Land, Agricultural and Energy Barriers – Opportunities to Increase Production in the East

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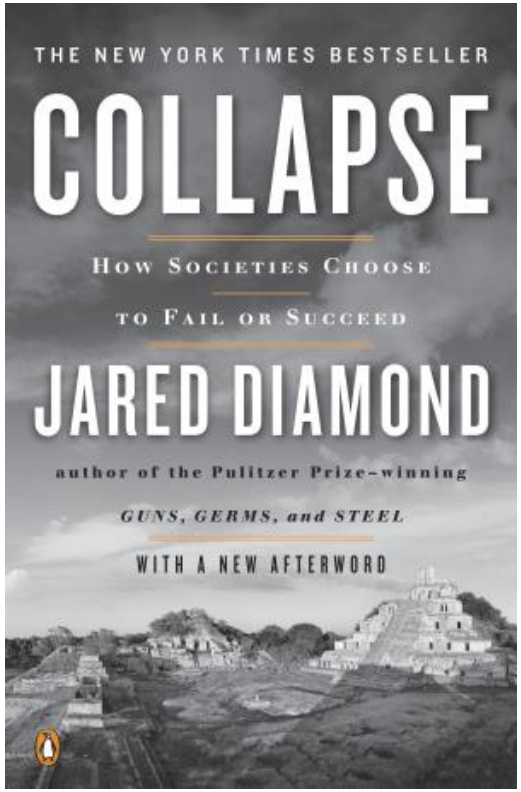
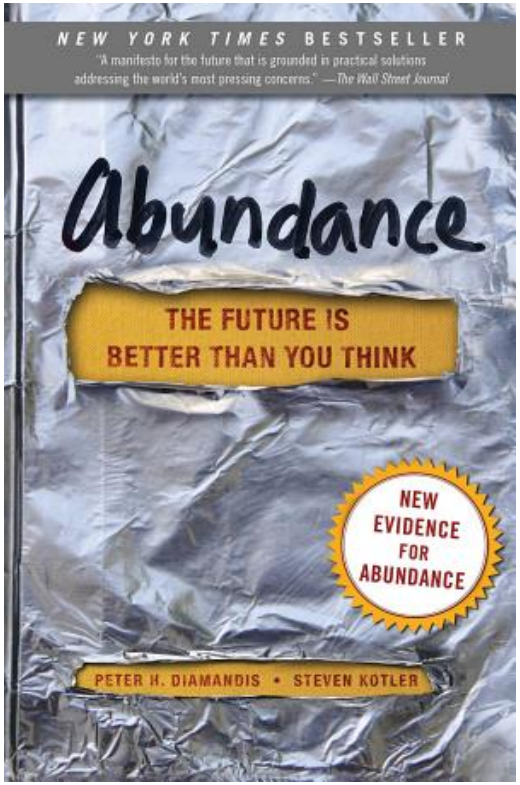
Books on My Shelf

Collapse (Jerrod Diamond)
Abundance (Diamandis & Kolter)





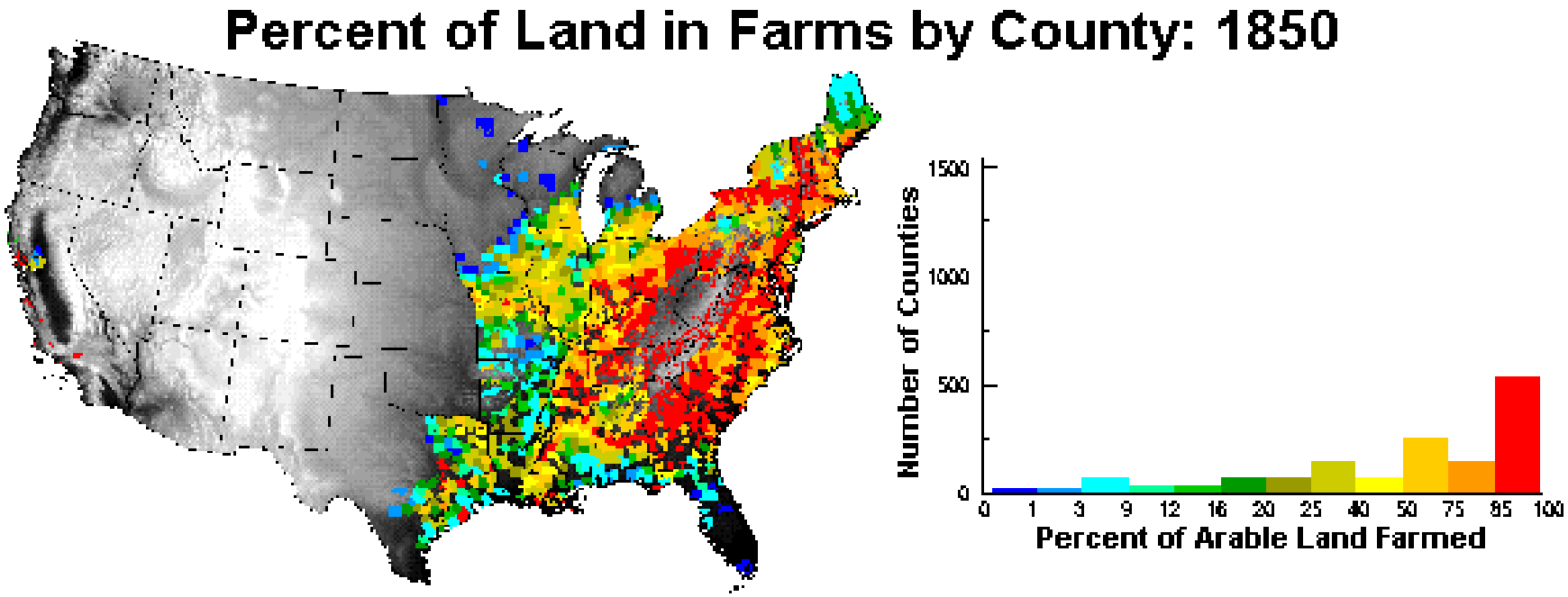
Food Security in the US

- Migration of Agriculture within the US is an alternative to importing food
- In 2015, nearly 1 million acres in CA were fallow, costing $2.7 billion to the economy and 18k jobs lost
- CA farmers are moving to Mexico
- Western Grower's survey (2014) found that 27 members had over 110,000 acres of vegetable production in Mexico employing 23,500 workers
- Reason? Labor, water and regulations!
- 75% of US consumed tomato's originate in Mexico

Source: http://www.capitalpress.com/Nation_World/Nation/20150618/some-worry-as-more-production-moves-outside-us

Introduction

- In 1850, eastern agriculture was very diverse
- Every farmer has a garden
- Midwest and west was unsettled
- Water and rail transportations systems being developed



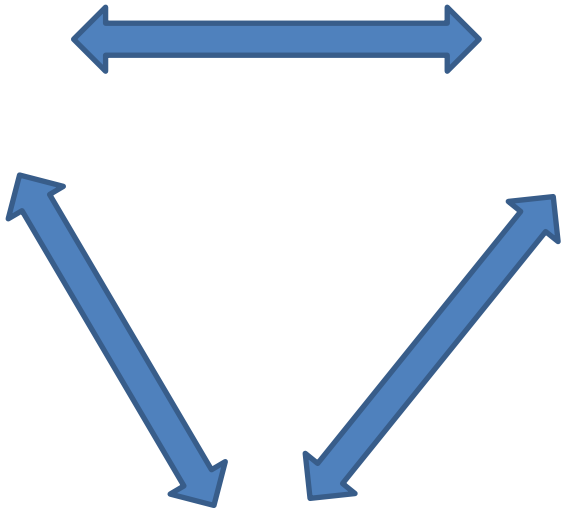
Southern and Eastern Resources

Food Energy Water Nexus

- Should food production migrate to the east?
- Is there sufficient land to increase production?
- How do we better utilize eastern timber resources for energy?
- What are the opportunities and barriers?
- What policies need to be developed?

Characteristics of East and Southeast

Food
Large poultry industry
Concentration of hogs in NC
Ship cattle to Midwest feedlots
Corn and soybean deficit states
Limited adoption of irrigation
Wide variety of crops

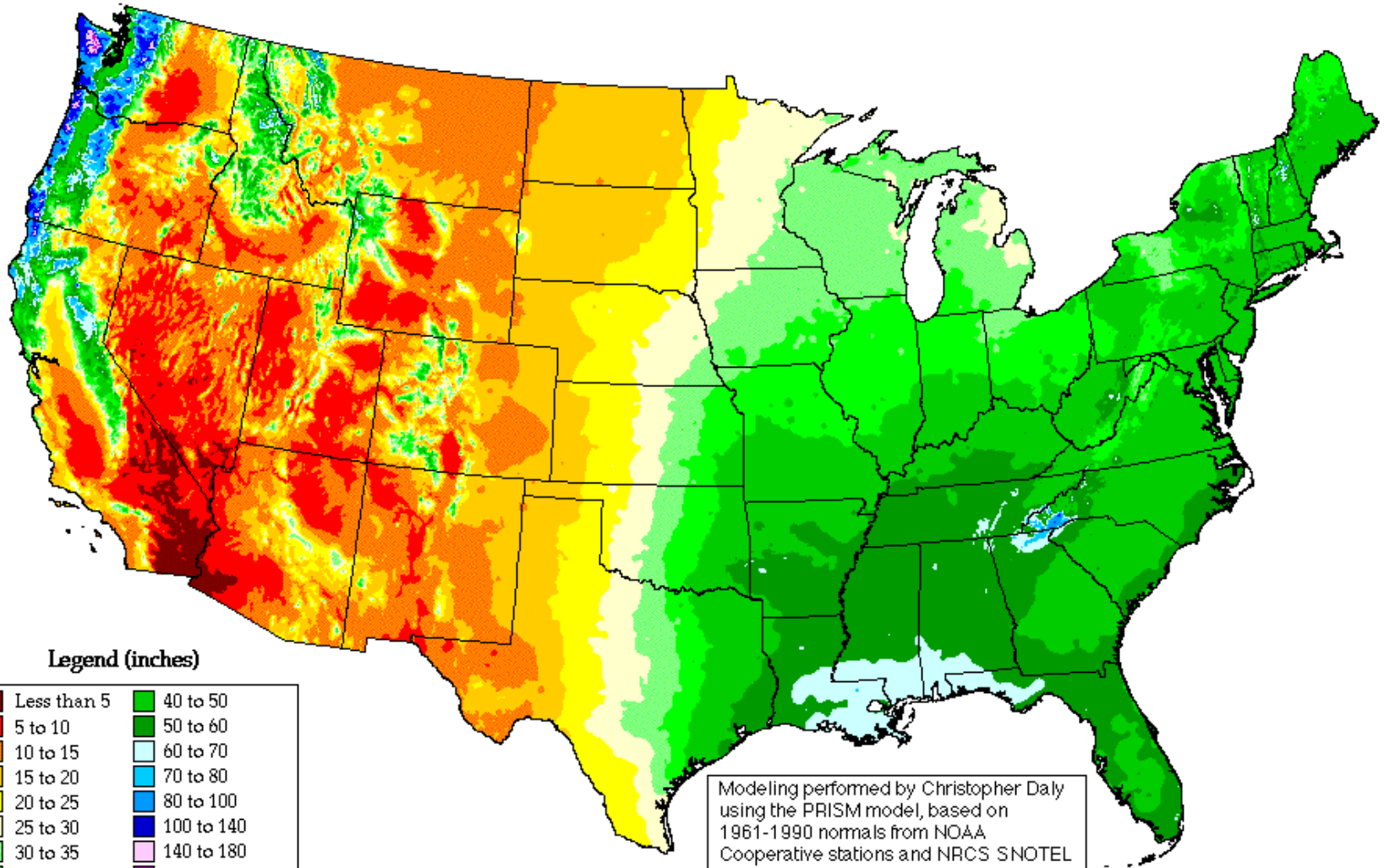


Energy
Established timber industry
Oil Refinery infrastructure
Close to population centers

Water
Sufficient precipitation
Distribution not uniform or predictable
Influenced by El Nino and La Nina
Large rainfall events creating high runoff
Limited surface water storage

Annual Average Precipitation

United States of America



Legend (inches)

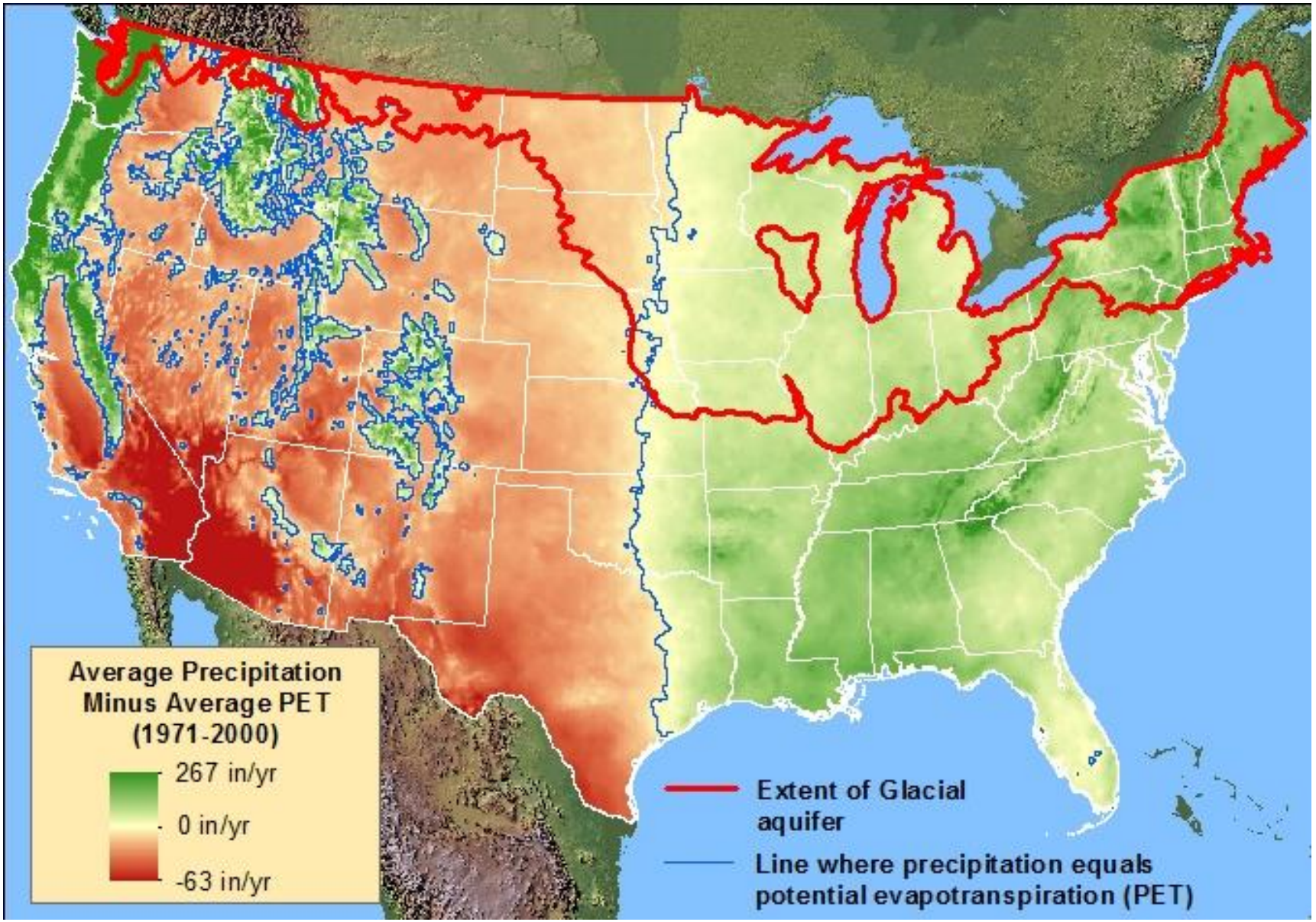
Less than 5	40 to 50
5 to 10	50 to 60
10 to 15	60 to 70
15 to 20	70 to 80
20 to 25	80 to 100
25 to 30	100 to 140
30 to 35	140 to 180
35 to 40	More than 180

Period: 1961-1990

Modeling performed by Christopher Daly using the PRISM model, based on 1961-1990 normals from NOAA Cooperative stations and NRCS SNOTEL sites. Sponsored by USDA-NRCS Water and Climate Center, Portland, Oregon.

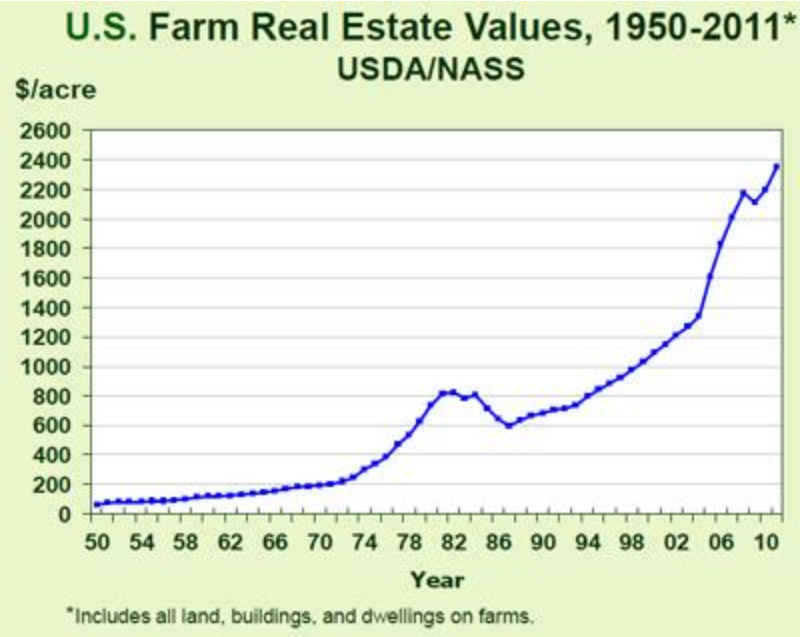
Oregon Climate Service
George Taylor, State Climatologist
(541) 737-5705

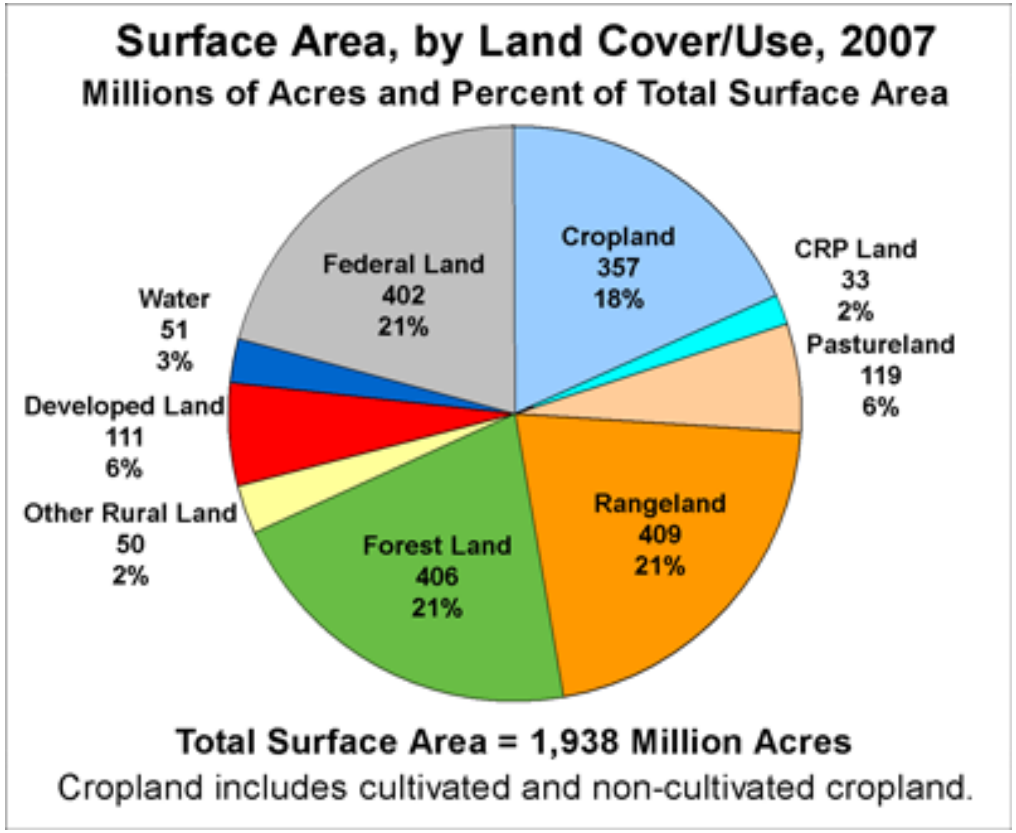
Average Annual Precipitation – Potential Evapotranspiration



Farmland Characteristics

- 2.3 Billion acres in US
- 18% is cropland
- 40%-50% of US farmland is rented [1]
- Financial firms (REITS) own 1% of farmland, trend is increasing
- Within 20 years, 400 m acres will be up for sale

