# Using Recent Land Use Changes to Validate Land Use Change Models

Bruce Babcock

Iowa State University

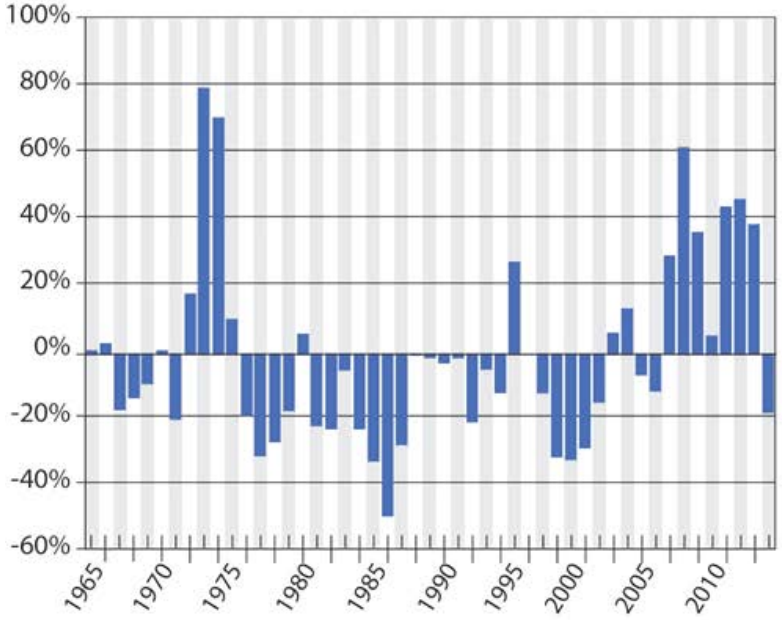
# Unique Opportunity to Estimate Ag Supply Response

- Largest sustained increased in agricultural production in the last 60 years

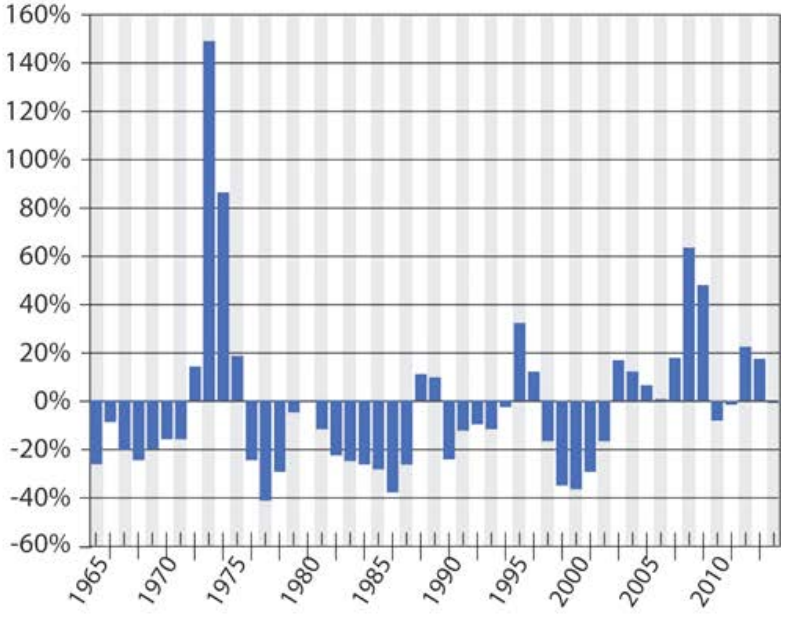
- Next chart:

% change in current price compared to lagged five year average price

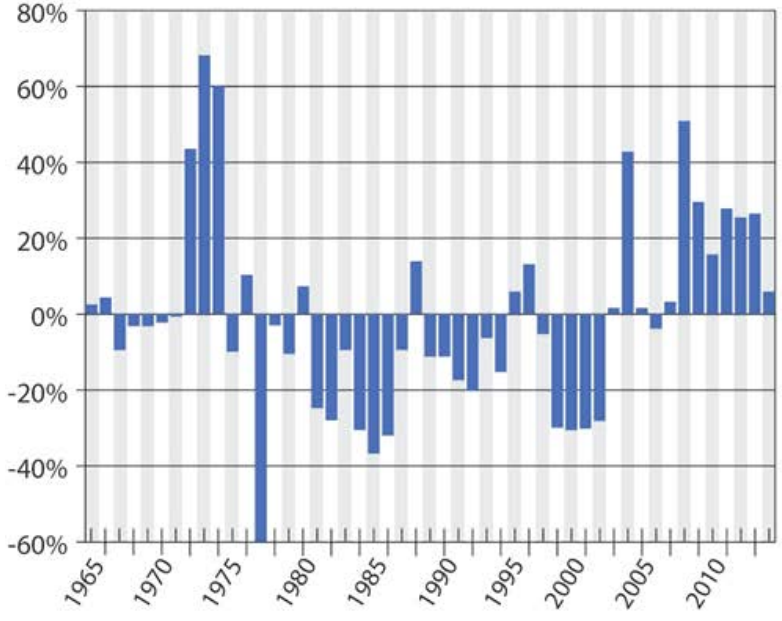
## Corn



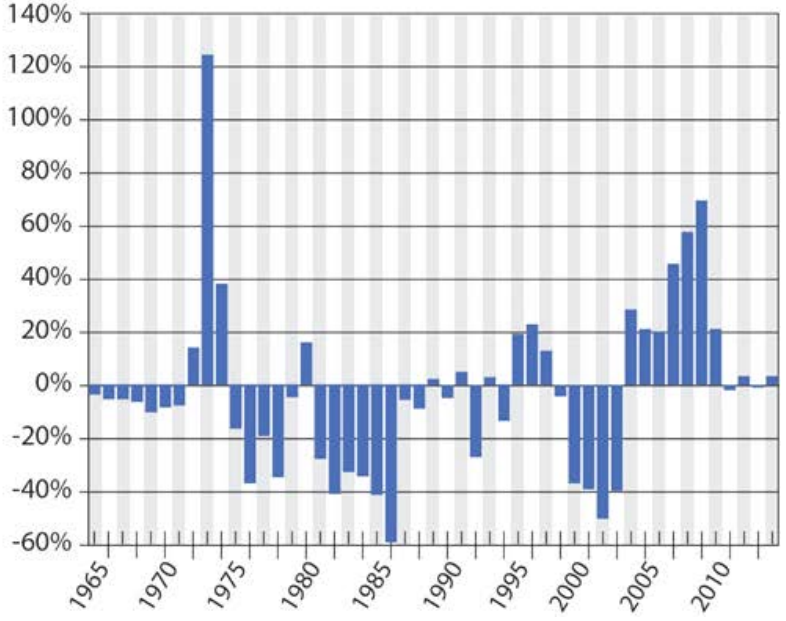

## Wheat

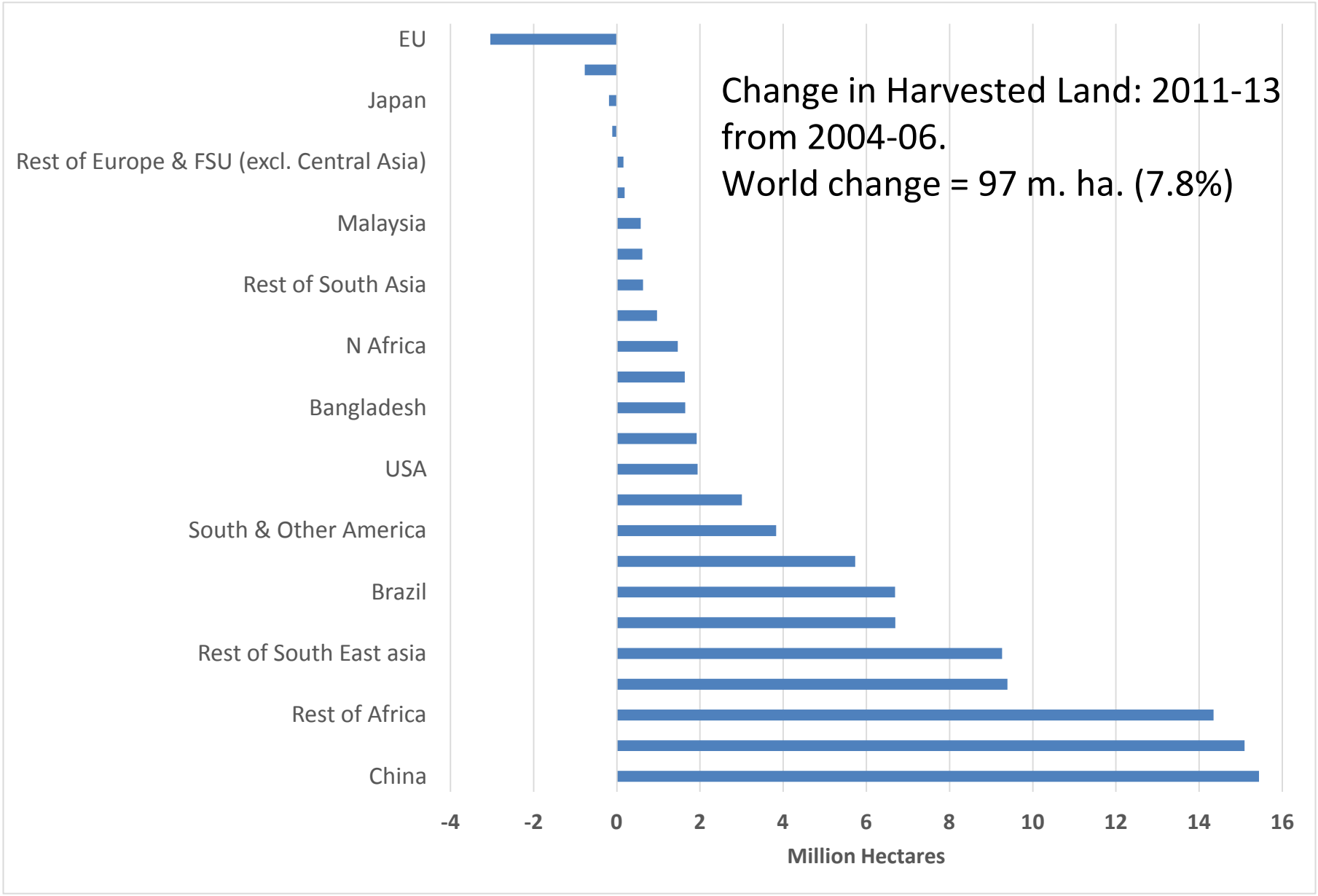



