 2050, ~ 40%, with increased average personal incomes

# Sources and Sinks of U.S. Forestland, 1982-1997



Source: USDA NRCS, NRI

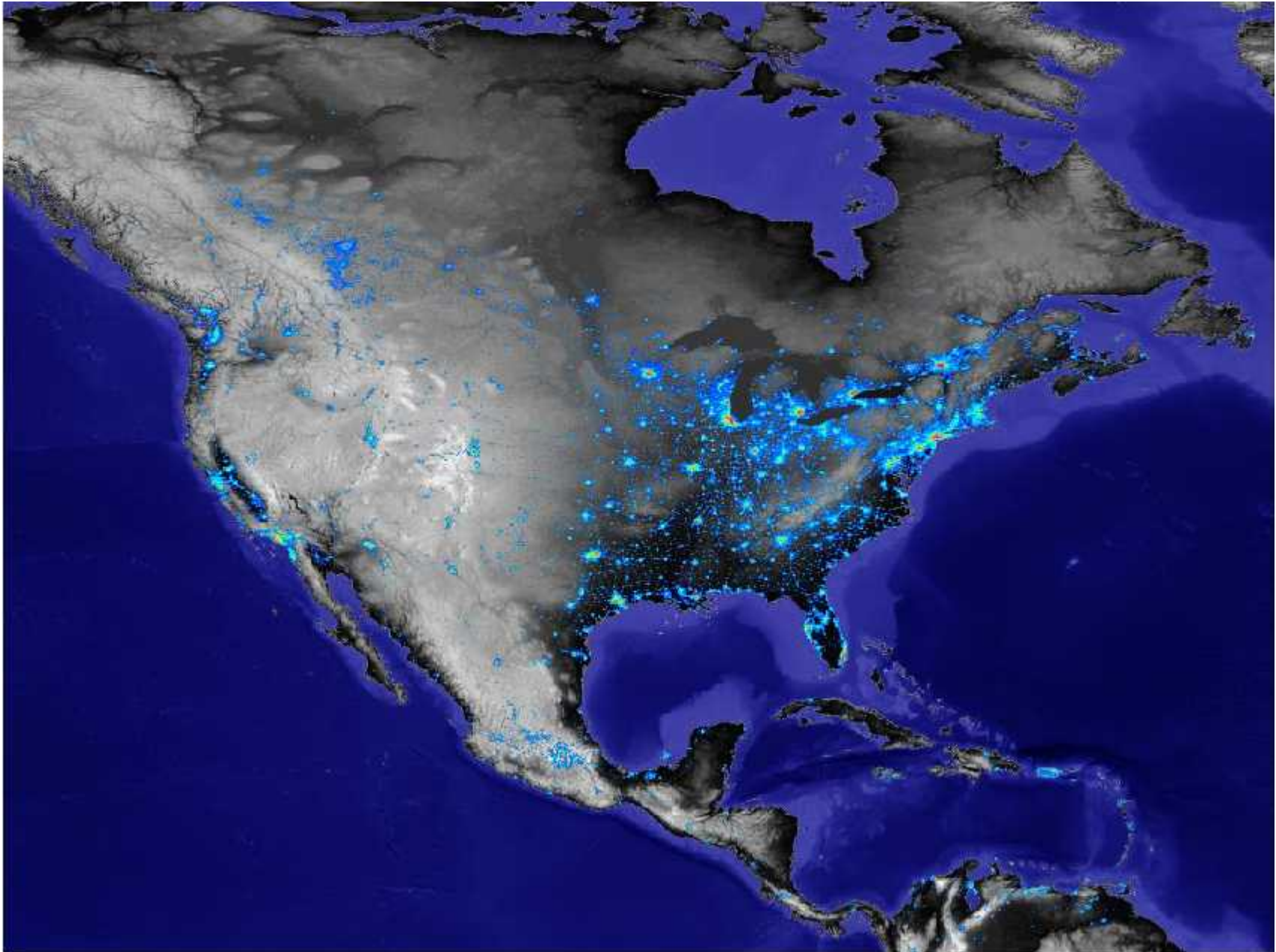
# Examples of earlier studies--regional

- Gravity index that is directly proportional to the population of a city and inversely proportional to the square of the distance between the city and the specific location of interest
- Individual gravity index represented the three cities with the most influence
- 95 cities in the PNWW region with a population greater than 5,000 (Kline and Alig, PNW)