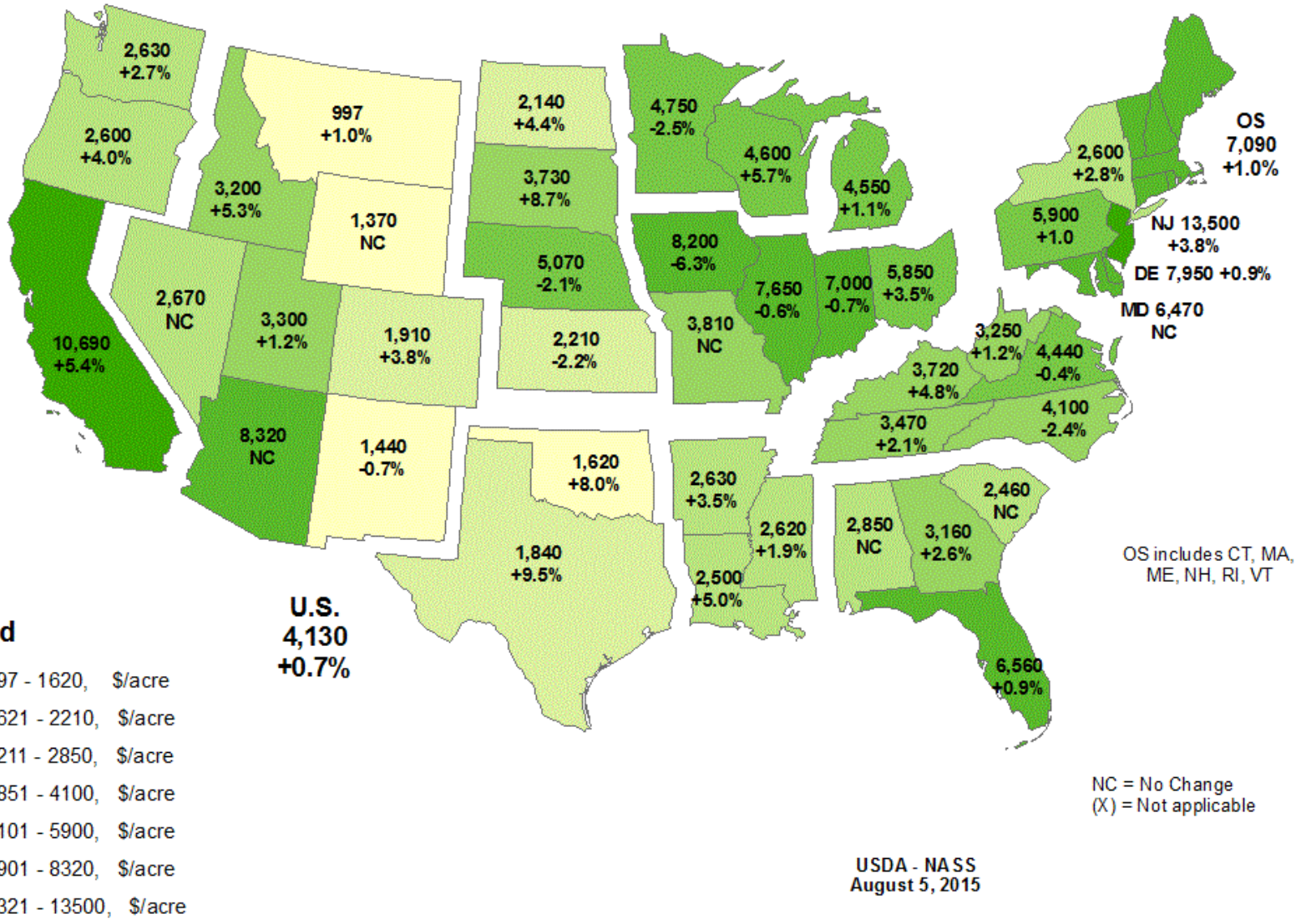




[1]Source: Mother Jones, March 14, 2014

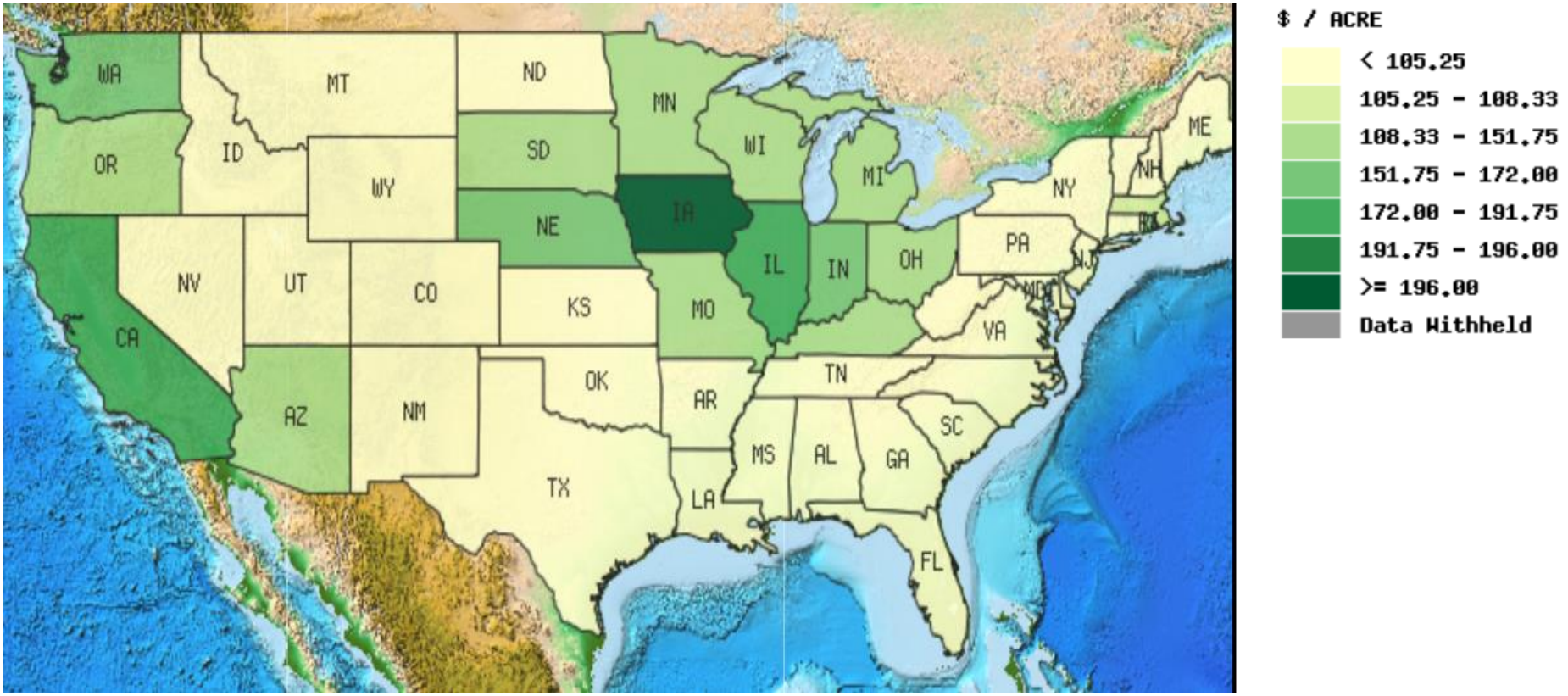
2015 Cropland Value by State

Dollars per Acre and Percent Change from 2014



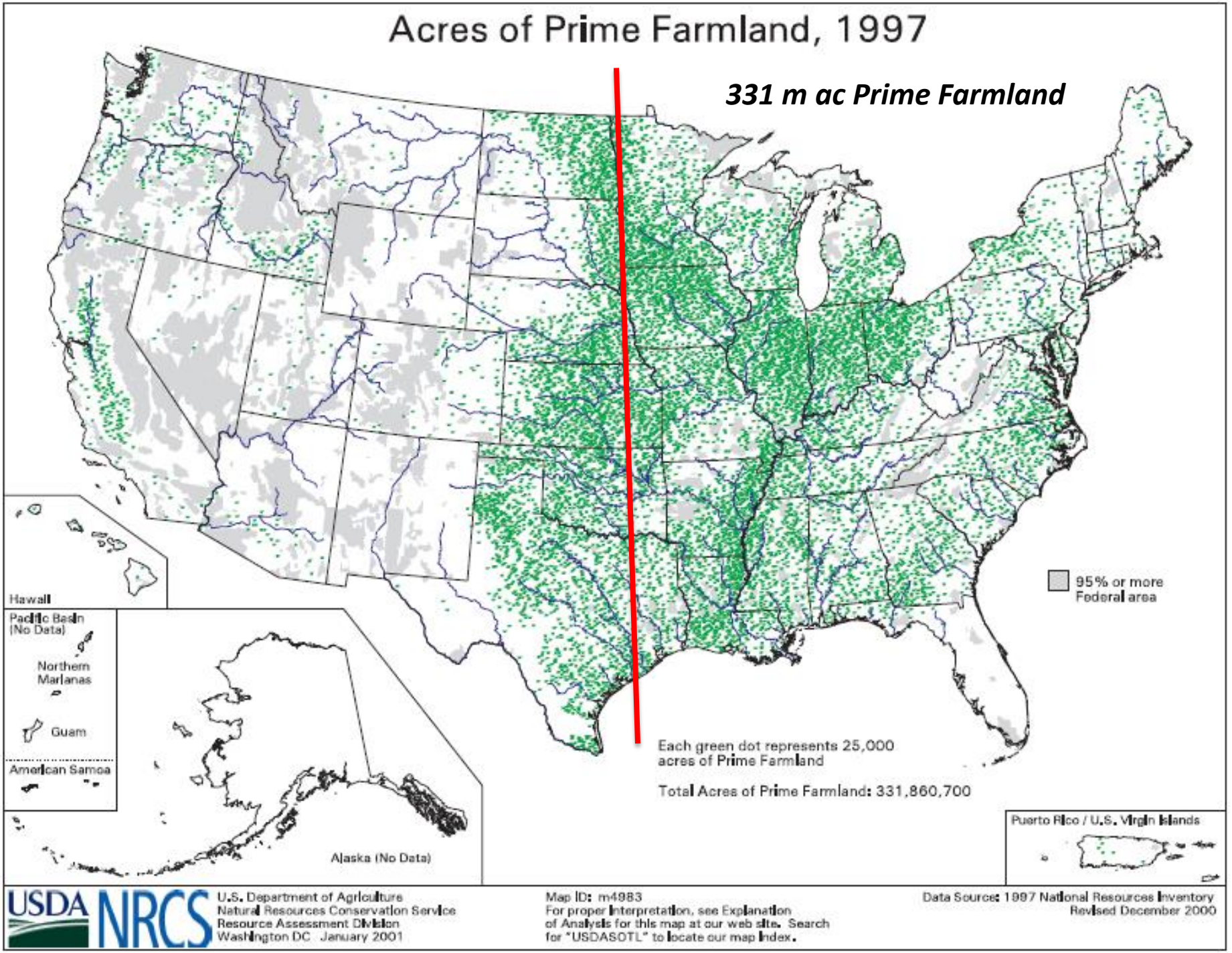
Source: http://www.nass.usda.gov/Charts_and_Maps/Land_Values_and_Cash_Rents/crop_value_map.asp

Average Cash Rent for Farmland in 2014

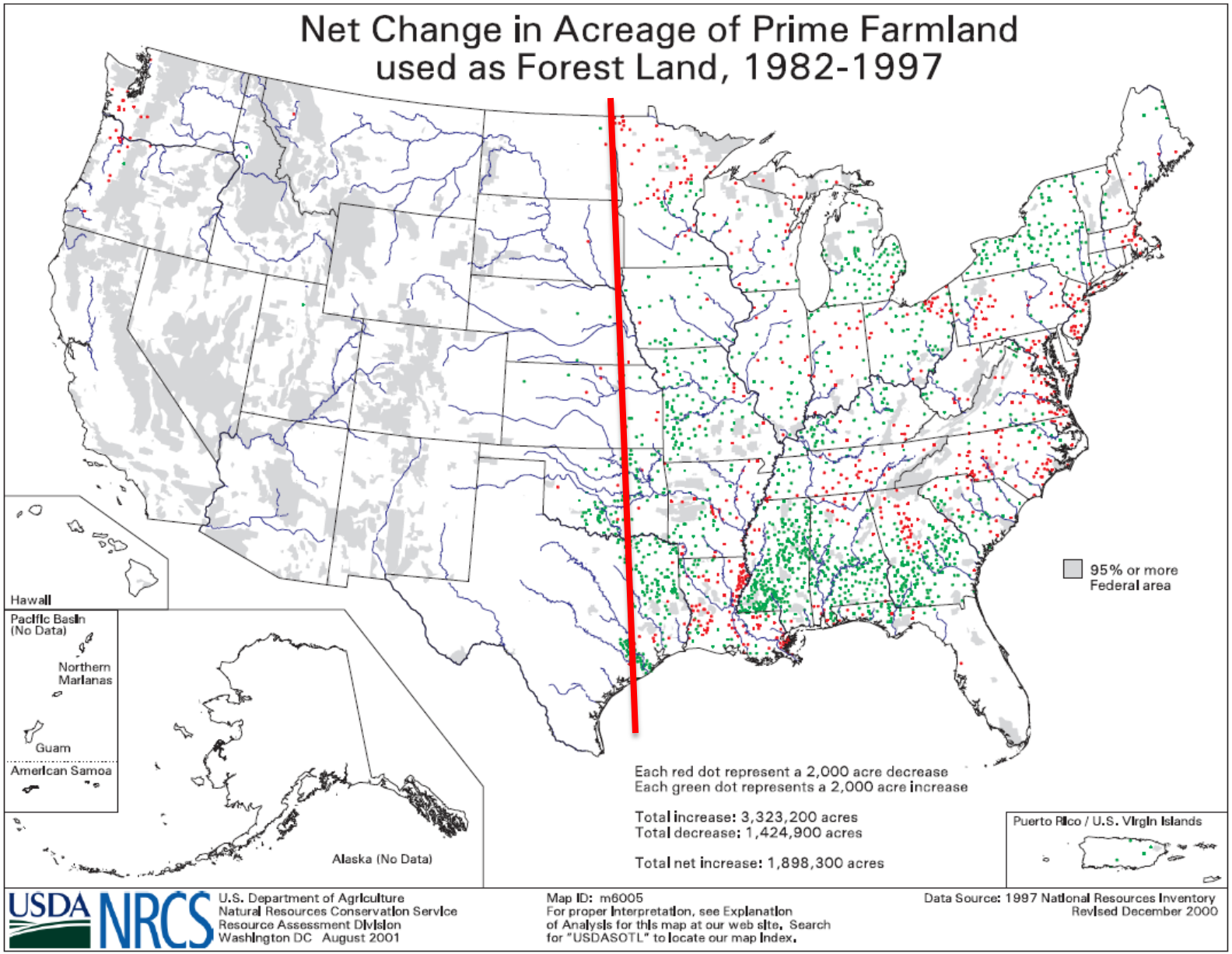


Rent in the SE-US is ½ that of the Midwest and California

Source: http://quickstats.nass.usda.gov/data/maps/7878272B-A9F3-3BC2-960D-5F03B7DF4826

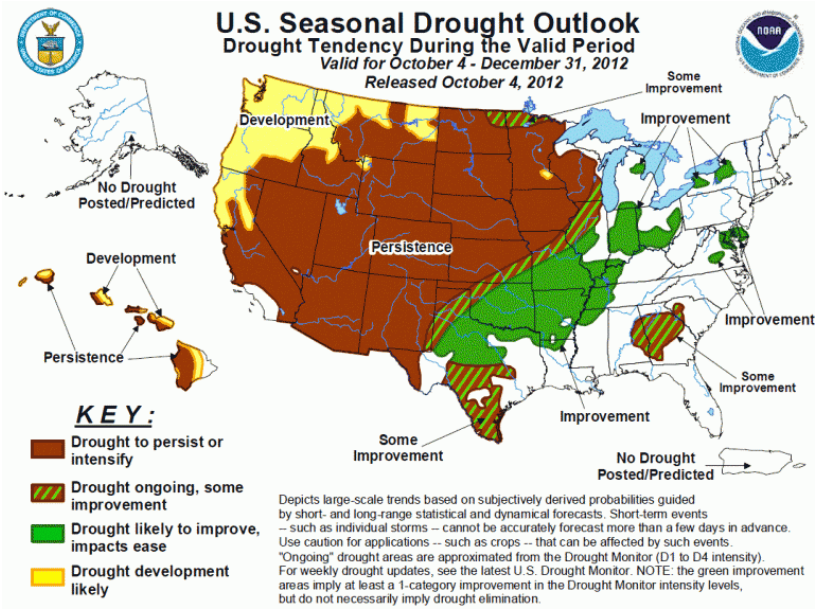

Acres of Prime Farmland, 1997
331 m ac Prime Farmland
95% or more Federal area
Each green dot represents 25,000 acres of Prime Farmland
Total Acres of Prime Farmland: 331,860,700
Hawaii
Pacific Basin (No Data)
Northern Marianas
Guam
American Samoa
Alaska (No Data)
Puerto Rico / U.S. Virgin Islands
USDA NRCS
U.S. Department of Agriculture
Natural Resources Conservation Service
Resource Assessment Division
Washington DC January 2001
Map ID: m4983
For proper interpretation, see Explanation of Analysis for this map at our web site. Search for "USDASOTL" to locate our map index.
Data Source: 1997 National Resources Inventory
Revised December 2000

Amount of Prime Farmland Recovered From Timber (1.8 m ac)

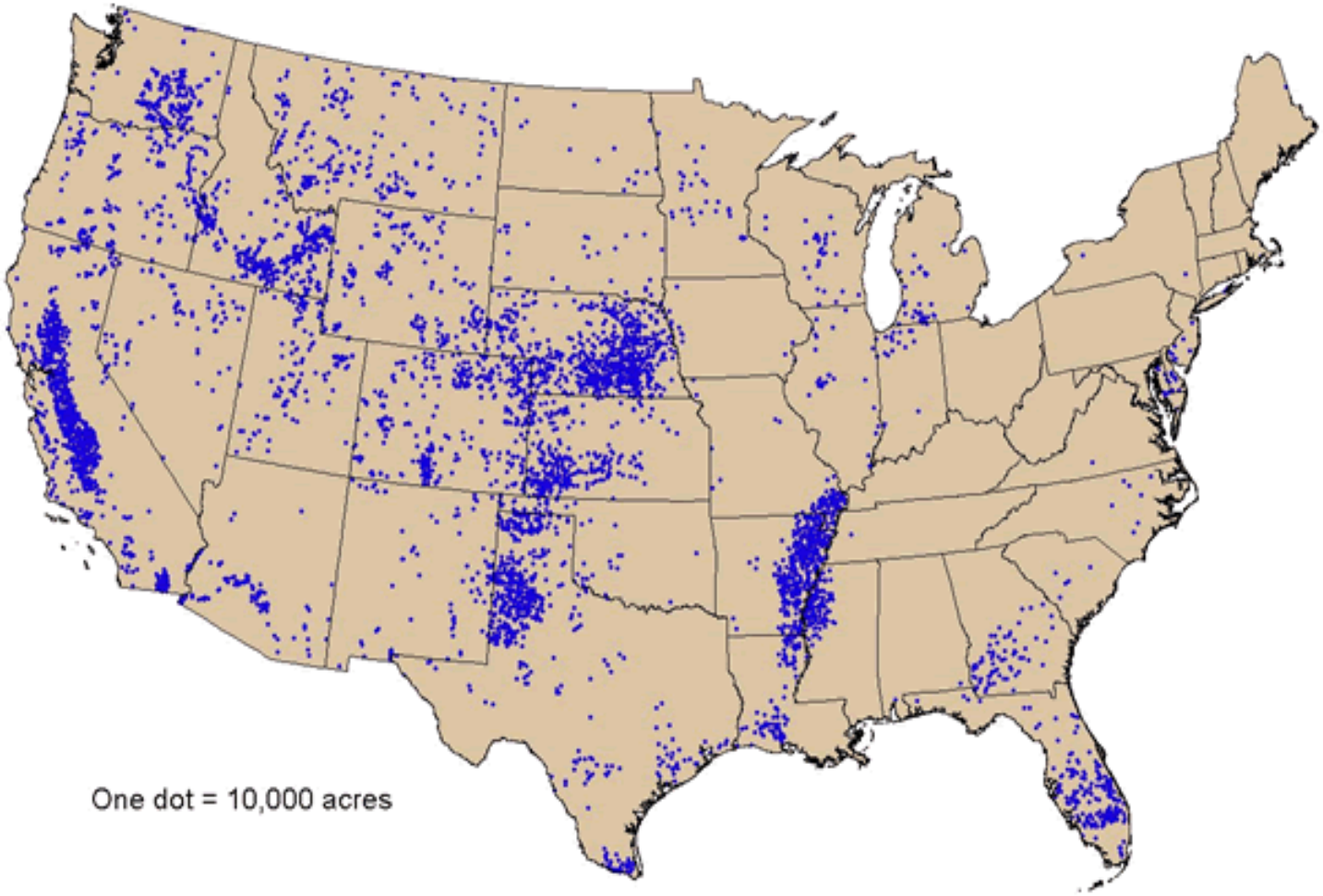


Timing of Water Can Be Limiting

- SE-US is primarily non-irrigated
- Rainfall is high, but not uniformly distributed
- April 29, 2014, 24” rainfall event on gulf coast
- Alabama runoff averages 29” each year
- 15% of all US surface water flows through Alabama