## Soybeans




## Rice

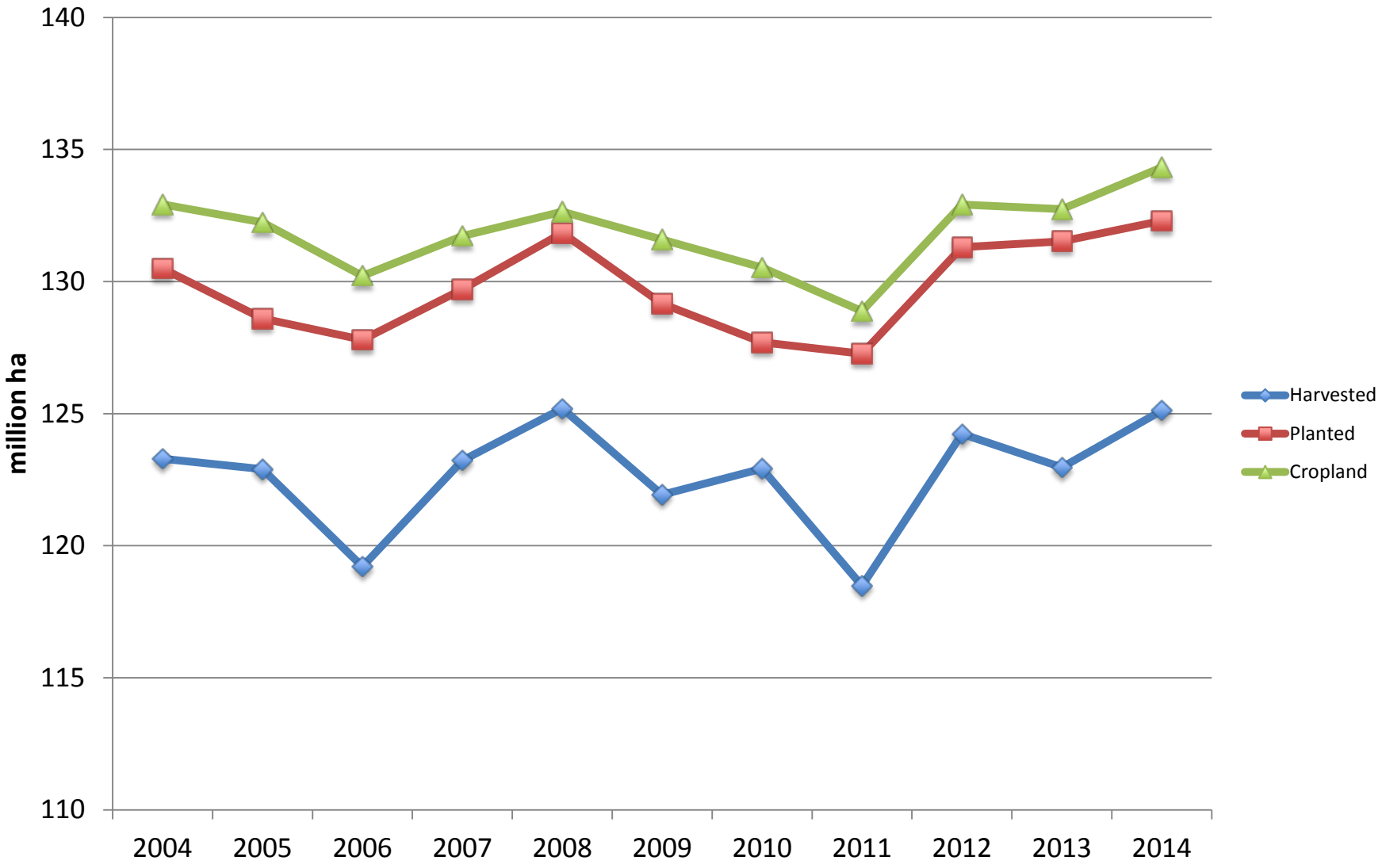


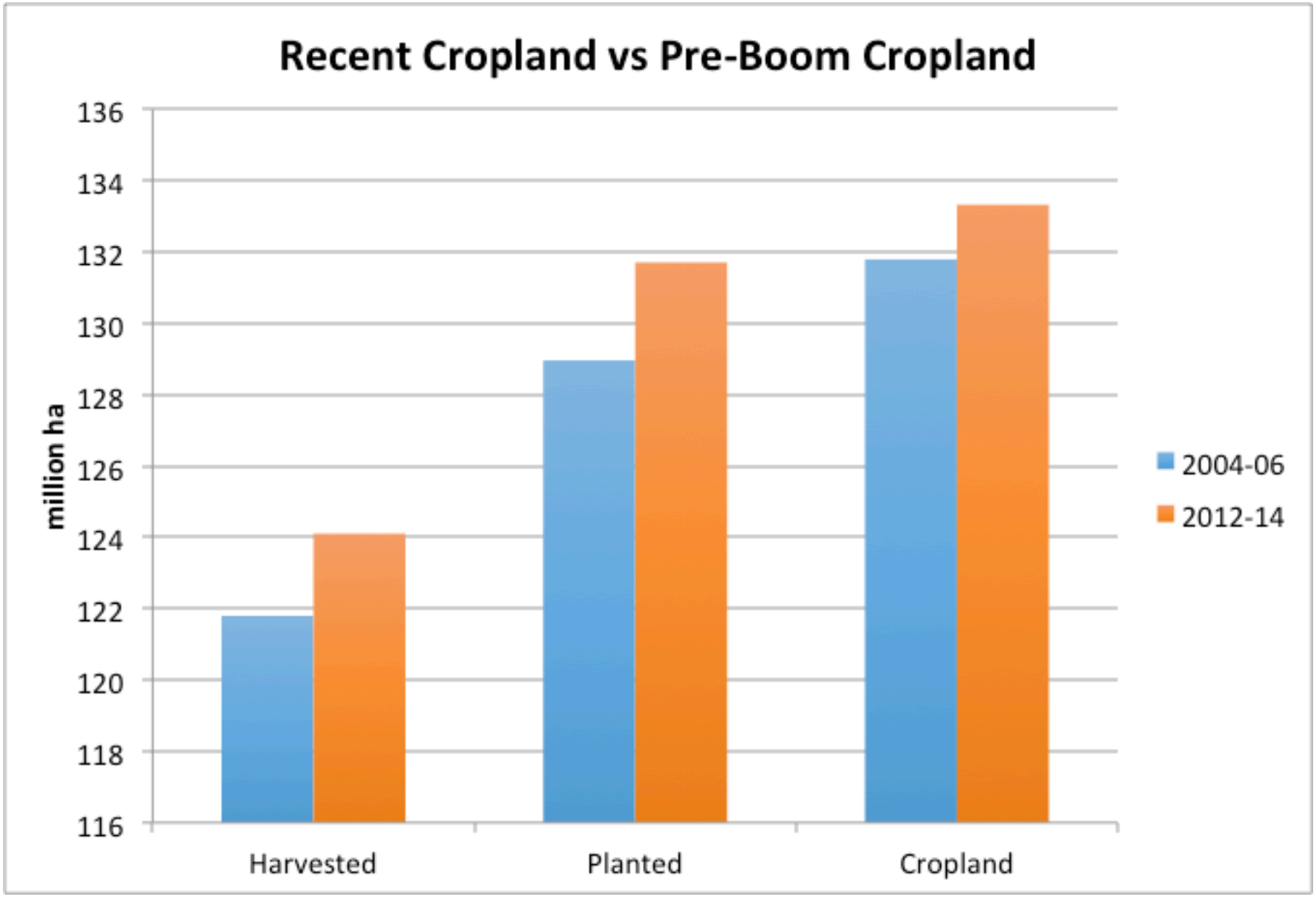

Change in Harvested Land: 2011-13 from 2004-06.
World change = 97 m. ha. (7.8%)
EU
Japan
Rest of Europe & FSU (excl. Central Asia)
Malaysia
Rest of South Asia