# U.S. Econometric Model

- Ruben Lubowski's PhD work at Harvard
- Collaboration with Andrew Plantinga, Oregon State University
- Application in the 2010 Resources Planning Act Assessment: Projections of land use change at a county-level

# Night Lights



# DEFORESTATION SIMULATIONS USING FASOM-GHG MODEL

- FASOM-GHG MODEL DISCUSSED BY BRUCE MCCARL AND OTHERS IN OTHER FORUM SESSIONS
- SIMULATIONS BY BRUCE MCCARL (in progress)
- Funding assistance by EPA



## **Collaborators**

**Darius Adams, Oregon State**  
**Gerald Cornforth, TAMU**  
**Brian Murray, RTI**  
**Chi-Chung Chen, TAMU, NTU**

**Bruce McCarl, Texas A&M**  
**Greg Latta, Oregon State**  
**Dhazn Gillig, TAMU**

**Mahmood El-Halwagi, TAMU**  
**Ben DeAngelo, EPA**  
**Steve Rose, EPA**  
**Ron Sands, PNNL, Maryland**  
**Thien Muang, TAMU**  
**Michael Shelby, EPA**

**Uwe Schneider, University of Hamburg**  
**Ken Andrasko, EPA**  
**Francisco Delachesnaye, EPA**  
**Heng-Chi Lee, Taiwan**  
**Kenneth Szulczyk, TAMU**

## **Sources of Support**

**USDA Forest Service**  
**USEPA**

# Exogenous amounts of Deforestation TO DEV in the Base Case

- Average exogenous loss of forest area to developed uses is more than 6 million acres per decade
- Total over 100 years is 60+ million acres
- Largest losses are in the South and NE

# “Avoiding” Scenarios: FOREST TO DEV

- 1/2 BASE amount
- 2X BASE amount
- No loss to developed uses

# Responses by Agricultural Sector

- BASE FOREST  $\leftrightarrow$  AG land transfers with FOREST to DEV scenario
- Unconstrained FOREST  $\leftrightarrow$  AG land transfers in response to FOREST to DEV exogenous amount
- No land transfers between forestry and agricultural sectors

# Responses

- Land allocation between forestry and agriculture
- Land management within a sector
- Changes within processing portions of sectors

## NO Deforestation to DEV Amount of Base Case—AG Response

- One half the loss of timberland area TO DEV in the base case, in each period and for each region
- Agriculture-forestry adjustment allowed, such as other forest land converted to ag. in response to lower forestland value prices
- Leakage?

# PATHWAYS IN DEFORESTATION MODELING— FULL AG RESPONSE ALLOWED WHEN NO PROJECTED FOREST TO DEV

LAND USE	<i>FOREST</i>	<i>AG</i>	<i>DEVELOPED</i>
<i>FOREST</i>	ENDOGENOUS (E.G.. MANAGEMENT T INTENSIFIC.)	ENDOGENOUS	EXOGENOUS AMOUNTS ELIMINATED
<i>AG</i>	ENDOGENOUS	ENDOGENOUS (E.G.. MANAGEMENT INTENSIFIC.)	EXOGENOUS AMOUNTS IN PLACE
<i>DEVELOPED</i>	<b>ASSUMED TO BE INSIGNIFICANT</b>	<b>ASSUMED TO BE INSIGNIFICANT</b>	EXOGENOUS

# Summary

- U.S. deforestation in recent decades has been substantial, and rate has accelerated
- **Increasing opportunity costs for keeping land in forest cover**
- Further baseline projected forest carbon storage loss is substantial, due to more than 60 million acres projected to be deforested over the next 100 years