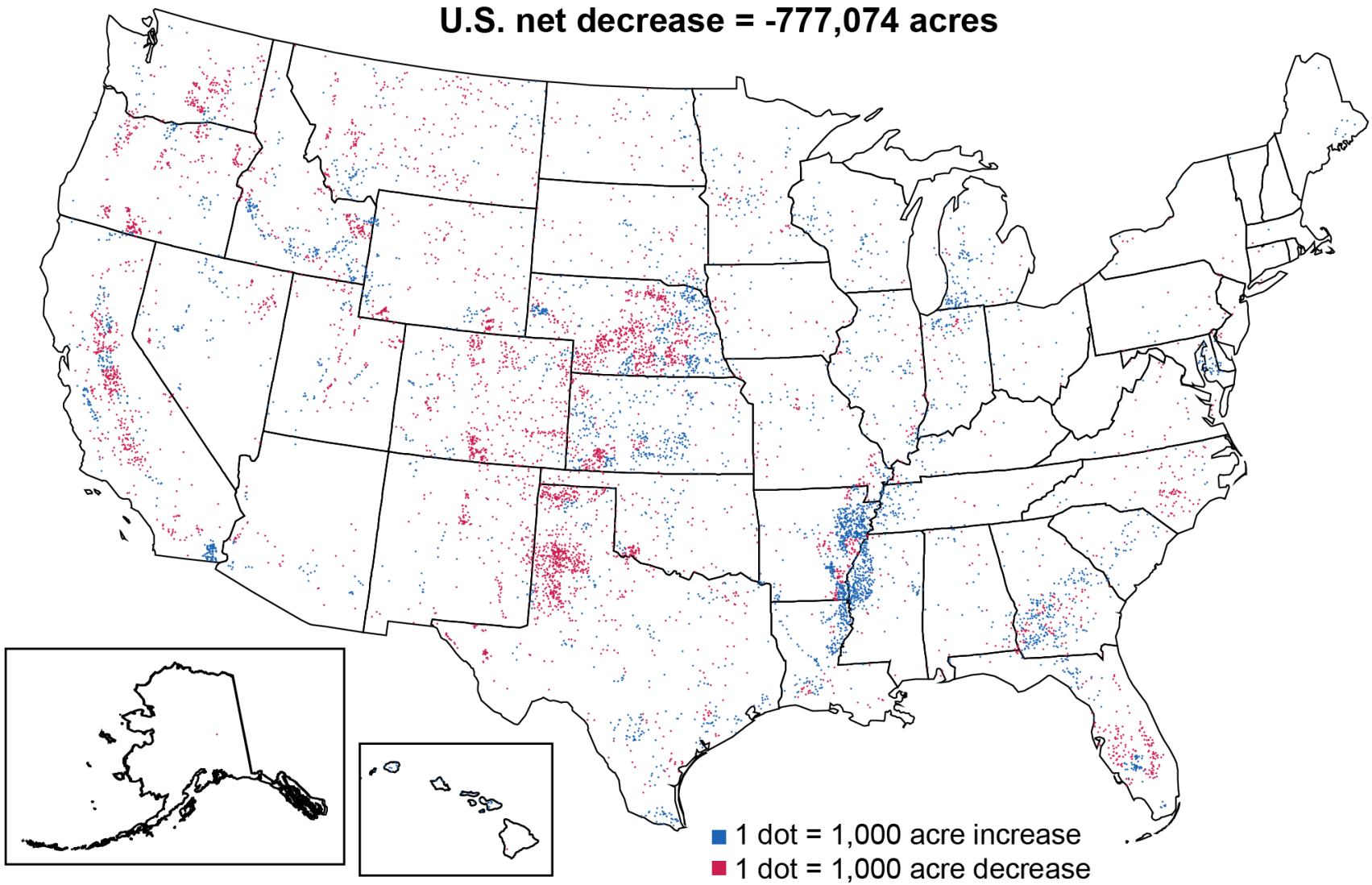


- 17% (55 million ac) of cropland was irrigated in 2012
- Irrigated farms accounted for 50% of crop sales
- Many farmers in the east are not using irrigation even though there is sufficient water



Source: ERS, based on USDA/NASS Census of Agriculture

Change in irrigated acreage, 2007-12



Source: USDA, National Agricultural Statistics Service, Map Atlases for the 2012 Census of Agriculture.

Irrigation is Needed

- Irrigation is needed for farmers in the SE-US to be competitive for some crops

- Irrigation is slowly being adopted in the SE-US

- Irrigated yields are competitive
  - Corn: 200-250 bu/ac
  - Soybean: 60-75 bu/ac
  - Peanuts: 5000-7000 lb/ac
  - Cotton: 2000-2500 lb/ac

- ***Policies needed to develop surface water systems***

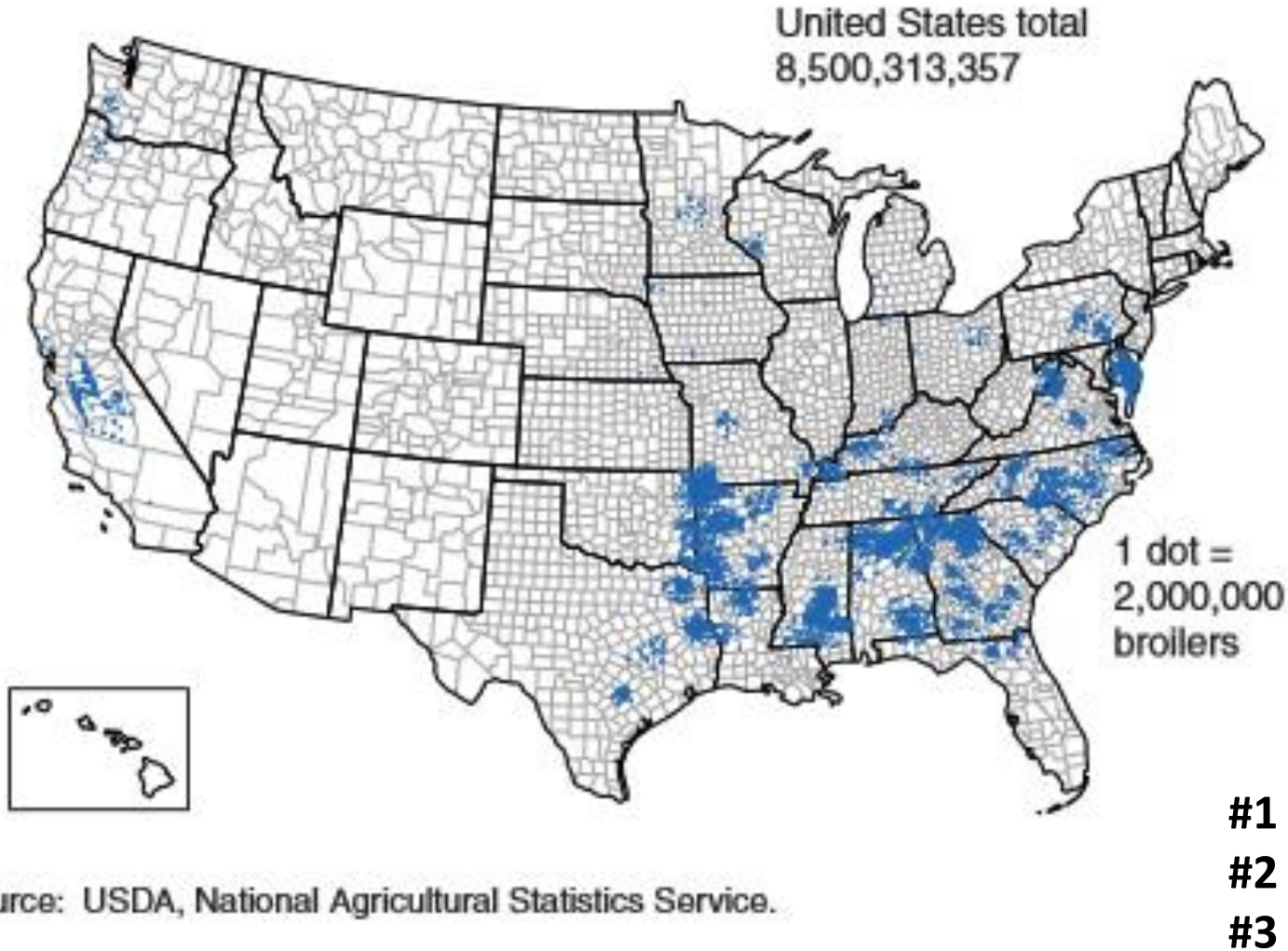
Barriers to Irrigation

- High level of rented land
- Non-operating owners own 77% of rented land[1]
- Landowners may not fund improvements
- Low aversion to risk
- Older farmers close to retirement
- Non-developed surface water storage
- Some urban/agricultural water competition emerging
- Low skill level of farm labor
- No policies to support transition
- Difficulty in constructing surface ponds (EPA)

[1]Trends in US Farmland Values and Ownership, USDA-ERS Bulletin 92, Feb. 2012.

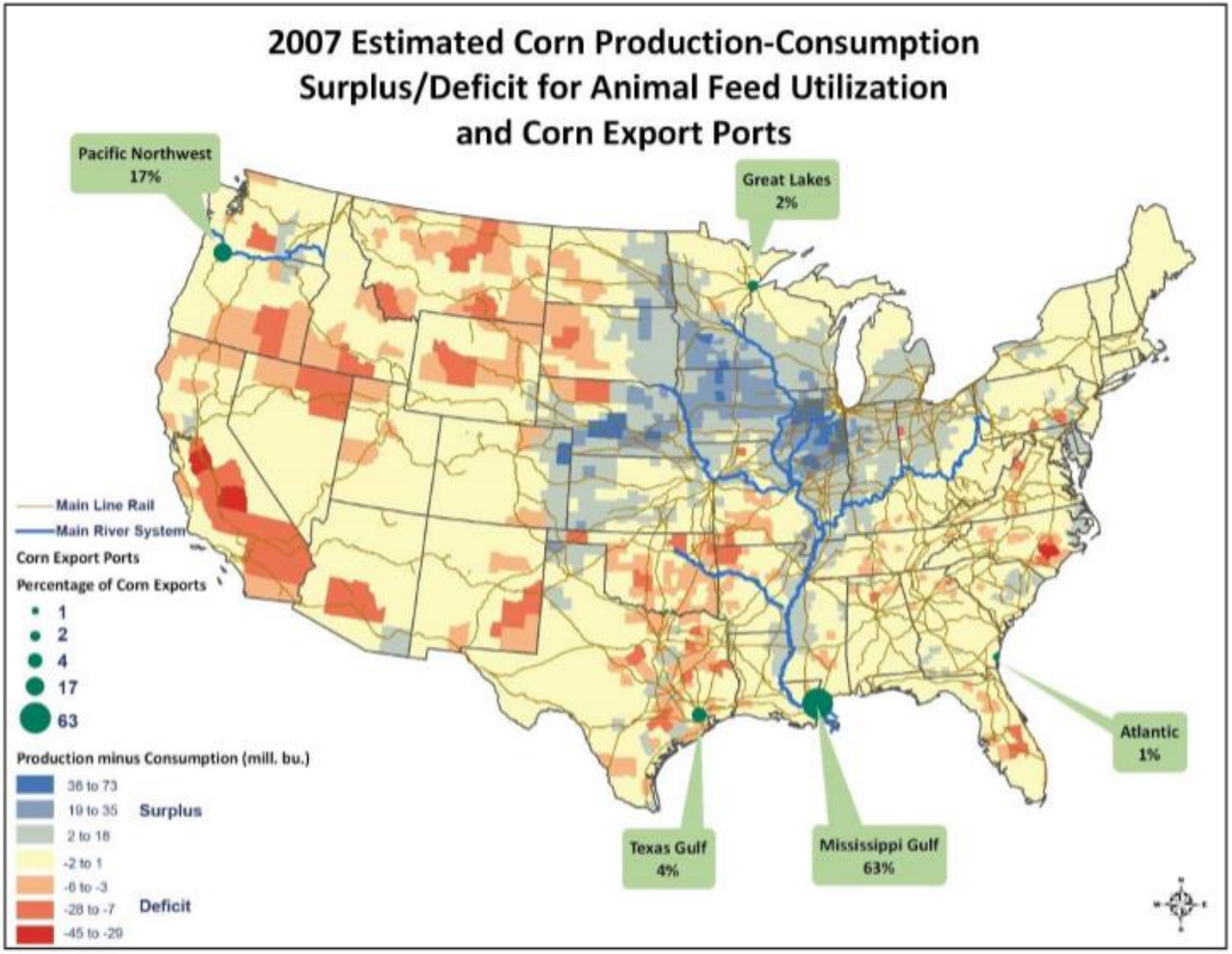
Opportunities for Feed Grain Expansion

Poultry Production in the US



#1 – Georgia
#2 – Alabama
#3 – Arkansas

Source: National Agricultural Statistics Service, 7/29/2015



Source: Census of Agriculture, 2007 and Economic Research Service, USDA. Surplus-deficit estimate is based on county-level production, U.S. feed use, and county-level animal inventories (summed based on Grain Consuming Animal Unit factors). U.S. Waterborne Exports and Imports from the Port Import Export Reporting Service (PIERS).

Alabama Poultry Feed Deficit for 1 Billion Broilers

Corn Produced: 30 million bu
Corn Used: 150 million bu
Deficit: 120 million bu

800K acres needed

Soybeans Produced: 8.7 million bu
Soybeans Used: 68 million bu
Deficit: 60 million bu

1 M acres needed

Bringing prime farmland back into production to overcome this deficit could have a direct economic impact of $1.5 billion, indirect impact of $5 billion, and create 18,000 jobs!

Barriers to Expanding Feed Grain Crops

- Land would come from timber or pasture
- Timber land requires $1000/ac to clear for crops
- Irrigation needed
- Capital requirements for row crop farms to expand
  - Farmer age
  - Risk aversion
  - Young farmers do not have credit
- Grain handling infrastructure

In Alabama, if we add 1.8 M acres to existing 2.4 M ac of row crops, we would need more farmers

Opportunities for Vegetable and Fruit Expansion

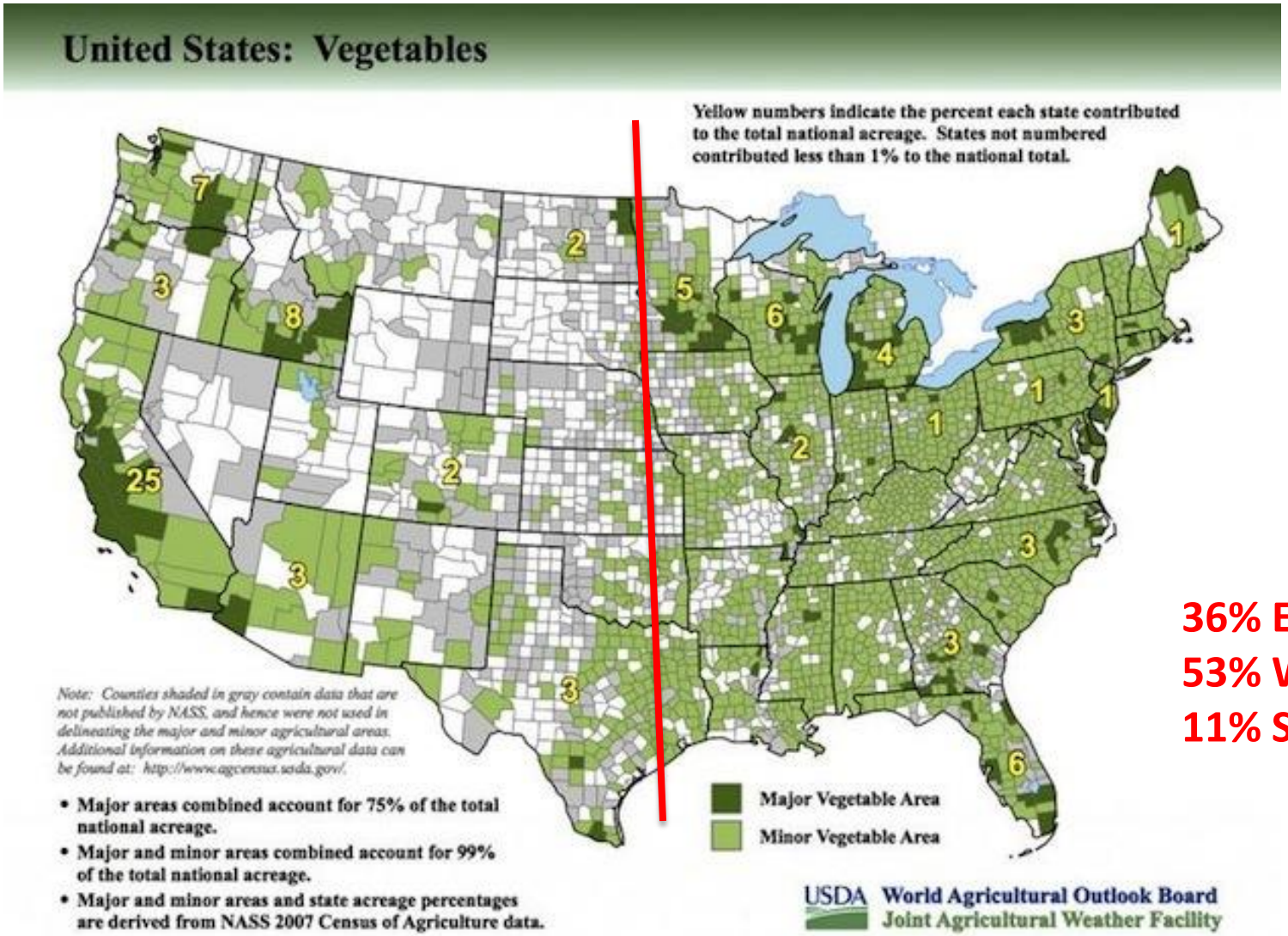
Crop and Livestock Commodities in which California Leads the Nation 1/			
Almonds	Escarole/Endive	Mandarins & Mandarin Hybrids 2/	Plums
Apricots	**Figs**	Melons, Cantaloupe	**Plums, Dried**
Artichokes	Flowers, Bulbs	Melons, Honeydew	Pluots
Asparagus	Flowers, Cut	Milk	**Pomegranates**
Avocados	Flowers, Potted Plants	Milk Goats	Raspberries
Beans, Dry Lima	Garlic	Nectarines	**Rice, Sweet**
Beans, F.M. Snap	**Grapes, Raisins**	Nursery, Bedding Plants	Safflower
Bedding/Garden Plants	Grapes, Table	Nursery Crops	Seed, Alfalfa
Broccoli	Grapes, Wine	**Olives**	Seed, Bermuda Grass
Brussels Sprouts	Greens, Mustard	Onions, Dry	**Seed, Ladino Clover**
Cabbage, Chinese	Hay, Alfalfa	Onions, Green	Seed, Vegetable and Flower
Cabbage, F.M.	Herbs	Parsley	Spinach
Carrots	Kale	**Peaches, Clingstone**	Strawberries
Cauliflower	**Kiwifruit**	Peaches, Freestone	Tomatoes, F.M.
Celery	Kumquats	Pears, Bartlett	Tomatoes, Processing
Chicory	Lemons	Peppers, Chile	Vegetables, Greenhouse
Cotton, American Pima	Lettuce, Head	Peppers, Bell	Vegetables, Oriental
Daikon	Lettuce, Leaf	Persimmons	**Walnuts**
Dates	Lettuce, Romaine	Pigeons and Squabs	Wild Rice
Eggplant	Limes	**Pistachios**	

1/ California is the sole producer (99 percent or more) of the commodities in **bold**.

2/ Includes tangelos, tangerines and tangors.