N Africa
Bangladesh
USA
South & Other America
Brazil
Rest of South East asia
Rest of Africa
China
-4
-2
0
2
4
6
8
10
12
14
16
Million Hectares

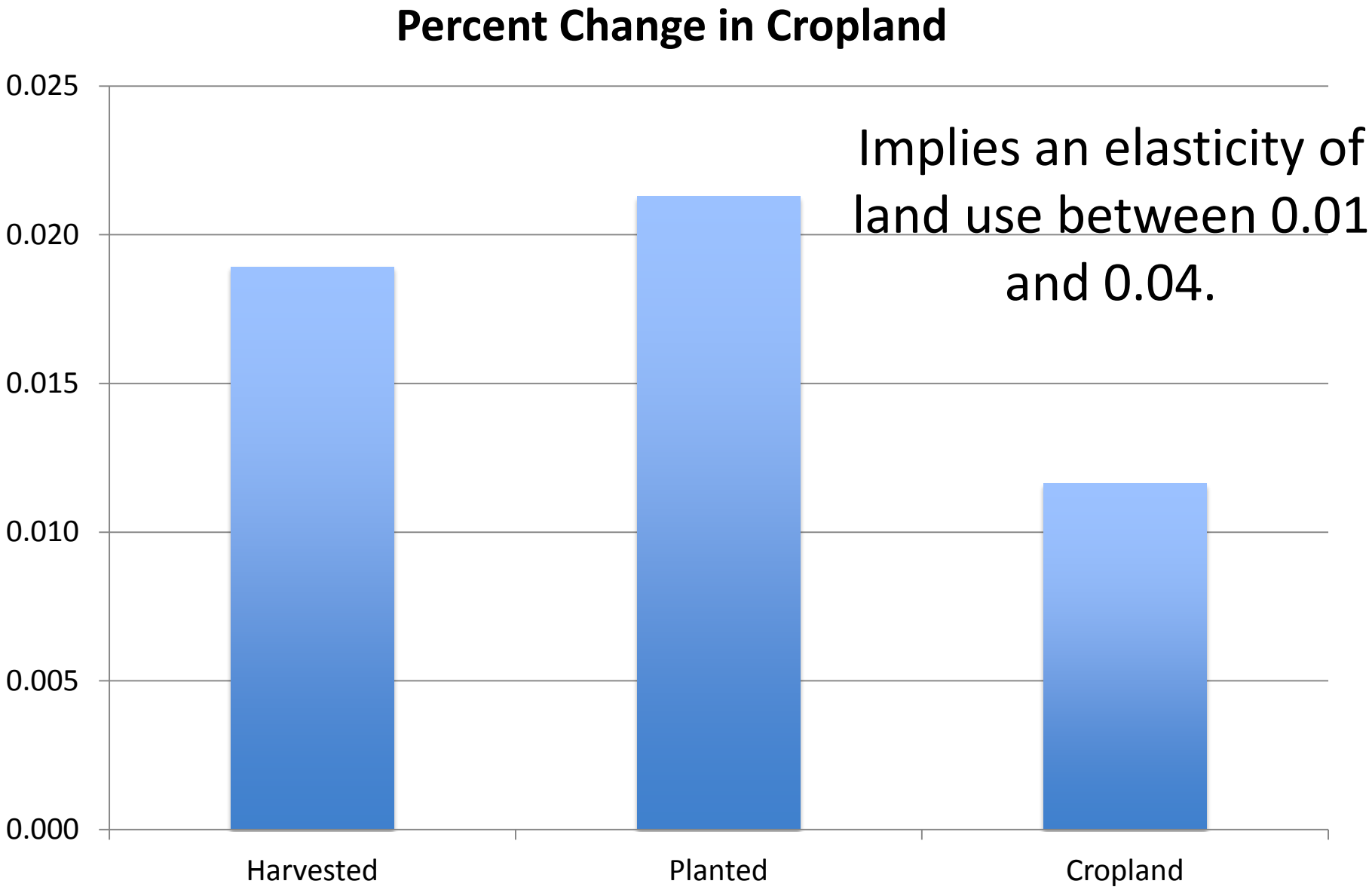
# What's Happened to US Cropland Since 2006?