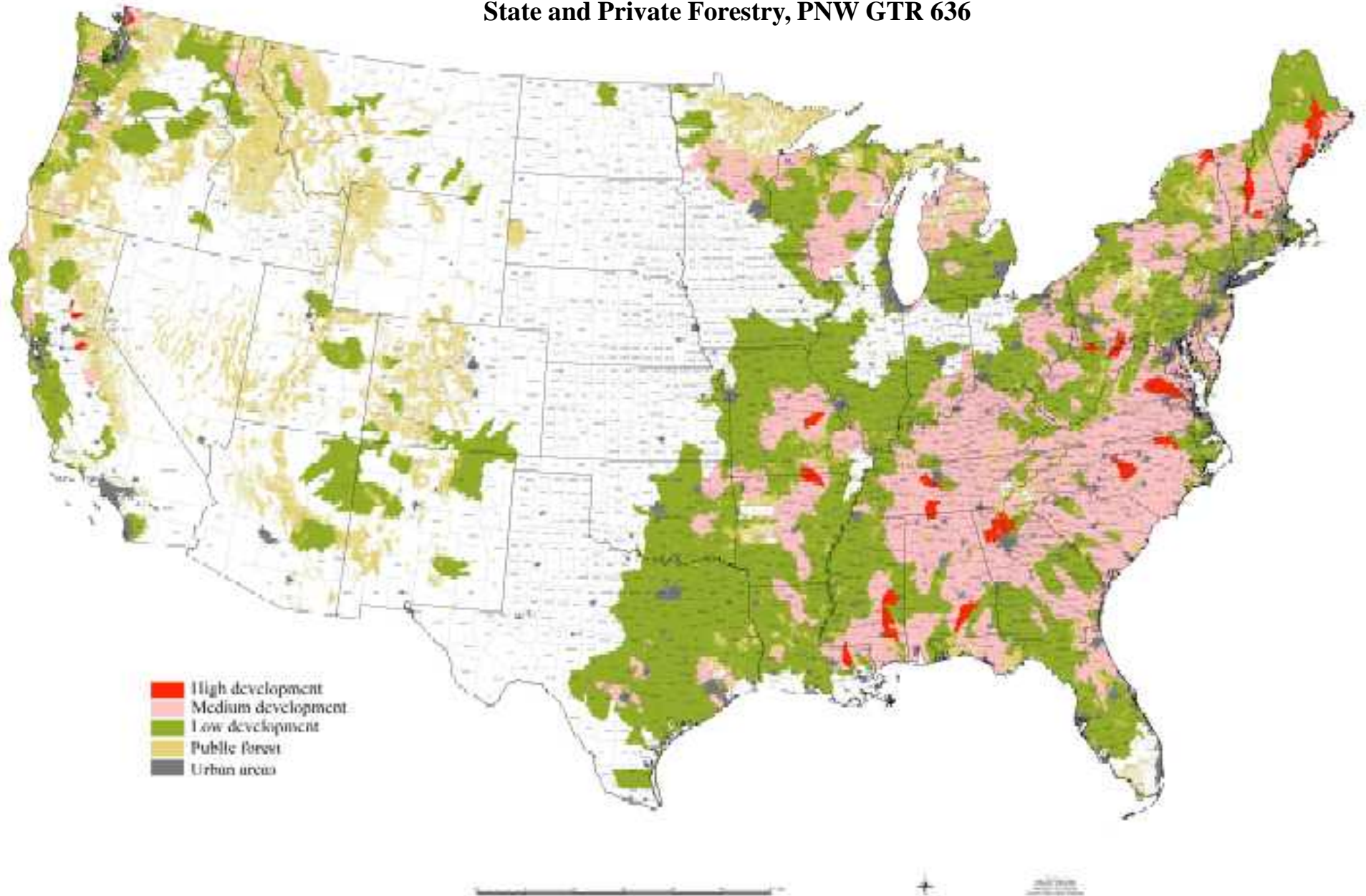


# Other Implications

- Forest Fragmentation: continuous forests are divided into smaller pieces--by roads, clearing for agriculture, urbanization, or other human land uses
- Habitat fragmentation, edge effects, increase in wildland/urban interface, loss of ecosystem services, invasive species pathways
- Parcelization: forest ownership tract is divided into smaller ownership tracts