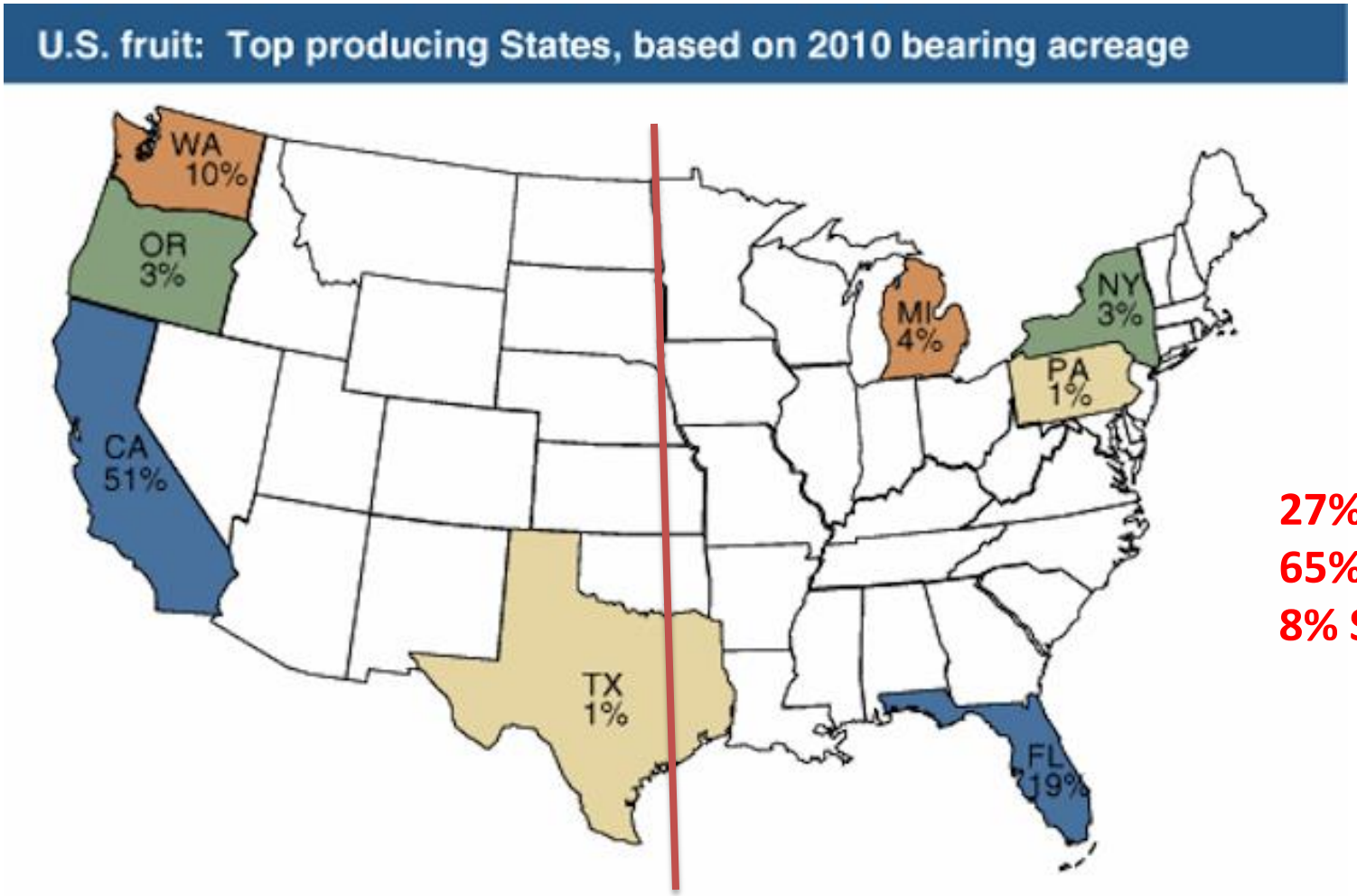
Success is dependent on varieties, knowledge, labor, infrastructure, markets

US Vegetable Production



36% East
53% West
11% Scattered

US Fruit Production



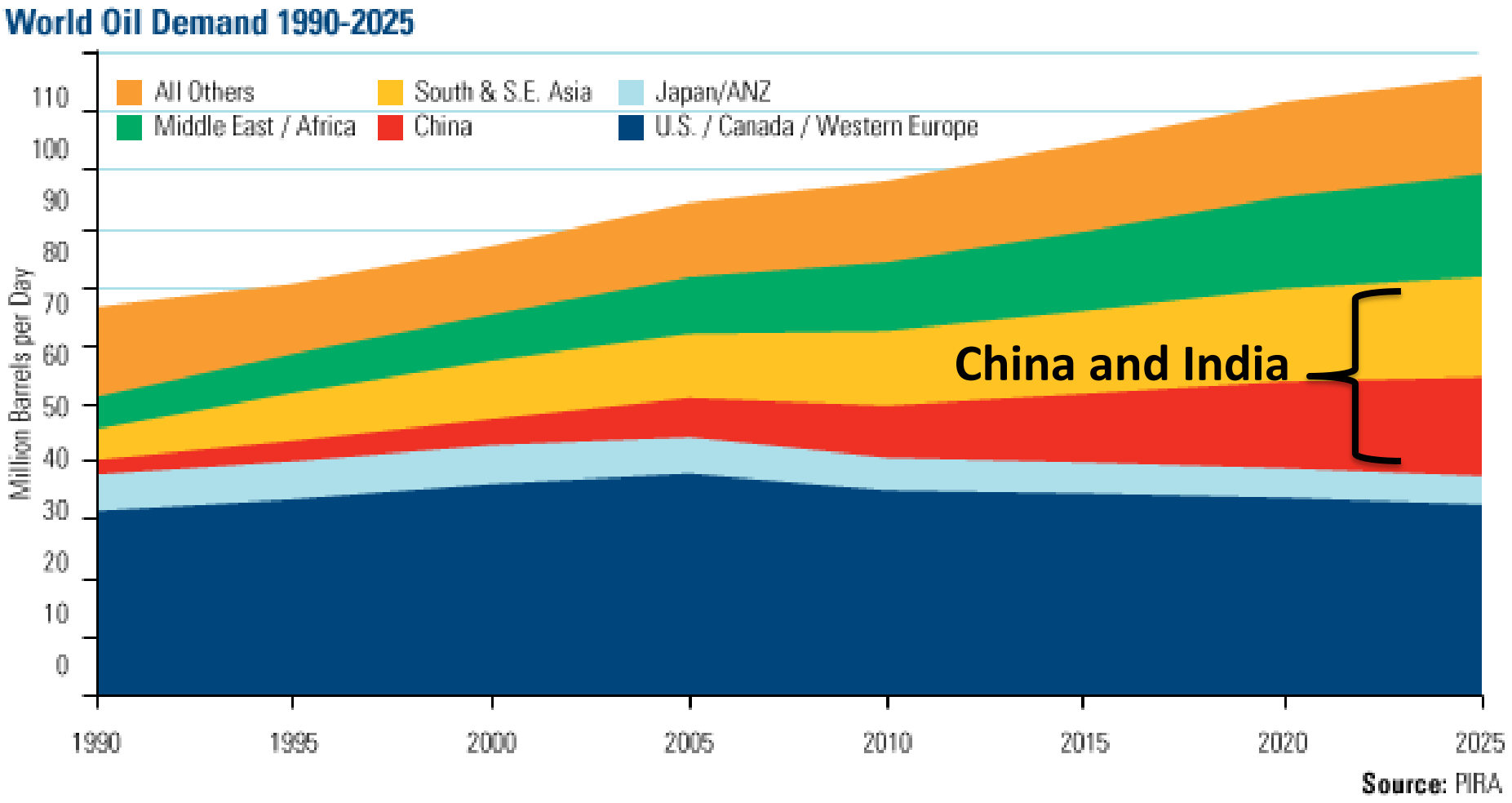
27% East
65% West
8% Scattered

Source: USDA, Economic Research Service using data from USDA, National Agricultural Statistics Service, *Citrus Fruits 2010 Summary and Noncitrus Fruits and Nuts 2010 Preliminary Summary.*

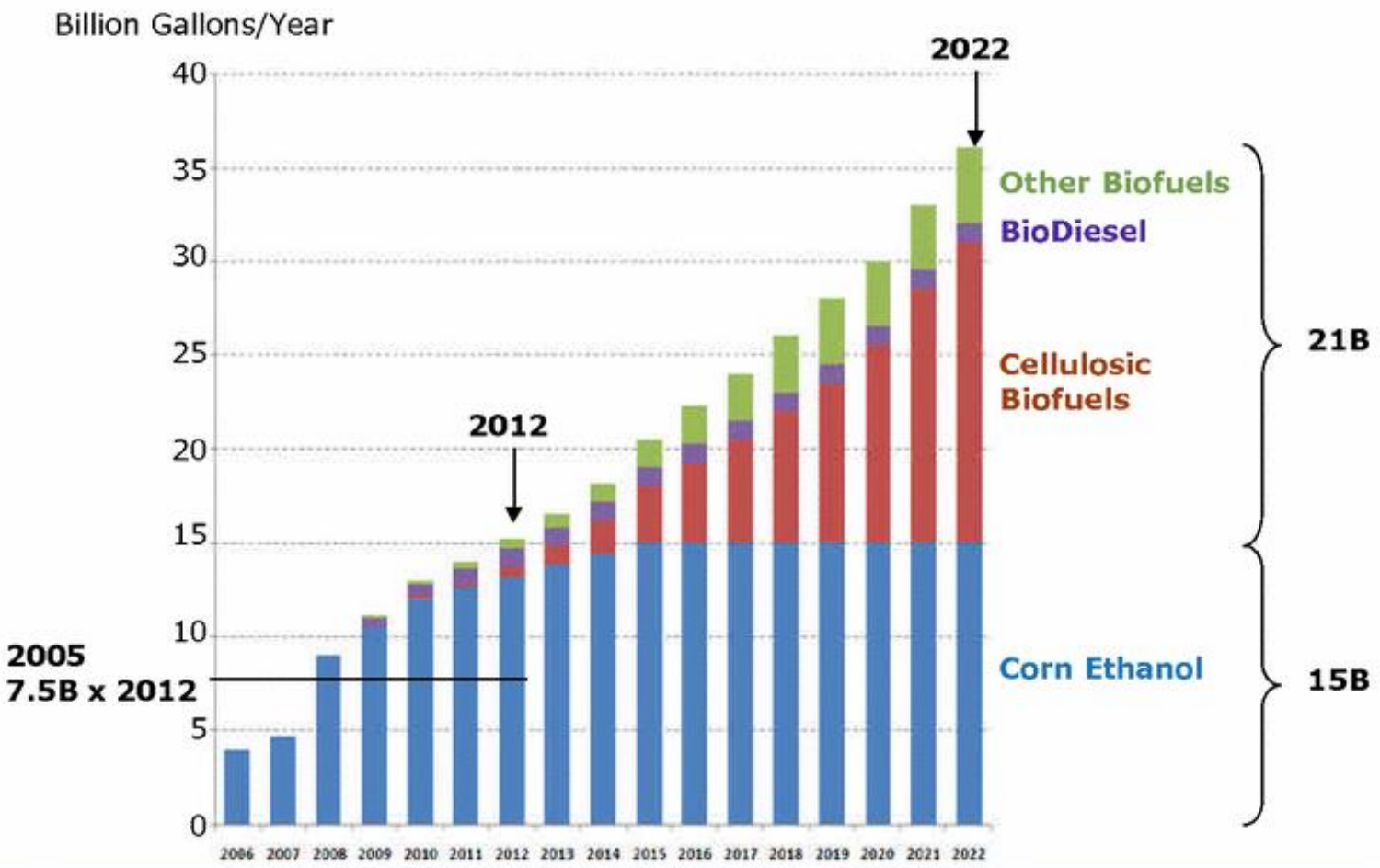
Barriers to Fruit & Vegetable Production

- Creditors are not familiar with the crop
- Diseases due to high humidity
- Rainfall interrupts harvest (hurricanes)
- Must develop in clusters for infrastructure
- Lack of farmer knowledge
- Farmer mindset and culture
- Single or double season (CA grows year-round)
- Labor force
- Few variety development programs
- Research and Extension programs
- Professor turnover rate of 30-40 yrs

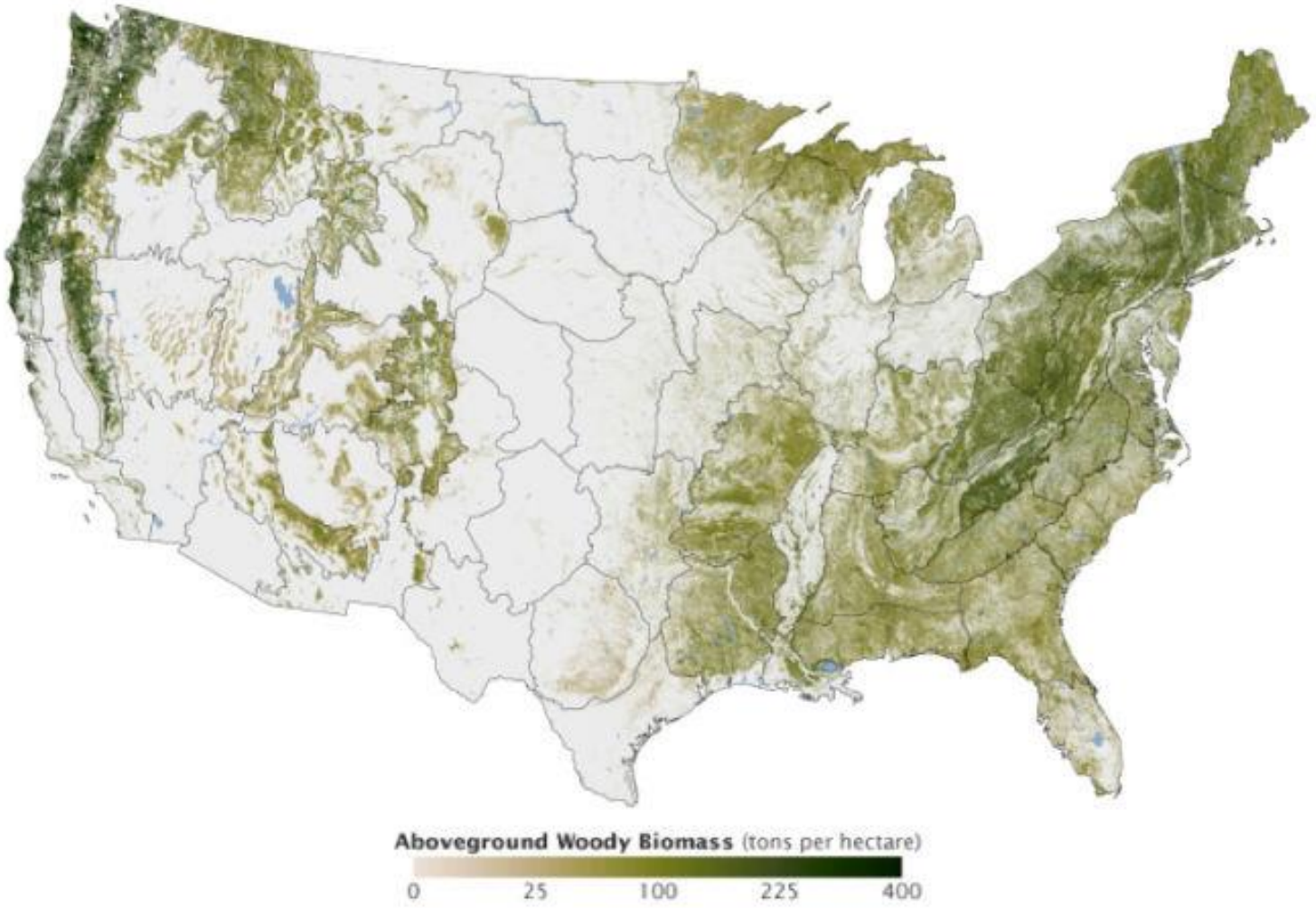
Opportunities for Bioenergy



Renewable Fuel Standard

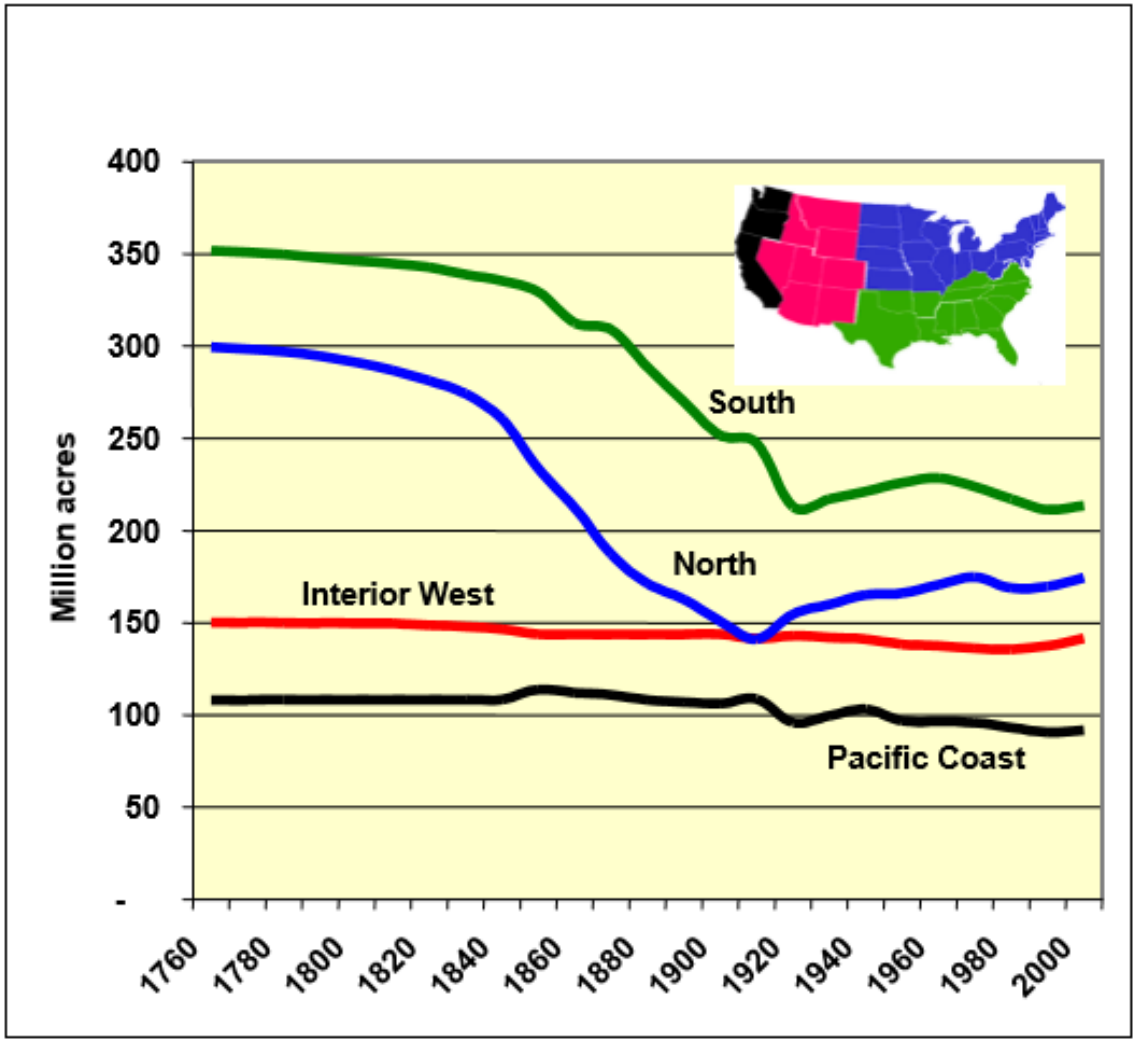


Forest Biomass in the US



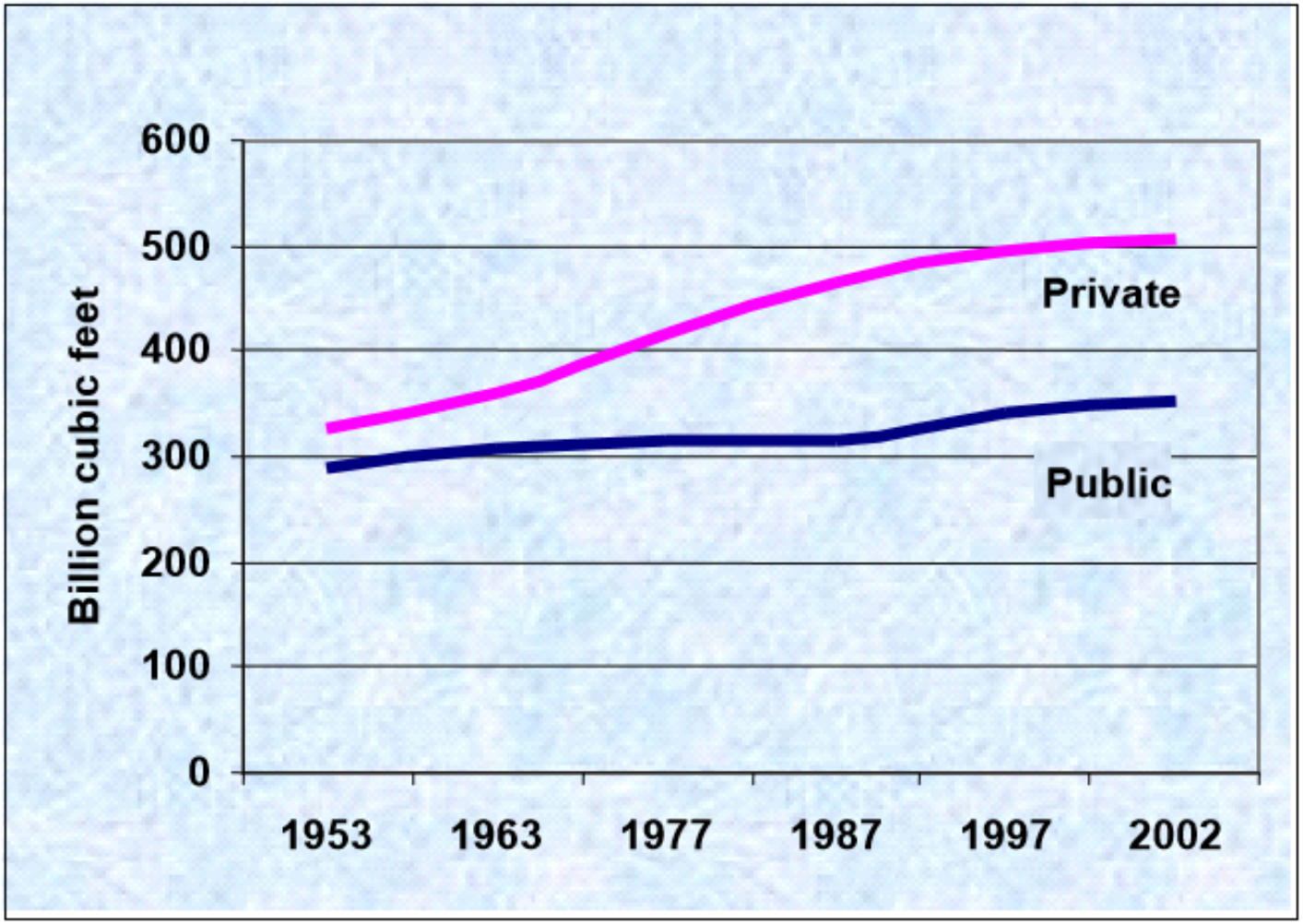
Source: Kellndorfer, J., Walker, W., LaPoint, E., Bishop, J., Cormier, T., Fiske, G., Hoppus, M., Kirsch, K., and Westfall, J. 2012. NACP Aboveground Biomass and Carbon Baseline Data (NBCD 2000), U.S.A., 2000. Data set. Available on-line at http://daac.ornl.gov from ORNL DAAC, Oak Ridge, Tennessee, U.S.A.http://dx.doi.org/10.3334/ORNLDAAC/1081.