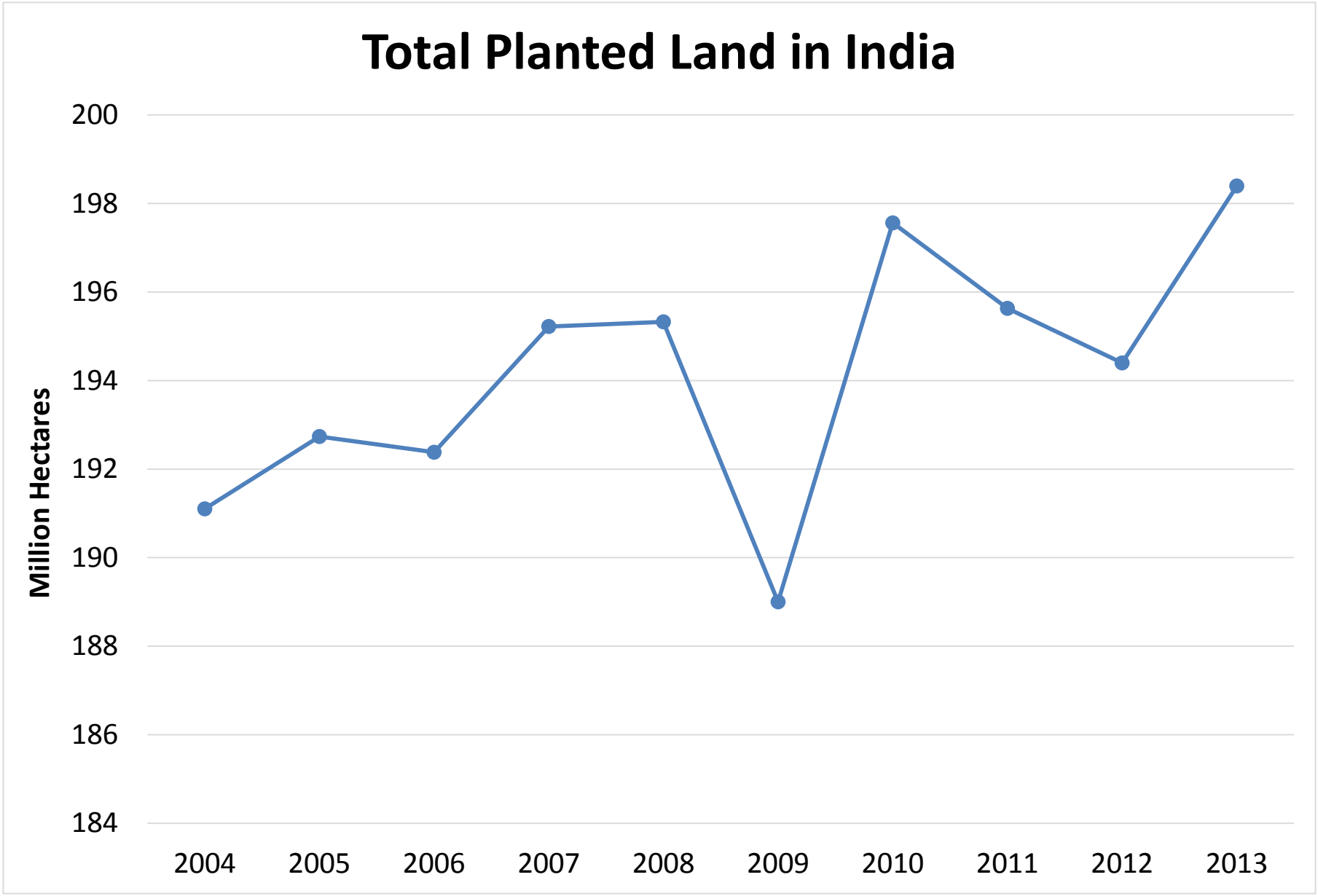
- Three measures:
  - Harvested land
    - double counts doubled cropped acreage, does not count fallow land, does not count planted but harvested acres
  - Planted land
    - double counts double cropped acres, does not count fallow land
  - US Cropland
    - adds fallow land, subtracts doubled cropped acres