# Forests on the Edge

## State and Private Forestry, PNW GTR 636



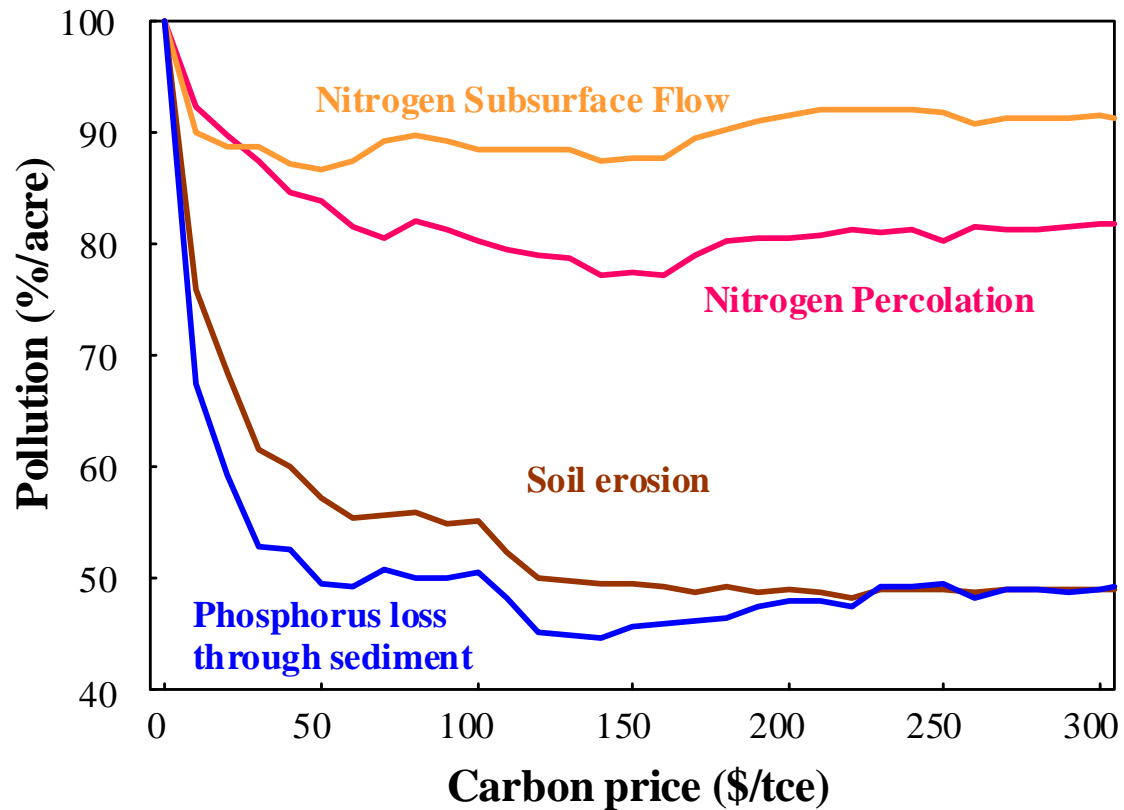
# Land Conservation Problems Ahead?