Regional Forest Trends in the 48 States (1970-2000)



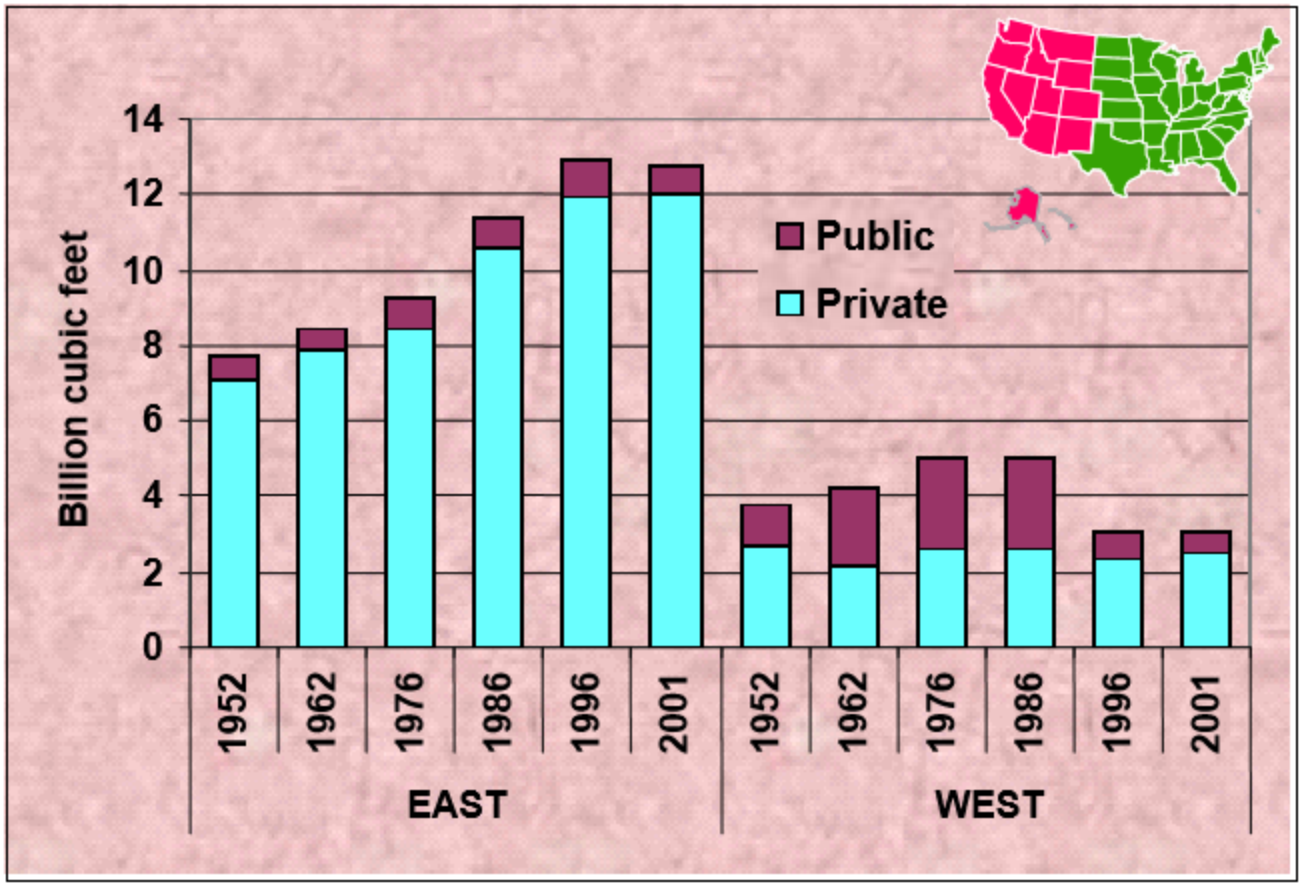
Source: National Report on Forest Resources and Other Historic Data

Growing Stock Volume on Productive Unreserved Forest Land (1953-2002)



Source: National Report on Forest Resources

Growing Stock Harvested by Major Owner, Region and Year



Source: National Report on Forest Resources

Timber Ownership in the US

- 250 million ha in 48 states (stable over last 100 years)
- 160 million ha privately owned (2/3)
- Number of small holdings increasing
- Large increase in number of owners, decrease in size of holding
- Forest fragmentation is becoming a problem

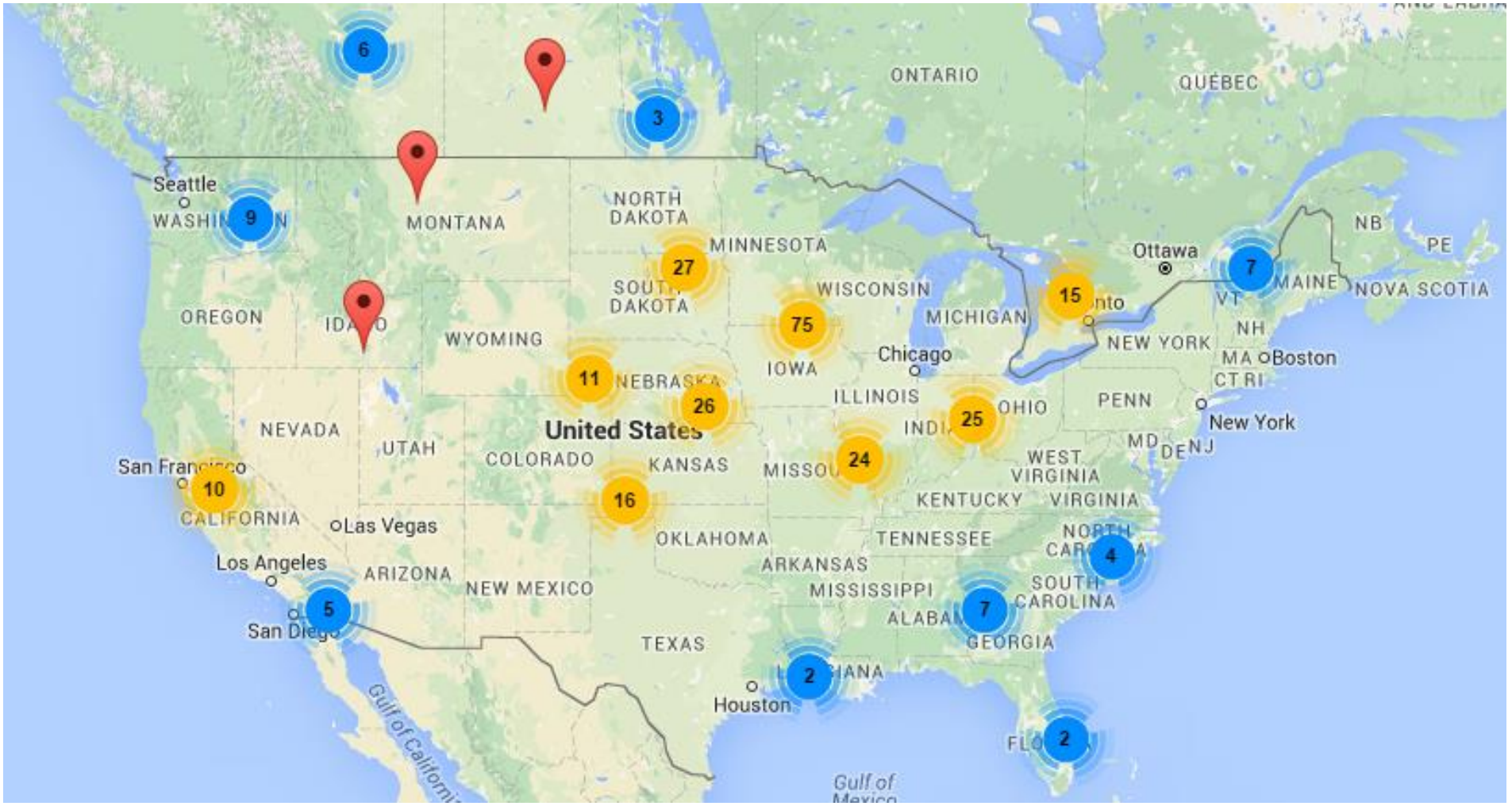
Alabama

- 23 million ac of timber land (22m ac corn and soybeans in Iowa)
- 71% of total area
- 94% of forestland is privately owned
- 432,000 land owners
- Large number of small landholders (<50 ac) (88%)
- Small number of large landholders
- Small landholdings often used for recreation rather than timber production

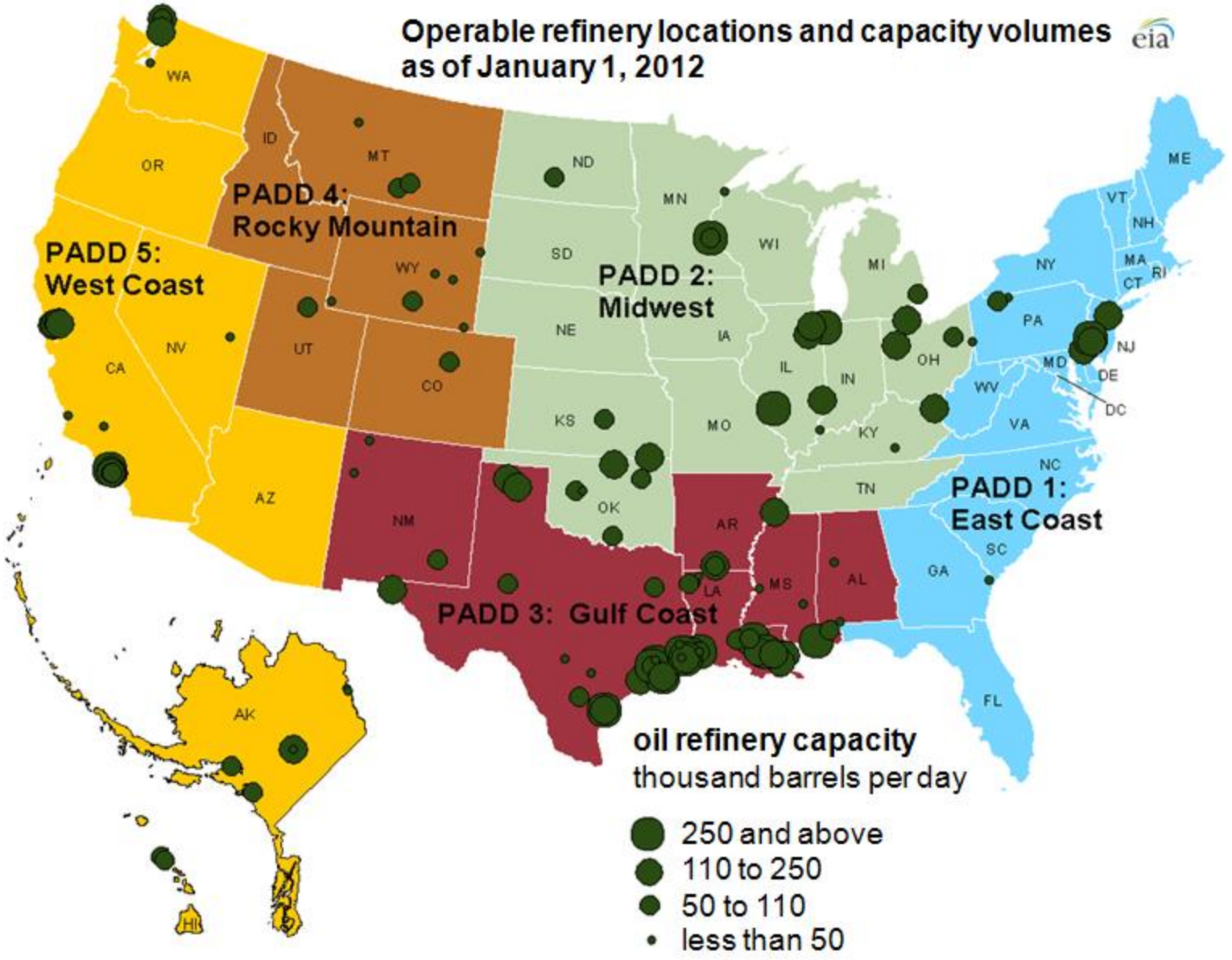
Renewable Energy from Timber

- Cellulosic Ethanol (efficiencies increasing)
- Gasification (improvements in catalysts)
- Pyrolysis (up to 100 gal/ton)
- Studies on short rotation bioenergy crops

Location and Number of Ethanol and Cellulosic Ethanol Plants in the US



Source: http://www.ethanolproducer.com/plants/map/


Operable refinery locations and capacity volumes as of January 1, 2012
eia
PADD 1: East Coast
PADD 2: Midwest
PADD 3: Gulf Coast
PADD 4: Rocky Mountain
PADD 5: West Coast
WA
OR
CA
ID
NV
MT
WY
UT
AZ
CO
NM
ND
SD
NE
KS
OK
TX
MN
IA
MO
AR
LA
WI
IL
MS
MI
IN
KY
TN
AL
OH
WV
VA
NC
SC
GA
FL
PA
NY
ME
VT
NH
MA
CT
RI
NJ
MD
DE
DC
AK
HI
oil refinery capacity
thousand barrels per day
250 and above
110 to 250
50 to 110
less than 50

Private Timberland!

Opportunities/Barriers

Opportunities

- Significant timber and infrastructure
- Private land used for recreation
- Conversion technology is improving
- Large company investments (DuPont, Syngenta)
- Renewable hydrocarbons produced near refinery infrastructure

Barriers

- Federal funding is decreasing in this area
- Venture capital has ceased
- Large public/private ventures have failed
- Higher valued crops could be grown on best timber land

Policy Matters!

2019 Farm Bill

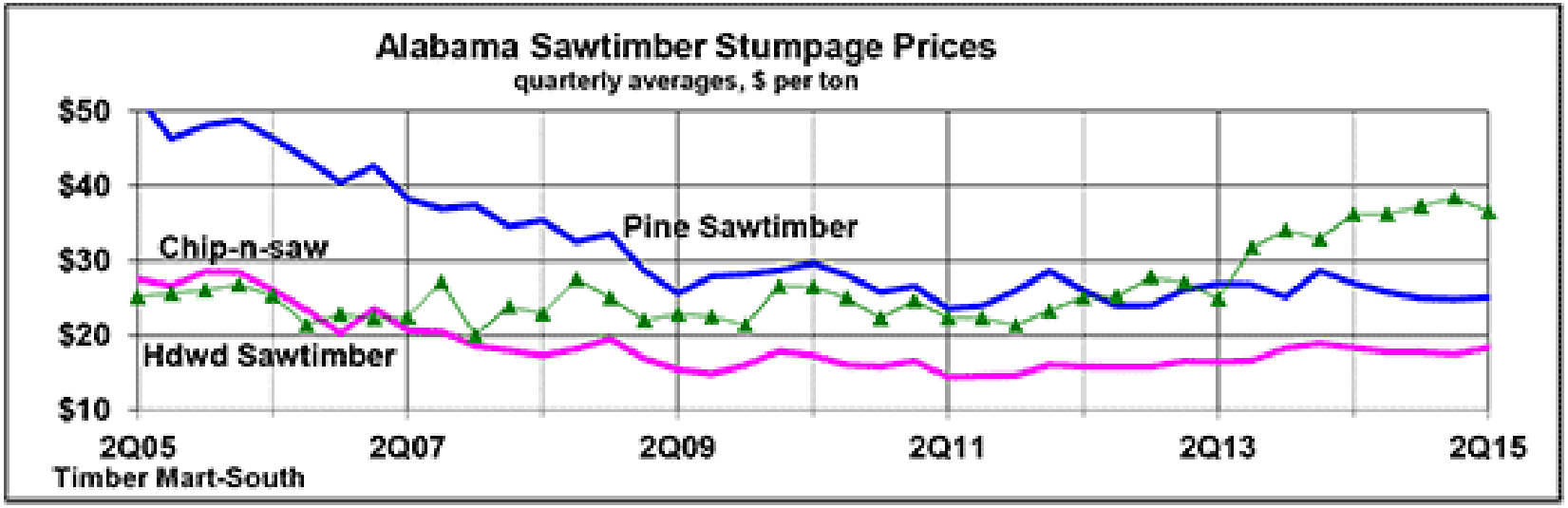
In 1991, the Andean Trade Preference Act directed the federal government to help establish asparagus farms in Peru in hopes of weaning growers away from producing cocoa leaves for cocaine. The effort resulted in Peruvian growers producing both crops and wiped out Washington state's 55 million-pound-a-year canned asparagus industry.