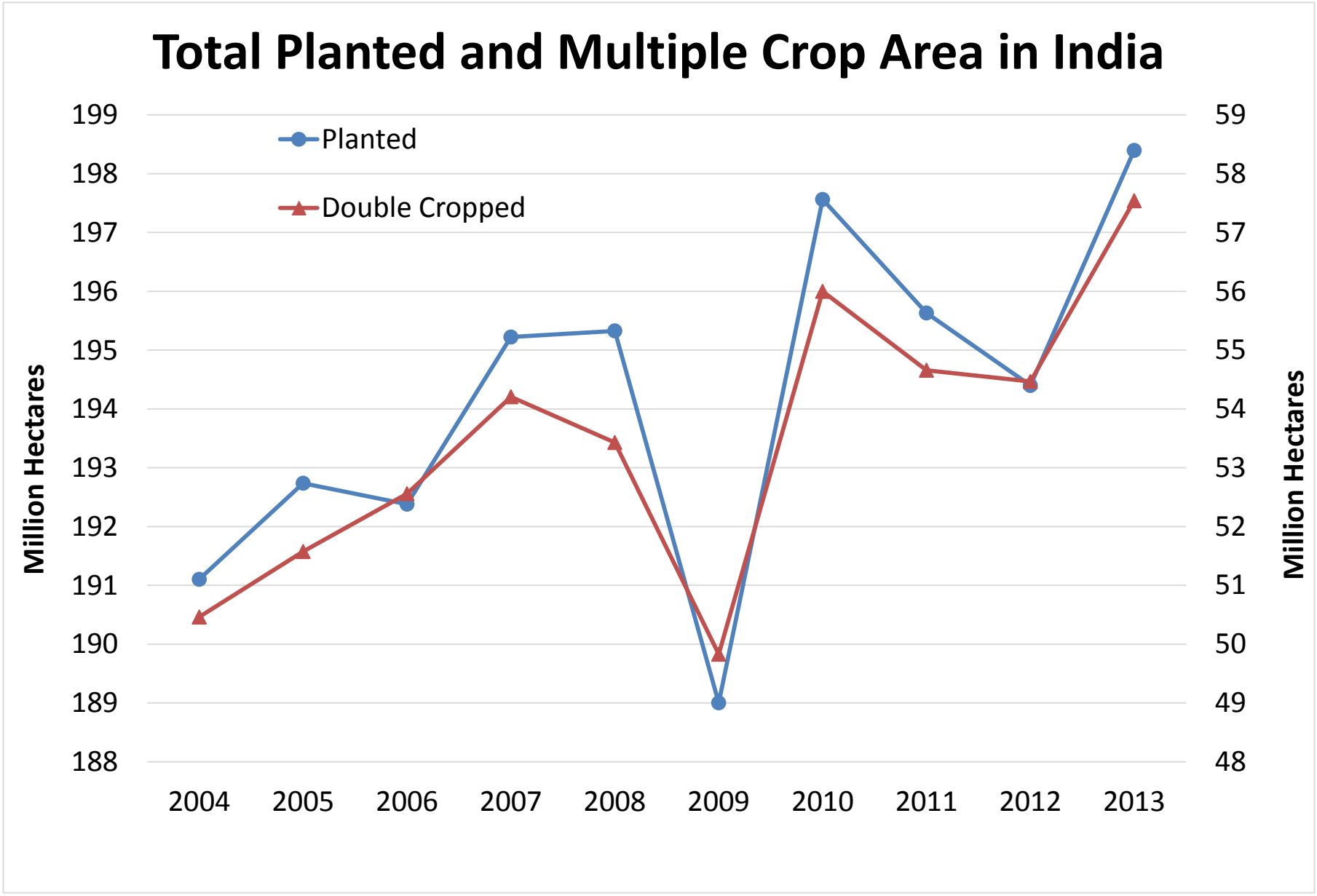
# US Cropland Changes since 2004

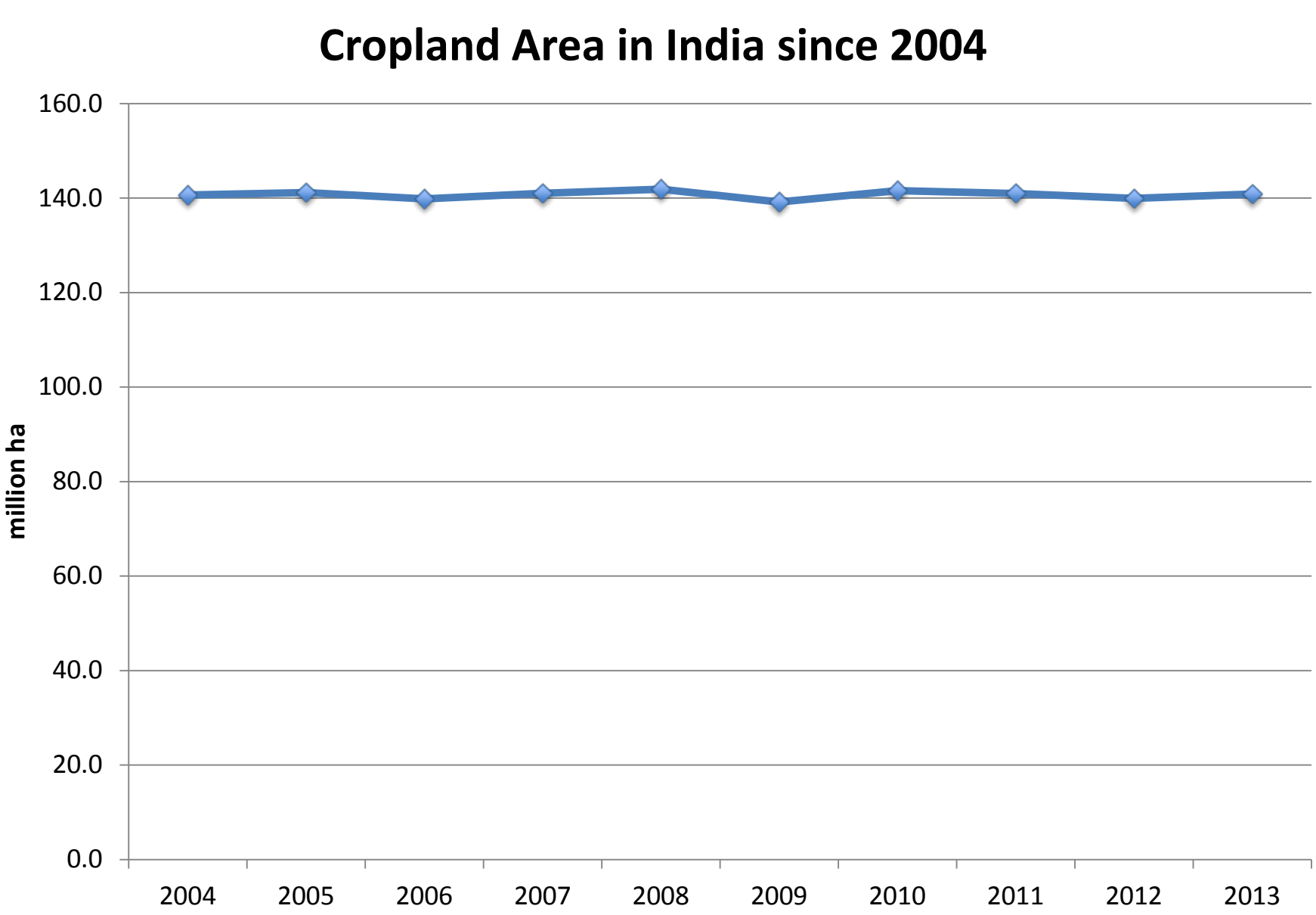


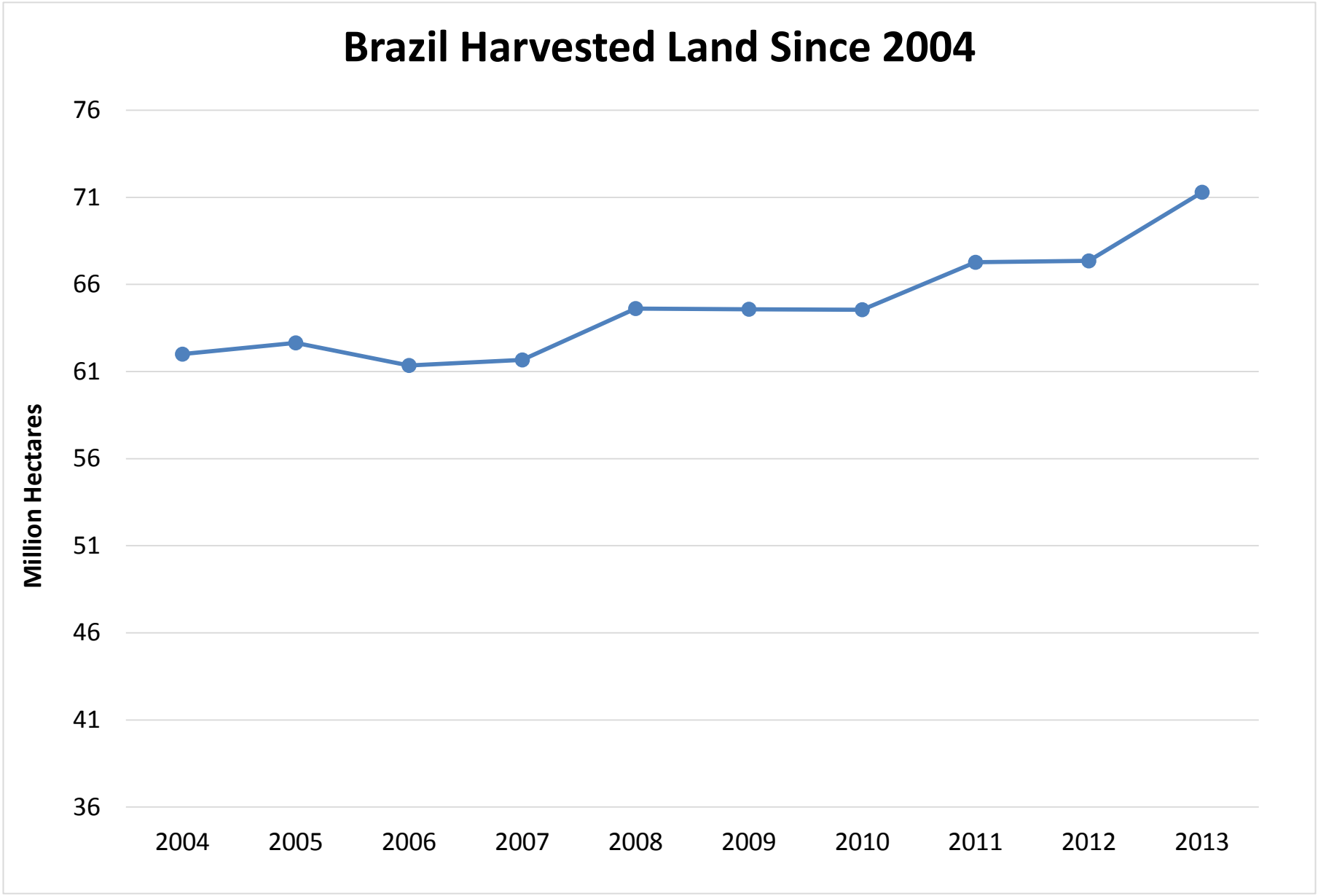

Recent Cropland vs Pre-Boom Cropland
136
134
132