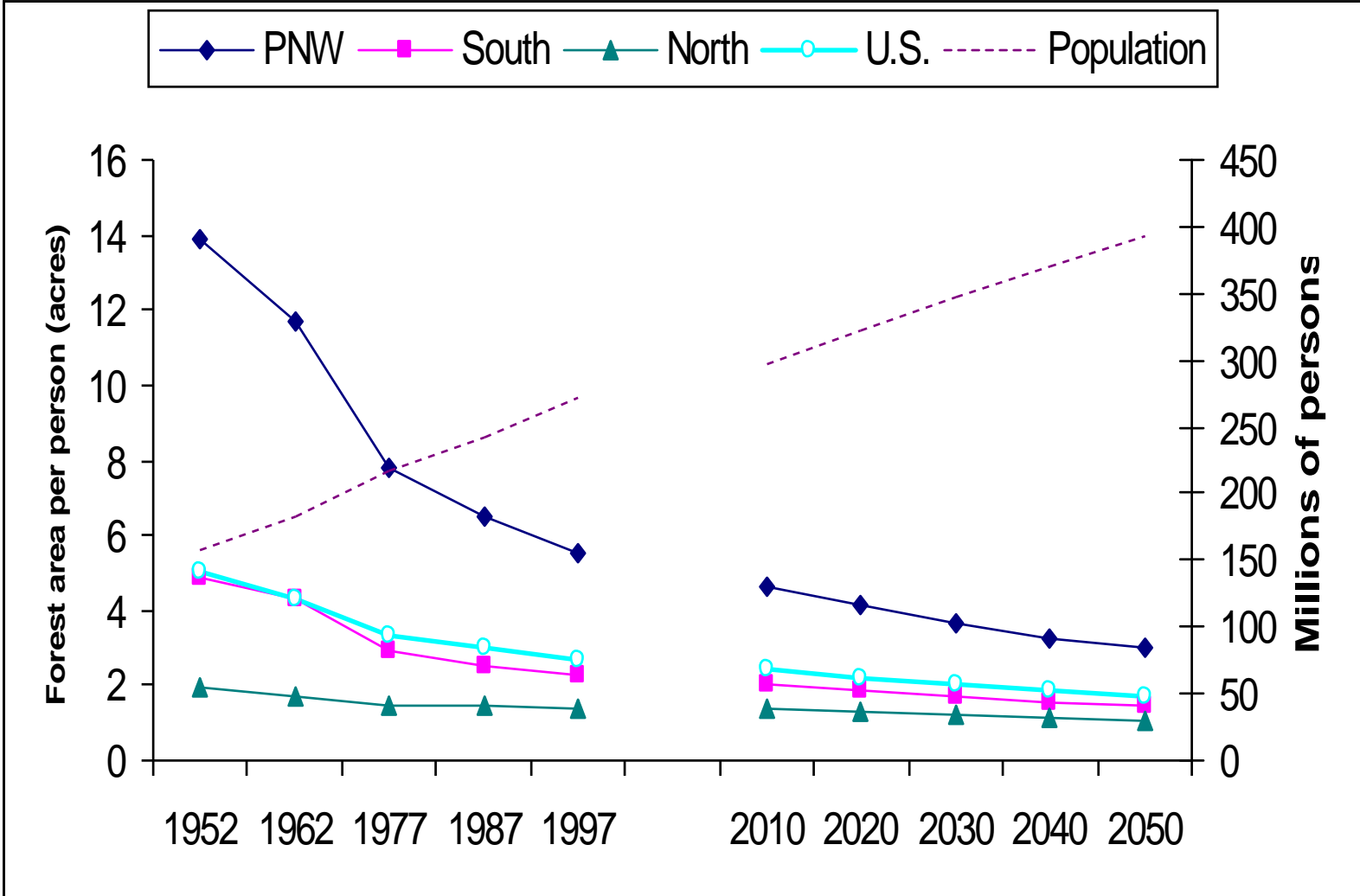
- Acceleration in developed area expansion
- Increased Demands for Land, Including Biofuels Production
- Increasing Opportunity Costs for Land Conservation
- Substantial deforestation projected
- Implications not only for wildlife, but for traditional land uses (e.g., farming, forestry) and recreation (e.g., hunting, fishing)



# Biofuels and Coeffects: Water and Land Conditions (Bruce's slide)

## Multi-environmental Impacts





# Low-density housing development

- Significant amount of low-density development has been part of the expansion in developed area
- Rural residential lots, while fewer in number than urban lots, tend to be larger, averaging nearly 3 acres per household, compared with less than a half acre for urban lots
- Forty-four million acres, 60 percent of all rural residential lands, are in the largest lot-size category, over 10 acres

# Data Needs

- As discussed several times at the Forum this week, large need is for NRI data for 1997+
- Fate of acres (and associated carbon) converted to developed uses
- Co-effects



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Forest Service

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# COOPERATING ACROSS BOUNDARIES