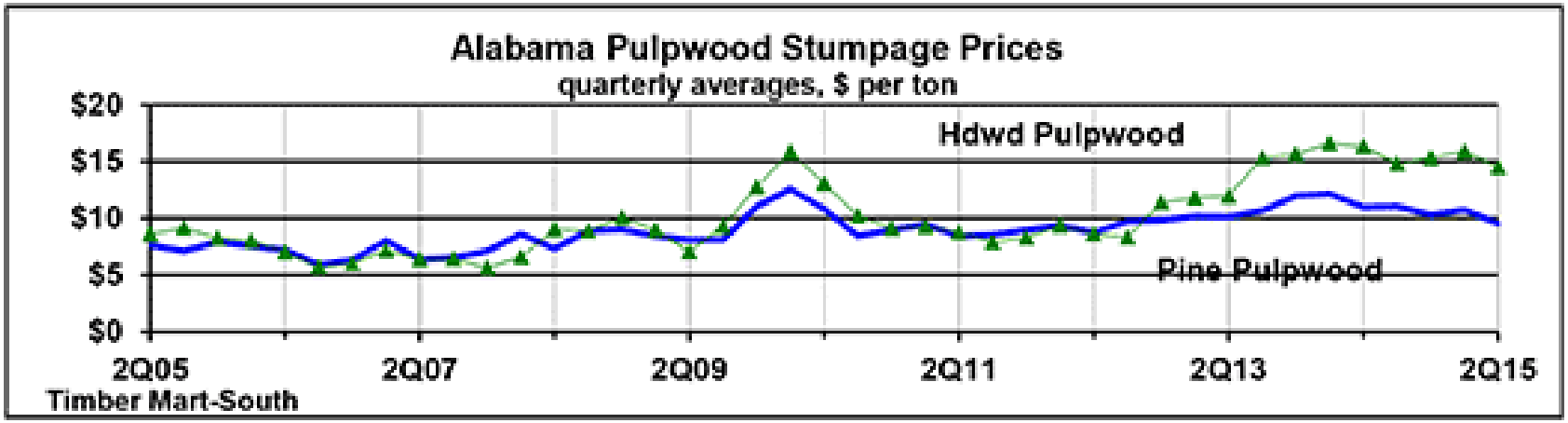
Source: http://www.capitalpress.com/Nation_World/Nation/20150618/some-worry-as-more-production-moves-outside-us

Conclusions

- Current national agricultural system is challenged
- East/SE has potential to diversify
- Research is needed to develop policies to diversify US Agriculture
- How to best utilize land resources?
- How to match land with need for FEW nexus
- Value of recreational land vs other uses

Value of Timber





Average Return of Timber

Average site

Age 15 thinning	$16/ac/yr
Age 22 thinning	$13/ac/yr
Age 35 Cut	$92/ac/yr
Total:	$107/ac/yr

This a good return for absentee landowner but land could be better utilized

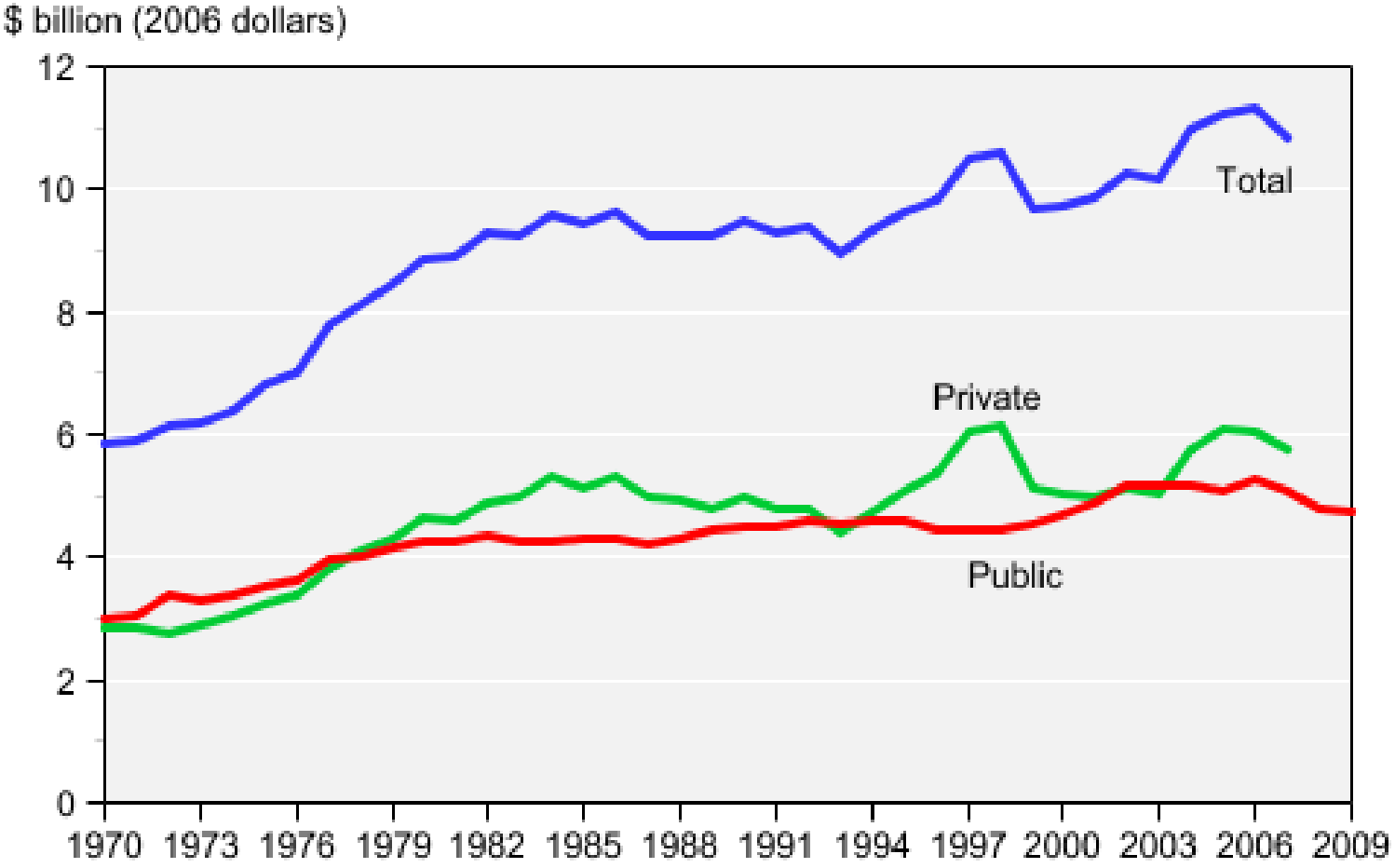
Introduction

- Desert Lands Act of 1877 designed to encourage development of small farms I desert west
- Reclamation Act of 1902 initiated development of large scale water projects
- Many projects to build dams an canals were initiated over the subsequent years
  - Hoover Dam on Colorado River (1935)
  - Coulee Dam on Columbia River (1942)
  - Shasta Dam in Central Valley (1945)
- Subsidized water brought farms to the dry west
- Urbanization is creating conflicting use for that water

Introduction

- Subsidized water brought farms to the dry west
- Long growing seasons created competitive advantage, especially for vegetable and nut production
- By the 1960's non-irrigated farms in the southeast could no longer compete with the midwest and west
- Much crop land has been converted to timber to support the paper and construction industry
- Policy created a highly efficient agricultural system

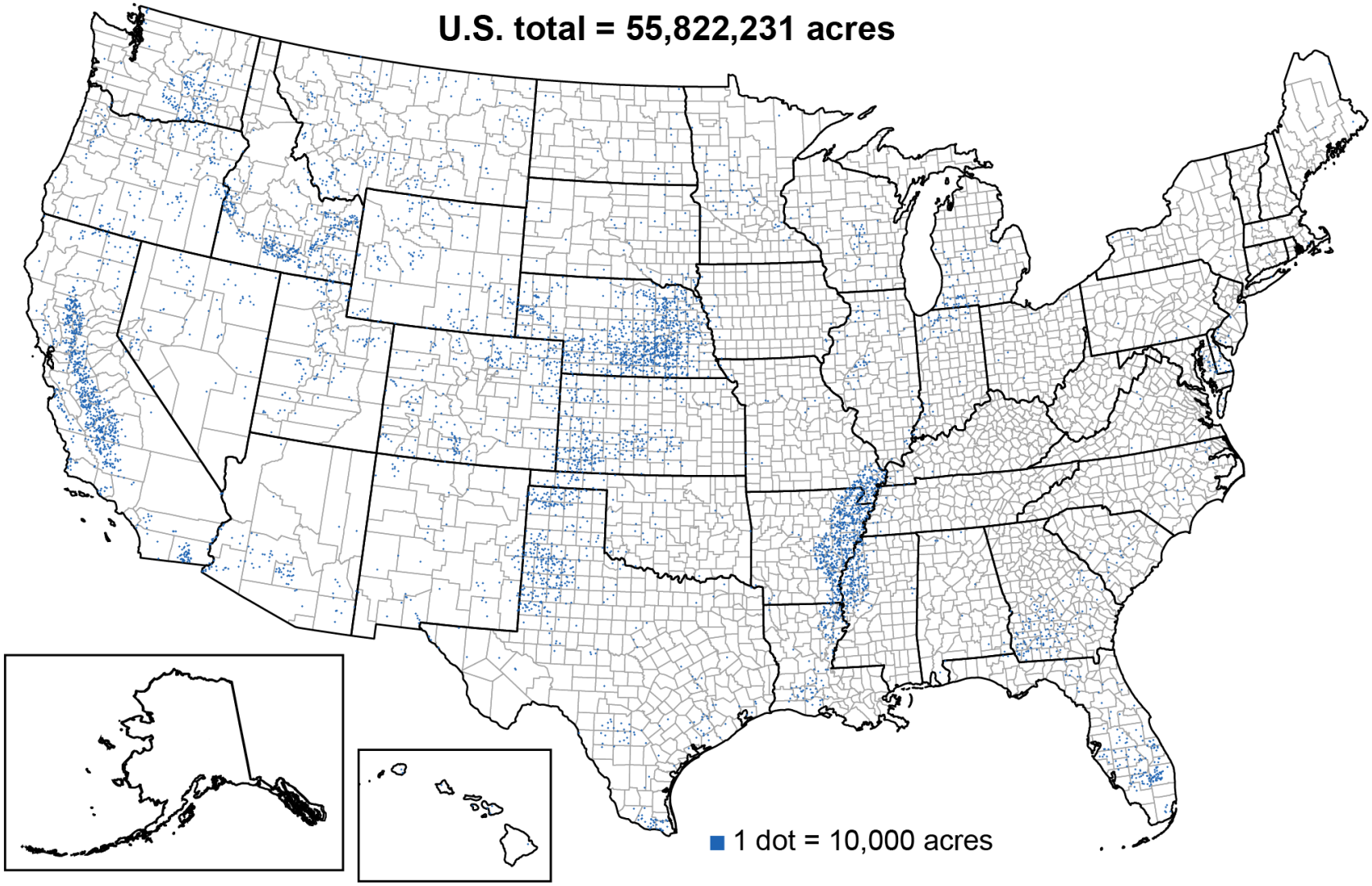
Real food and agricultural research and development funding, 1970-2009



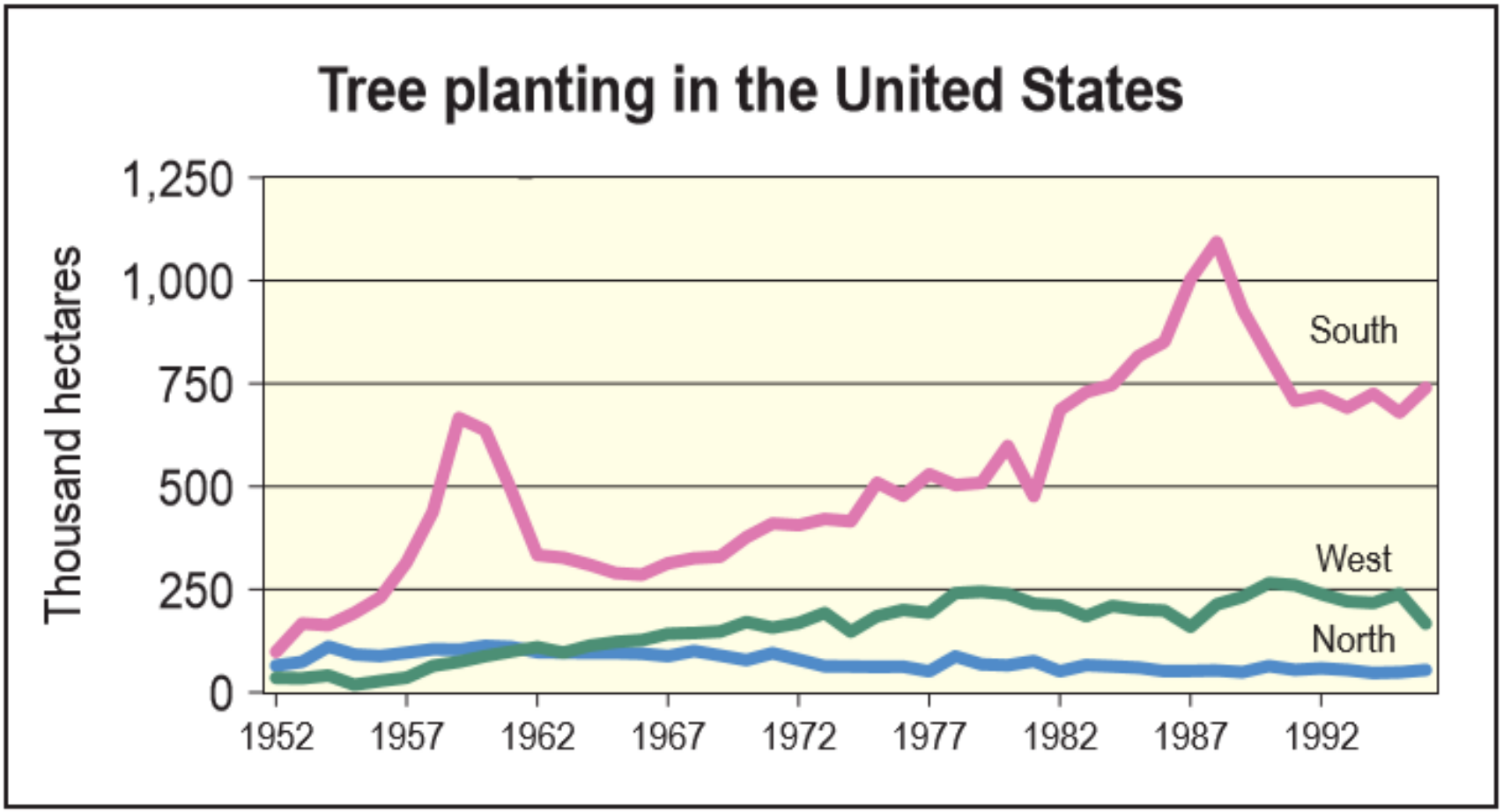
Note: Data for 2008-09 are preliminary.
Source: USDA, ERS based on data from National Science Foundation, USDA's Current Research Information Systems (CRIS), and various private sector data sources. Data are adjusted for inflation using an index for agricultural research spending developed by ERS.

Source: http://www.ers.usda.gov/data-products/agricultural-research-funding-in-the-public-and-private-sectors.aspx

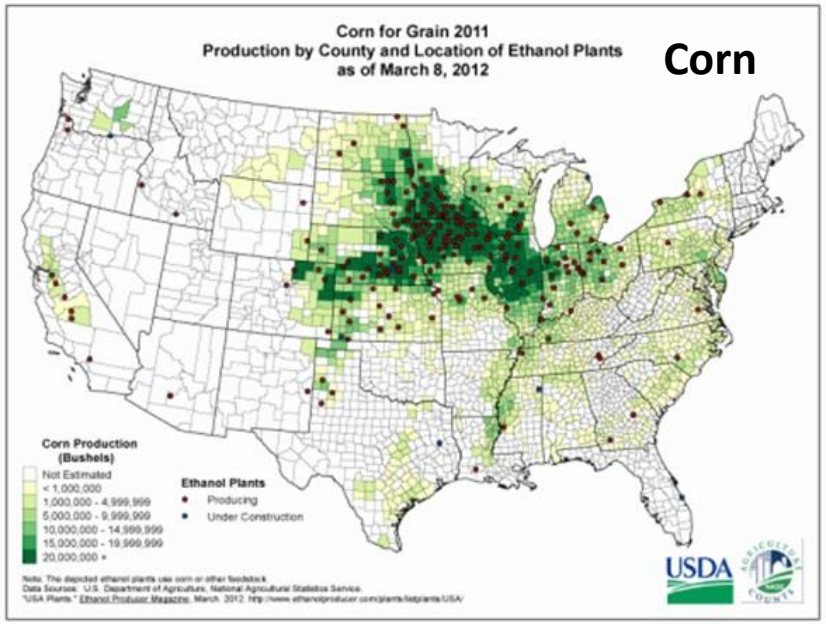
Acres of irrigated land, 2012

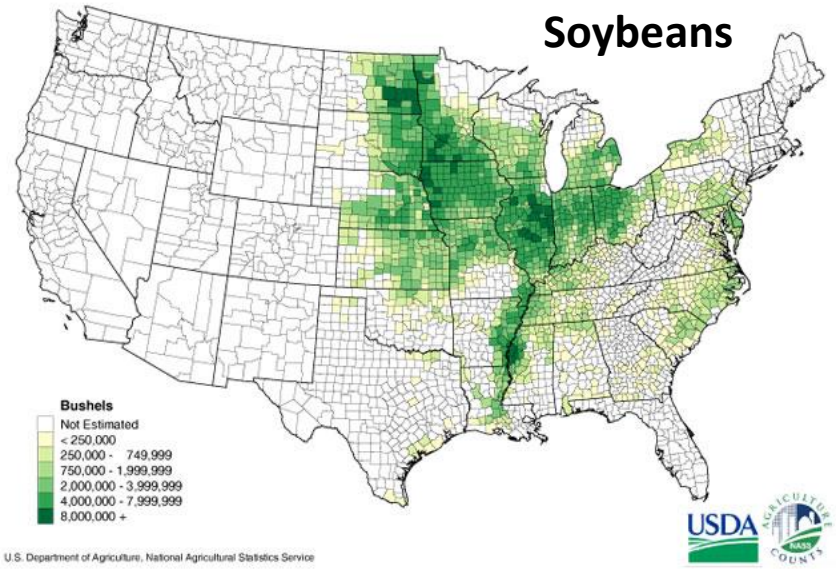


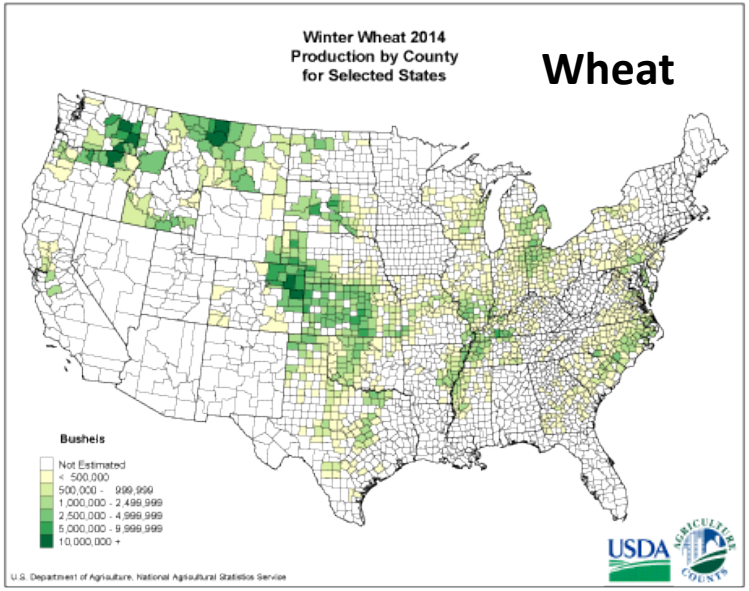
Source: USDA, National Agricultural Statistics Service, Map Atlases for the 2012 Census of Agriculture.

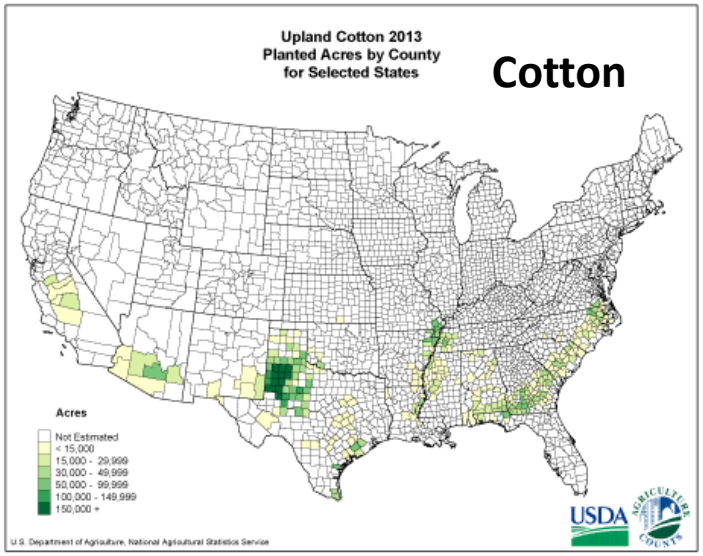


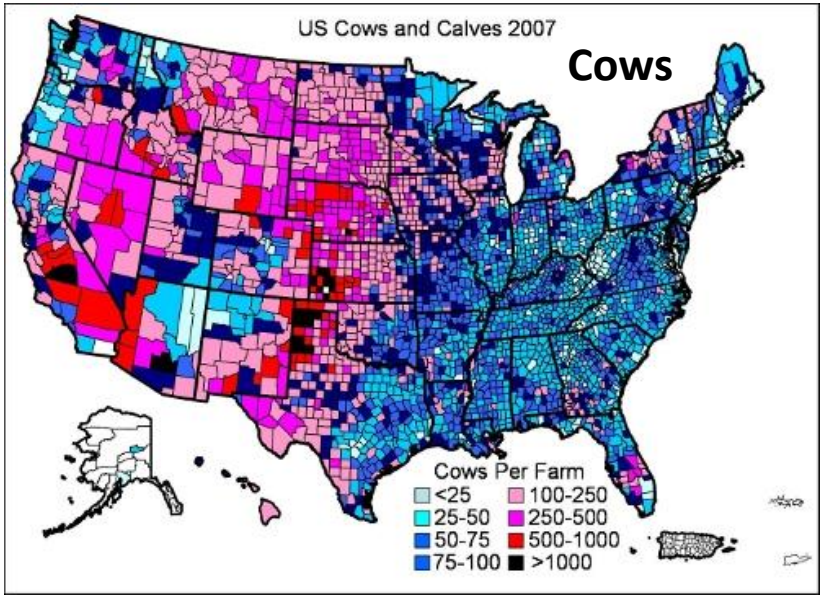
Source: US Forest Facts and Historical Trends, US Forest Service , FS-696-M, 2001


Corn for Grain 2011
Production by County and Location of Ethanol Plants
as of March 8, 2012
Corn
Corn Production
(Bushels)
Not Estimated
< 1,000,000
1,000,000 - 4,999,999
5,000,000 - 9,999,999
10,000,000 - 14,999,999
15,000,000 - 19,999,999
20,000,000 +
Ethanol Plants
Producing
Under Construction
USDA

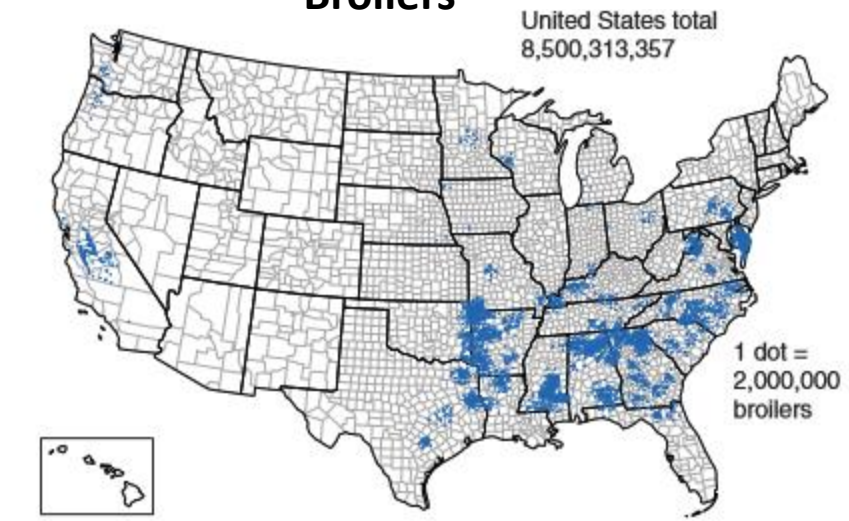

Soybeans
Bushels
Not Estimated
< 250,000
250,000 - 749,999
750,000 - 1,999,999
2,000,000 - 3,999,999
4,000,000 - 7,999,999
8,000,000 +
USDA
U.S. Department of Agriculture, National Agricultural Statistics Service


Winter Wheat 2014
Production by County
for Selected States
Wheat
Bushels
Not Estimated
< 500,000
500,000 - 999,999
1,000,000 - 2,499,999
2,500,000 - 4,999,999
5,000,000 - 9,999,999
10,000,000 +
USDA
U.S. Department of Agriculture, National Agricultural Statistics Service

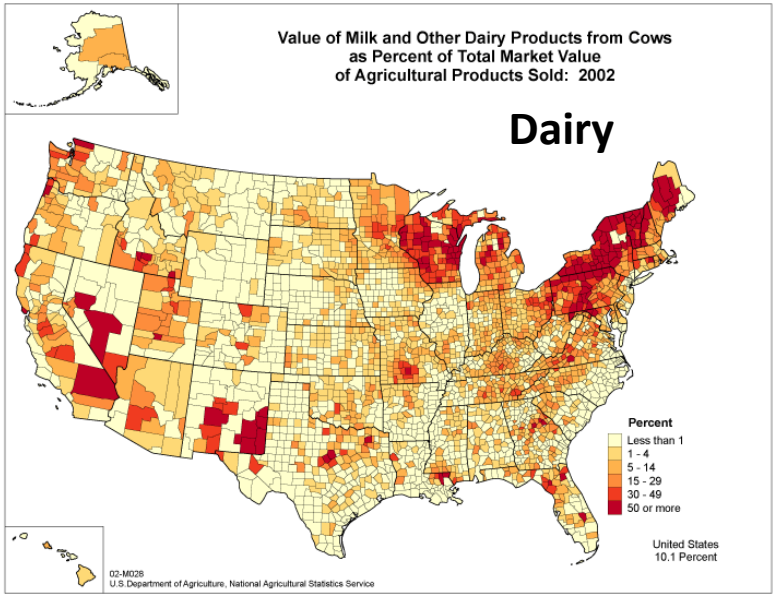

Upland Cotton 2013
Planted Acres by County
for Selected States
Cotton
Acres
Not Estimated
< 15,000
15,000 - 29,999
30,000 - 49,999
50,000 - 99,999
100,000 - 149,999
150,000 +
USDA
U.S. Department of Agriculture, National Agricultural Statistics Service

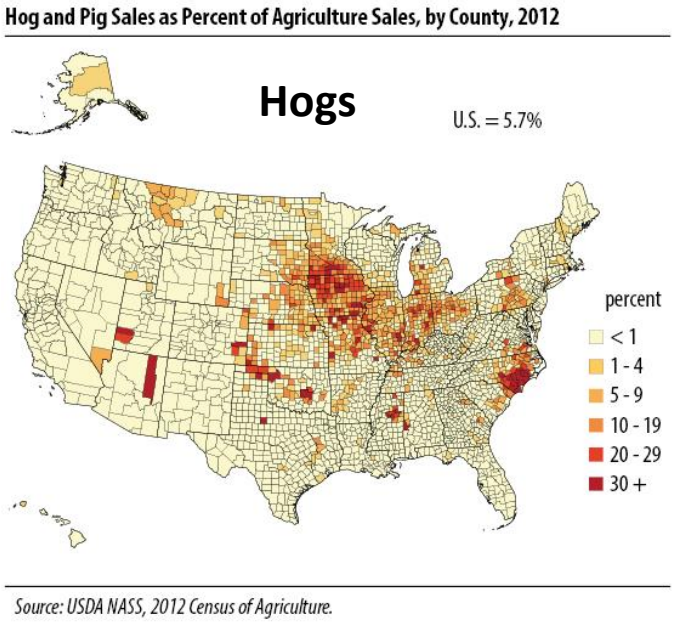


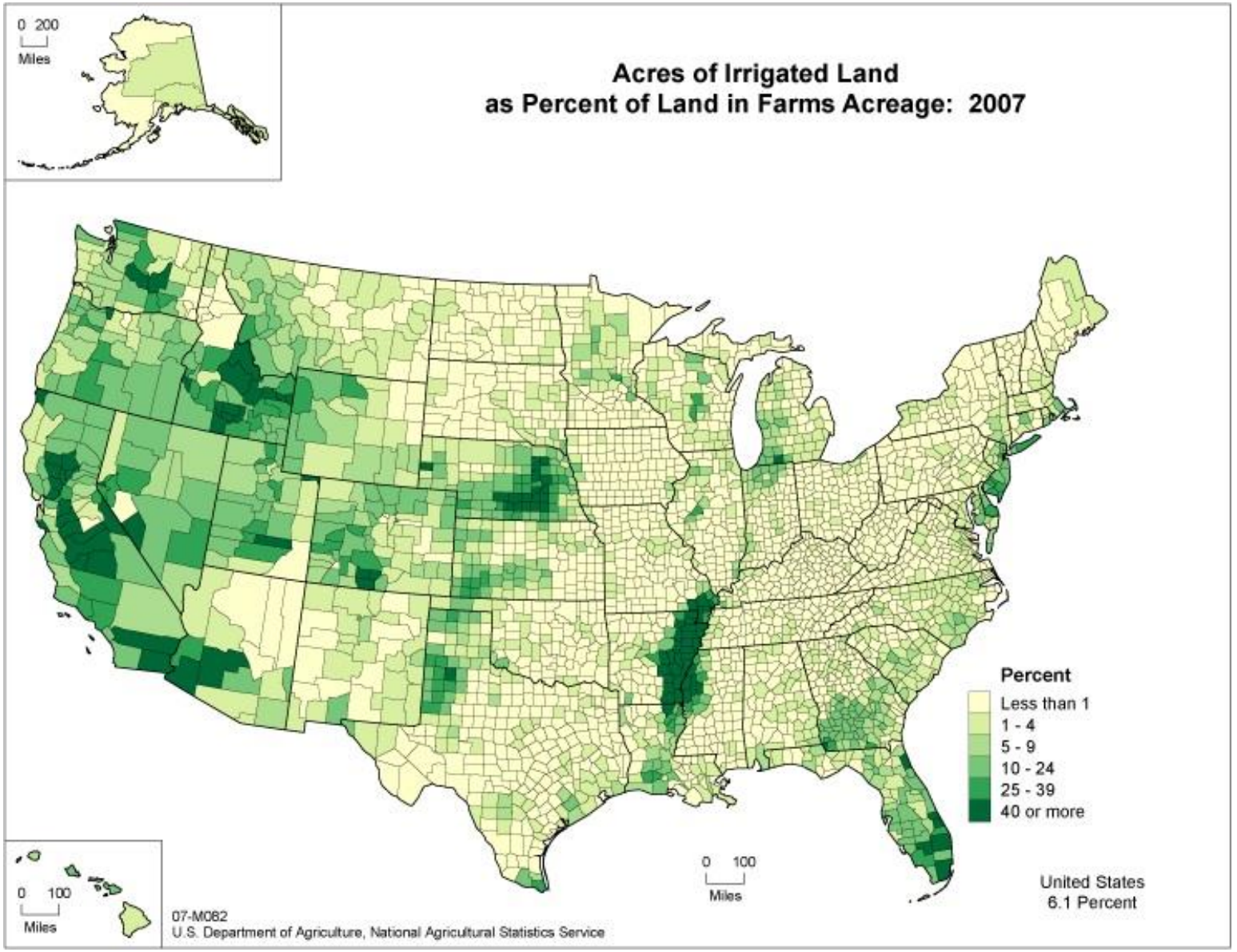
Broilers



Source: USDA, National Agricultural Statistics Service.

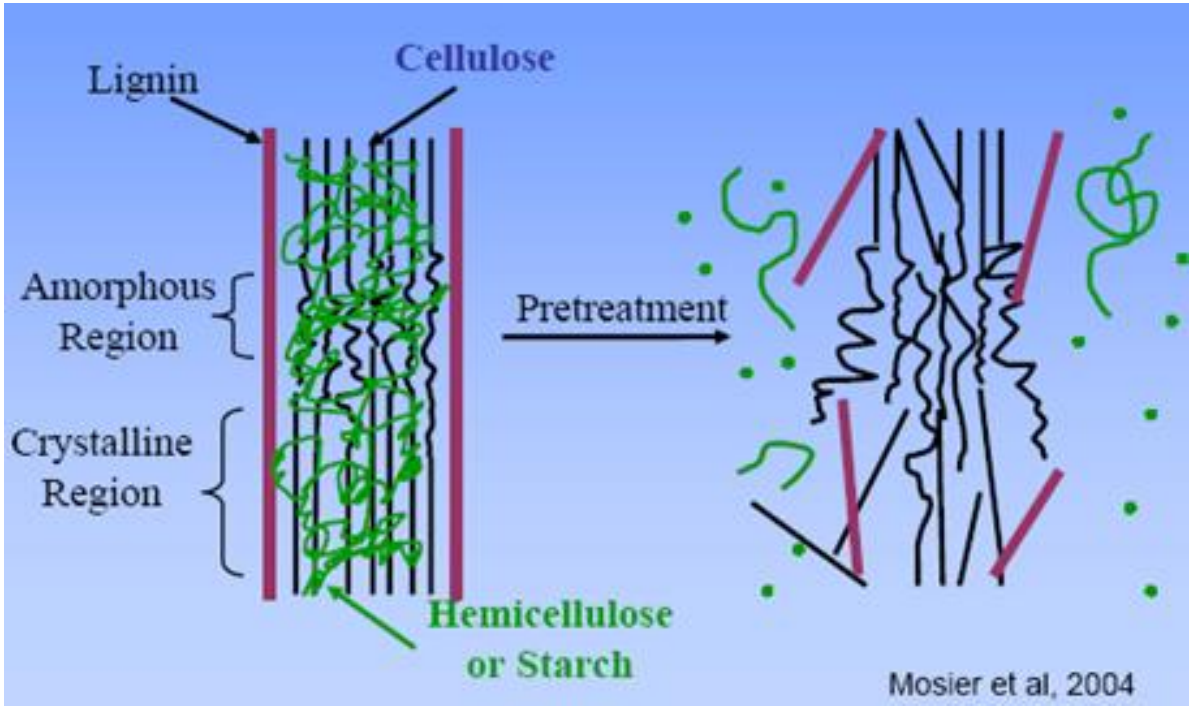





0 200
Miles
Acres of Irrigated Land
as Percent of Land in Farms Acreage: 2007
Percent
Less than 1
1 - 4
5 - 9
10 - 24
25 - 39
40 or more
0 100
Miles
United States
6.1 Percent
0 100
Miles
07-M082
U.S. Department of Agriculture, National Agricultural Statistics Service

Cellulosic Ethanol

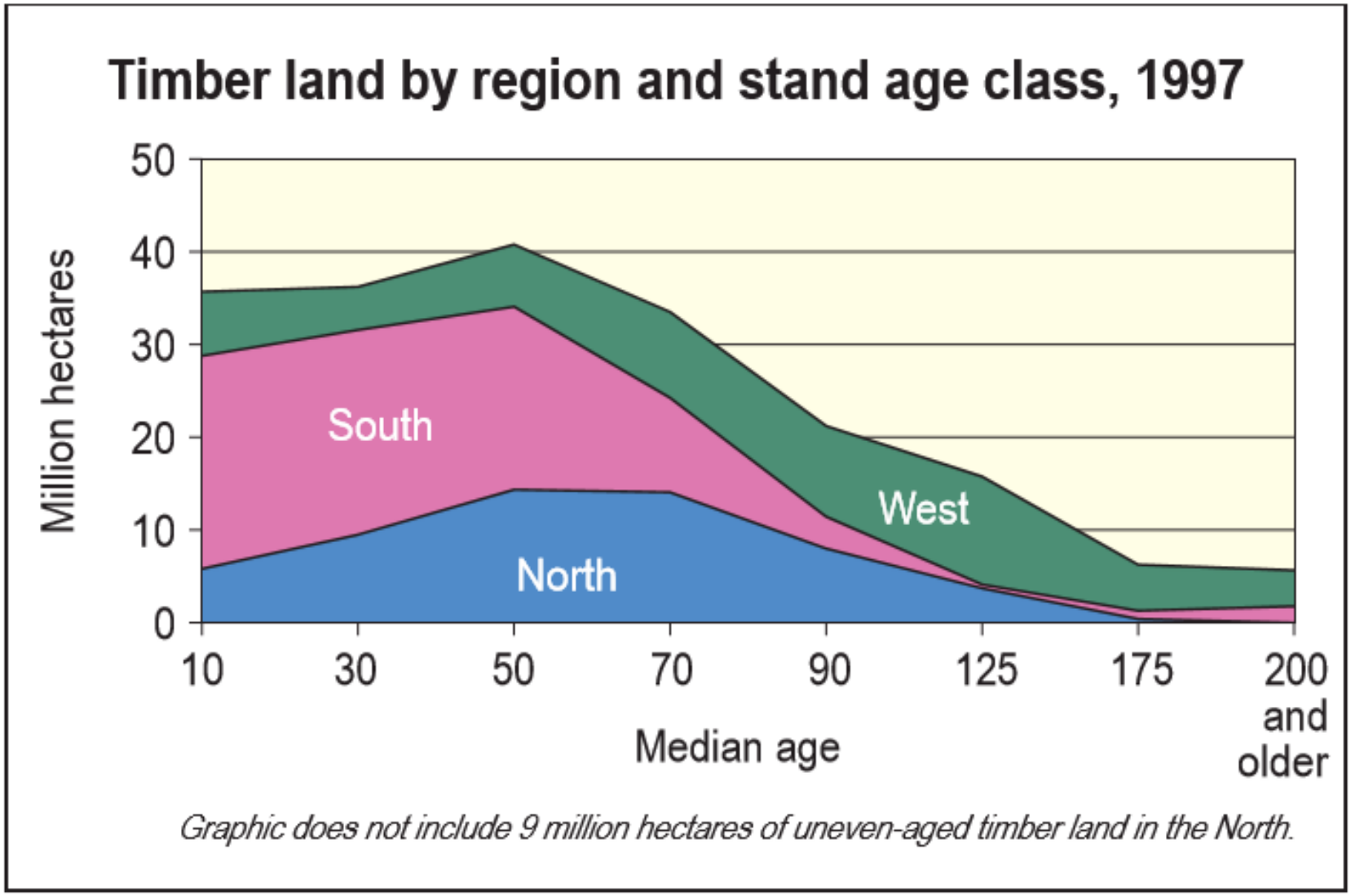
- Use enzymes to break down rigid cellulose structure into sugars
- Use microbial fermentation to convert sugars into ethanol
- Separate ethanol from byproducts (ie. lignin)
- Distillation to achieve 99.5% ethanol



14 Commercial and Pilot Scale Plants in US

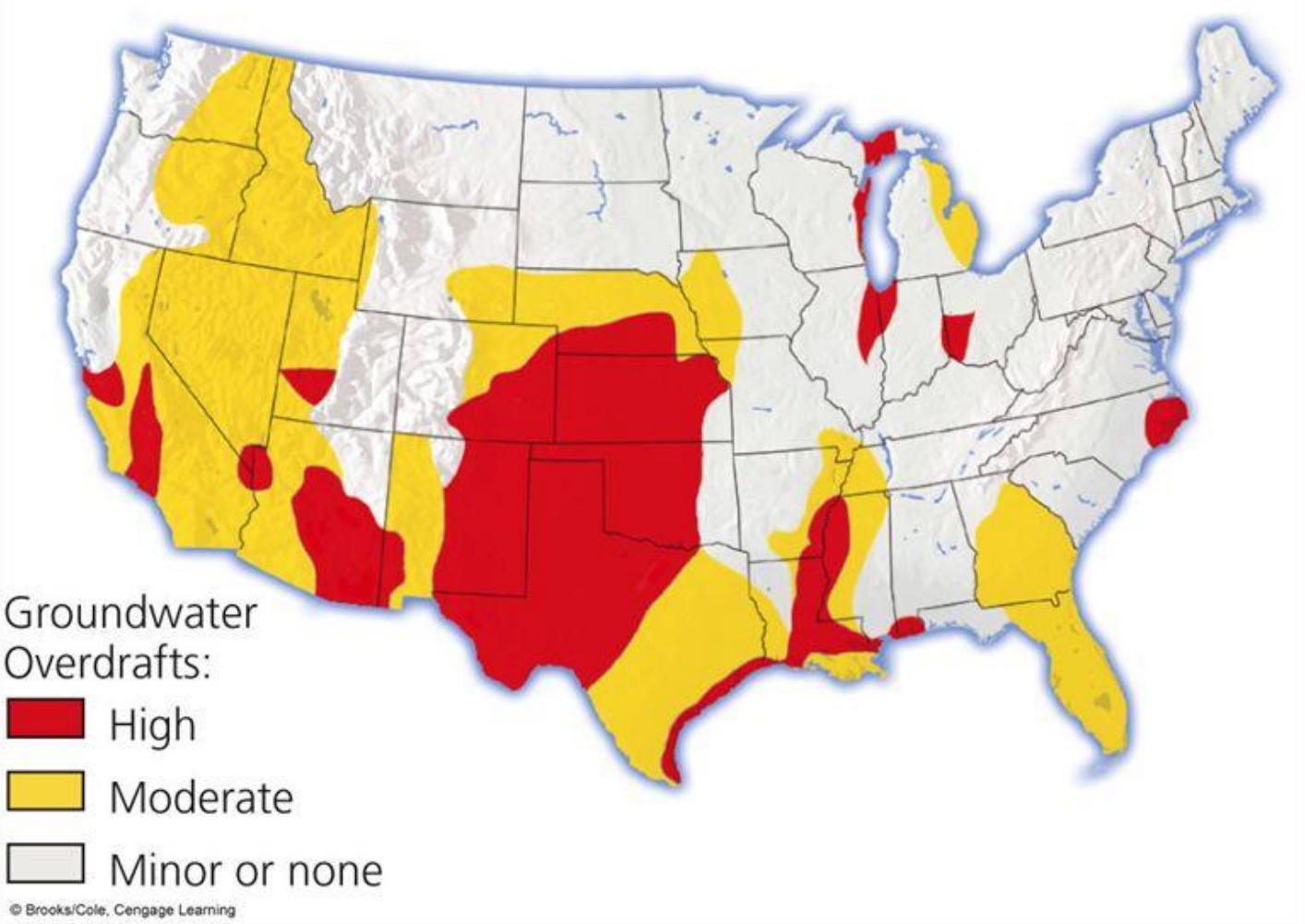
- Cellulosic Ethanol Technologies, LLC, Galva, IA (2M gpy)
- Abengoa, Hugoton, KS (25M gpy)
- Poet-DSM, Emmetsburg, IA (25M gpy)
- Dupont, Nevada, IA (under construction, 25M gpy)
- 14[1] commercial and demonstration plants in US with capacity of 70M gpy
- Many other projects underway

[1]Source: http://www.ethanolproducer.com/plants/listplants/US/Existing/Cellulosic