PARTNERSHIPS TO CONSERVE  
OPEN SPACE IN RURAL AMERICA





# More Info Regarding Forest Service's Open Space Initiative

- <http://www.fs.fed.us/openspace/>

# Wildland-urban interface (WUI)

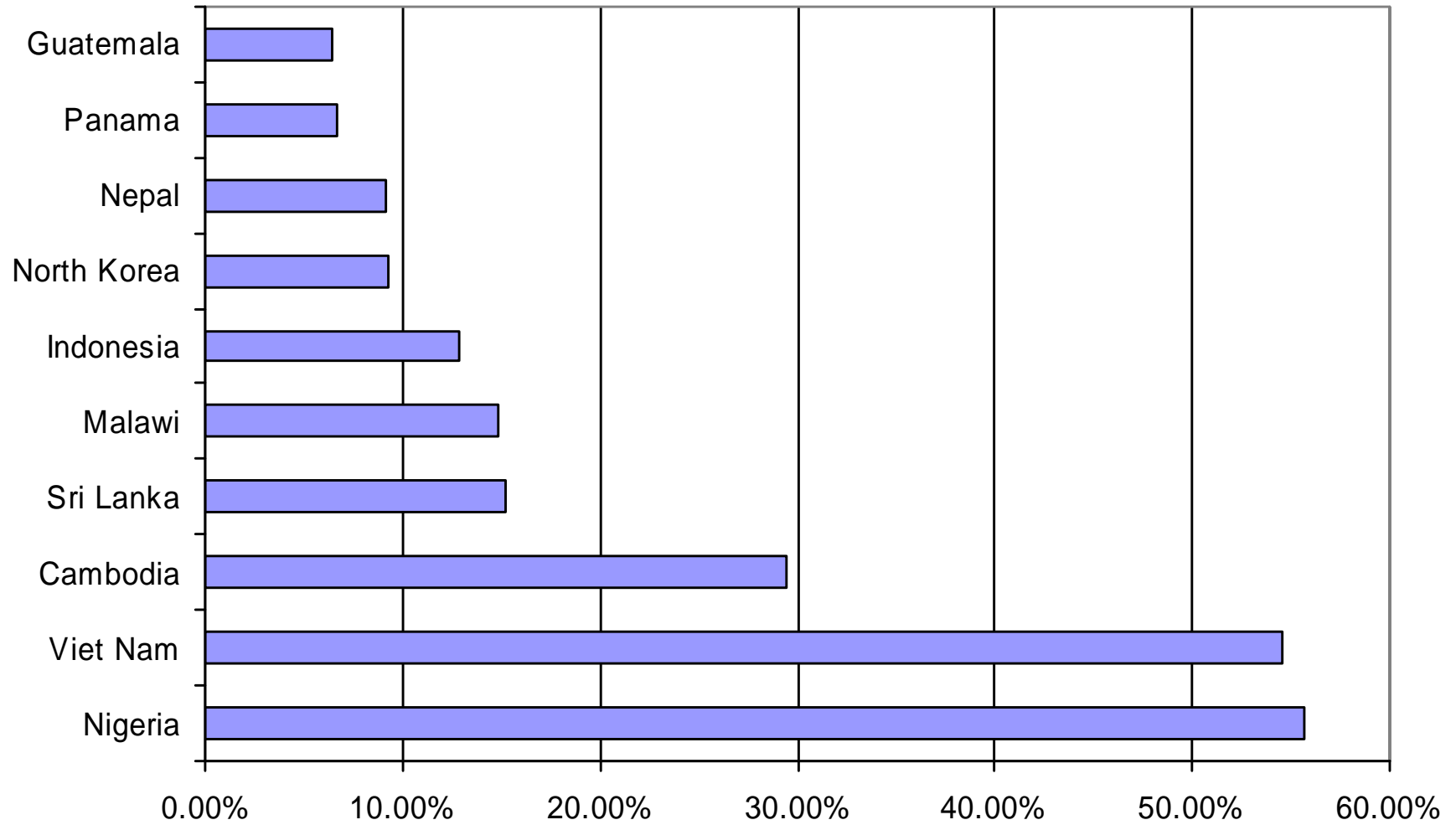
Across the U.S., the 1990s was a period of rapid housing growth, with a net gain of 13.5 million housing units, a rate of 13% growth.

- The WUI was a preferred setting for new housing. Nationwide, more than 60% of housing units built in the 1990s were constructed in or near wildland vegetation.

## Complementary and Strategic Opportunities Concerning Land Conservation Policies

- National: USDA Forest Legacy; next Farm Bill; climate change and energy security; endangered species act
- State: Oregon's Land Use Law and Measure 37
- Local: Boulder's urban containment policy, and open space/habitat protection
- NGO Land Trusts

## Top Ten World Deforestation Rates 2000-2005



# Avoiding Deforestation: Challenges

- How to get the incentives right to slow or stop deforestation
- Market mechanisms and beyond: zoning, regulations, etc., e.g., Oregon's land use law
- Mix of FOREST to DEV and FOREST to AG deforestation differs across countries

# What's Next Concerning Land Conservation Analyses



- 2010 RPA Assessment of Forest and Range Lands
- Multiple resource assessments, including wildlife, outdoor recreation, water, and climate change
- Population trends in wildlife species, and future conservation of biological diversity
- [www.fs.fed.us/pl/rpa](http://www.fs.fed.us/pl/rpa)