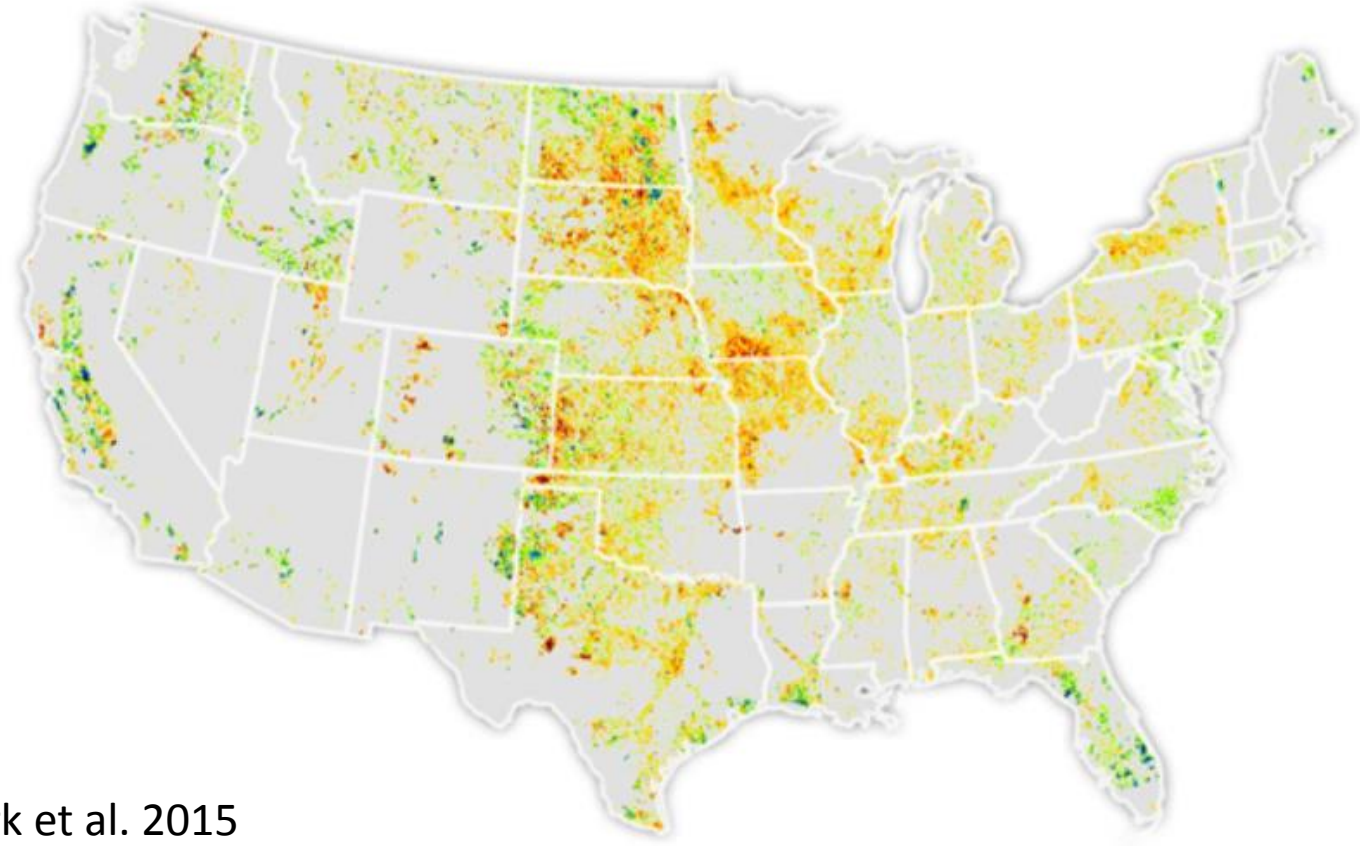


Source: US Forest Facts and Historical Trends, US Forest Service , FS-696-M, 2001

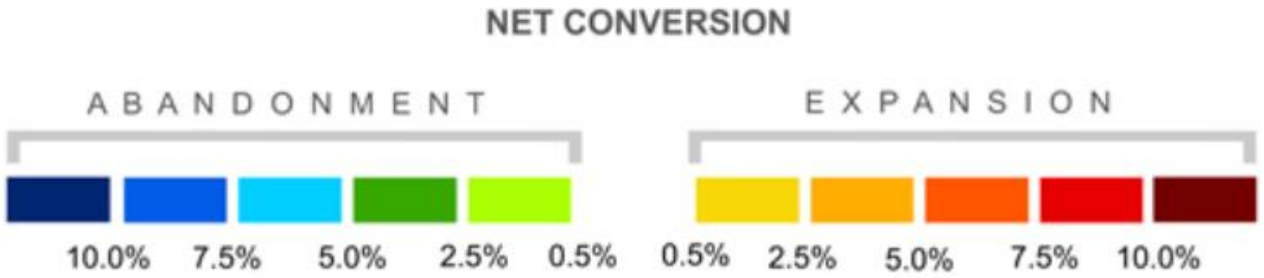
Natural Capital Degradation: Areas of Greatest Aquifer Depletion in the U.S.



Land is Already being Taken out of Production

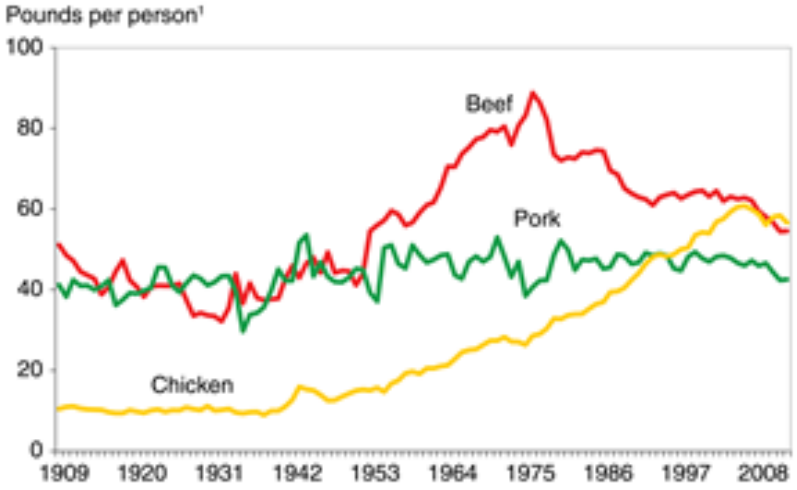


Source: Lark et al. 2015



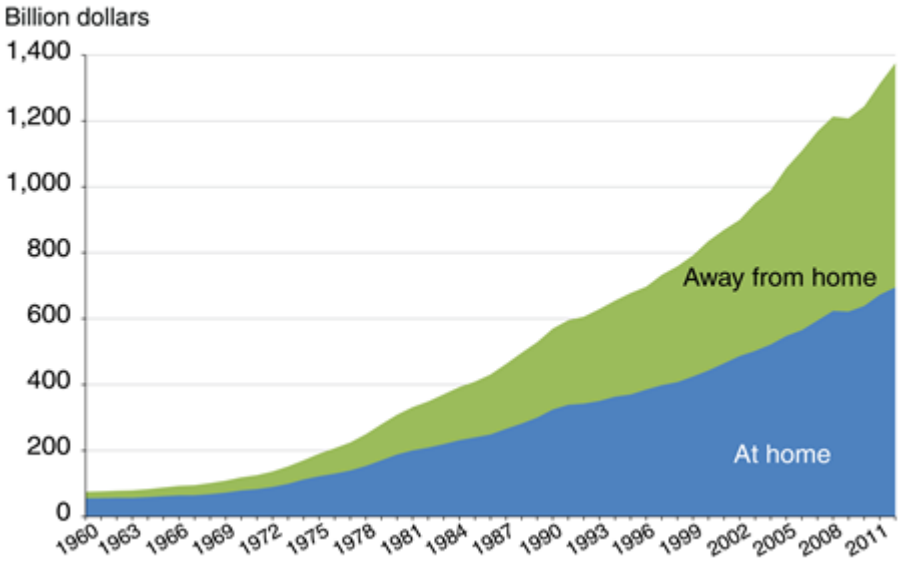
Consumption Trends

U.S. per capita availability of beef, pork, and chicken, 1909-2012

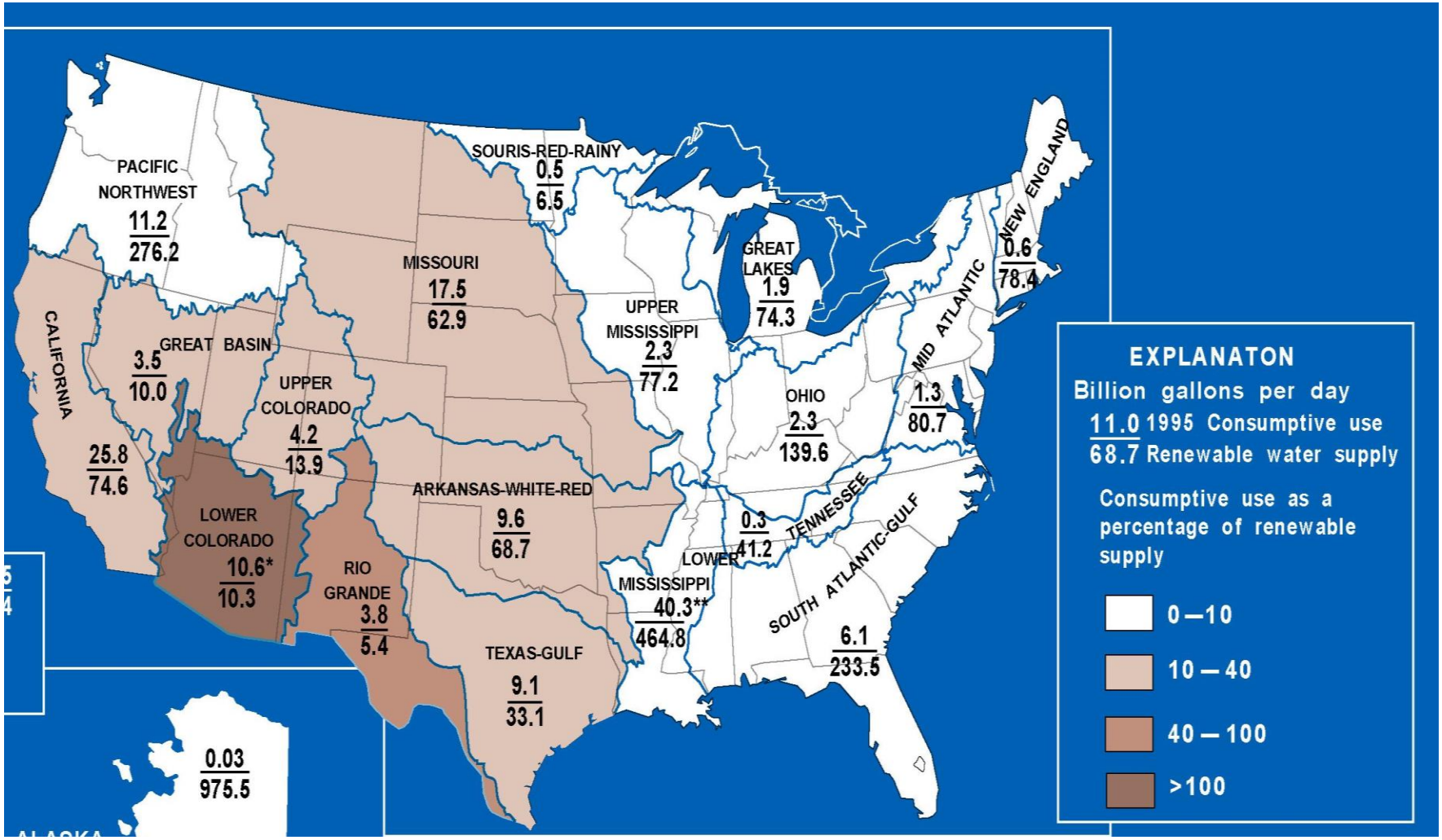


[1]Calculated on the basis of raw and edible meat in boneless, trimmed (edible) weight. Excludes edible offals, bones, viscera, and game from red meat. Includes skin, neck, and giblets from chicken. Excludes use of chicken for commercially prepared pet food.
Source: USDA, Economic Research Service, Food Availability Data.

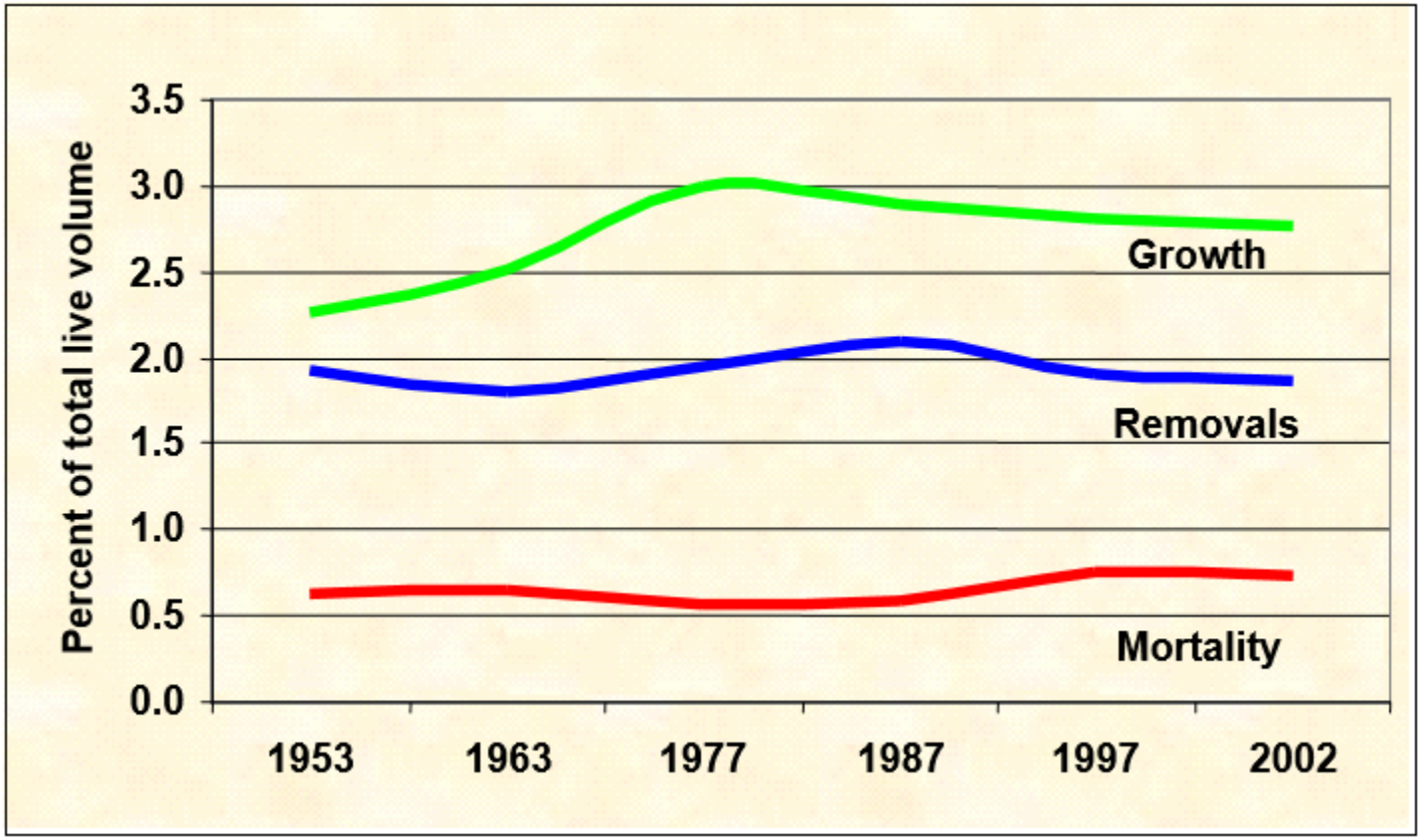
Food-at-home and away-from-home expenditures in the United States, 1960-2012



Source: USDA, Economic Research Service, Food Expenditure Series.

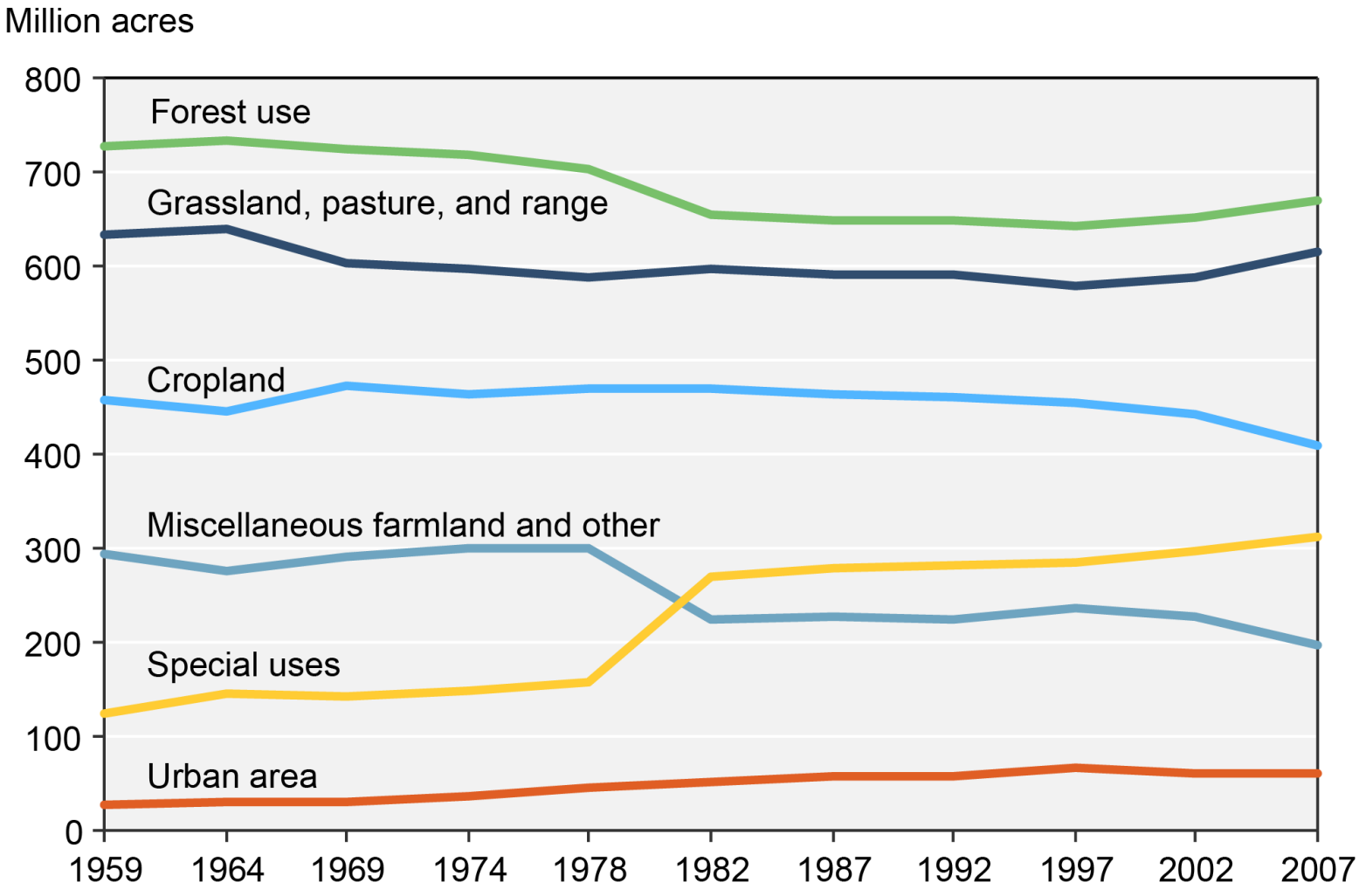

PACIFIC NORTHWEST
11.2
276.2
CALIFORNIA
25.8
74.6
GREAT BASIN
3.5
10.0
UPPER COLORADO
4.2
13.9
LOWER COLORADO
10.6*
10.3
RIO GRANDE
3.8
5.4
MISSOURI
17.5
62.9
SOURIS-RED-RAINY
0.5
6.5
ARKANSAS-WHITE-RED
9.6
68.7
TEXAS-GULF
9.1
33.1
UPPER MISSISSIPPI
2.3
77.2
GREAT LAKES
1.9
74.3
OHIO
2.3
139.6
TENNESSEE
0.3
41.2
LOWER MISSISSIPPI
40.3**
464.8
SOUTH ATLANTIC-GULF
6.1
233.5
MID ATLANTIC
1.3
80.7
NEW ENGLAND
0.6
78.4
0.03
975.5
EXPLANATON
Billion gallons per day
11.0 1995 Consumptive use
68.7 Renewable water supply
Consumptive use as a percentage of renewable supply
0—10
10—40
40—100
>100

Rates of Growing Stock Growth, Removal and Mortality on Productive Unreserved Forest (1953-2002)



Source: National Report on Forest Resources

Major uses of land, 1959-2007



Source: USDA, Economic Research Service, Major Land Use data product.

Source: http://www.ers.usda.gov/topics/farm-economy/land-use,-land-value-tenure/major-land-uses.aspx