130
128
126
124
122
120
118
116
million ha
Harvested
Planted
Cropland
2004-06
2012-14


Percent Change in Cropland
0.025
0.020
0.015
0.010
0.005
0.000
Harvested
Planted
Cropland
Implies an elasticity of land use between 0.01 and 0.04.

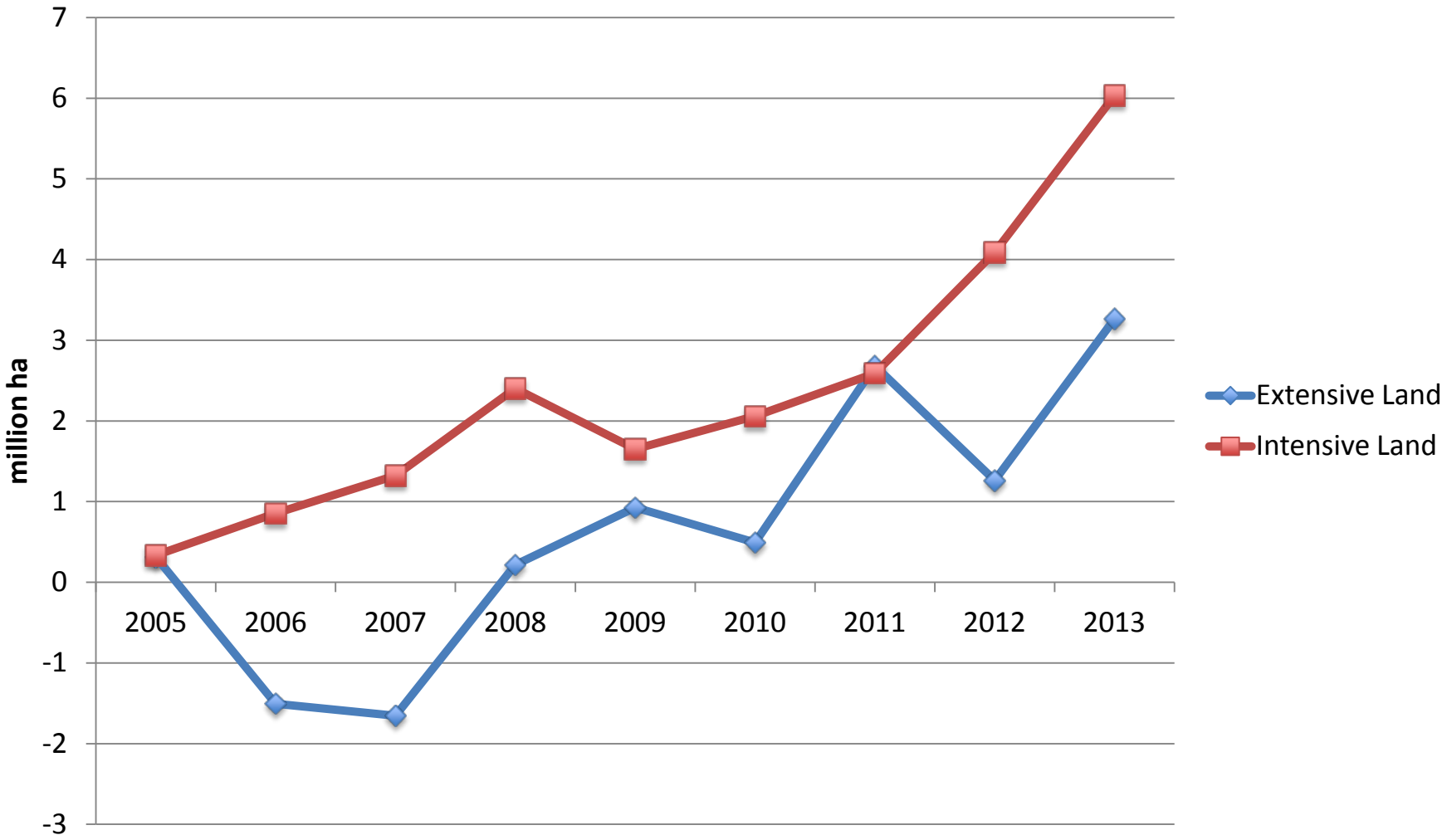

Total Planted Land in India
Million Hectares
200
198
196
194
192
190
188
186
184
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

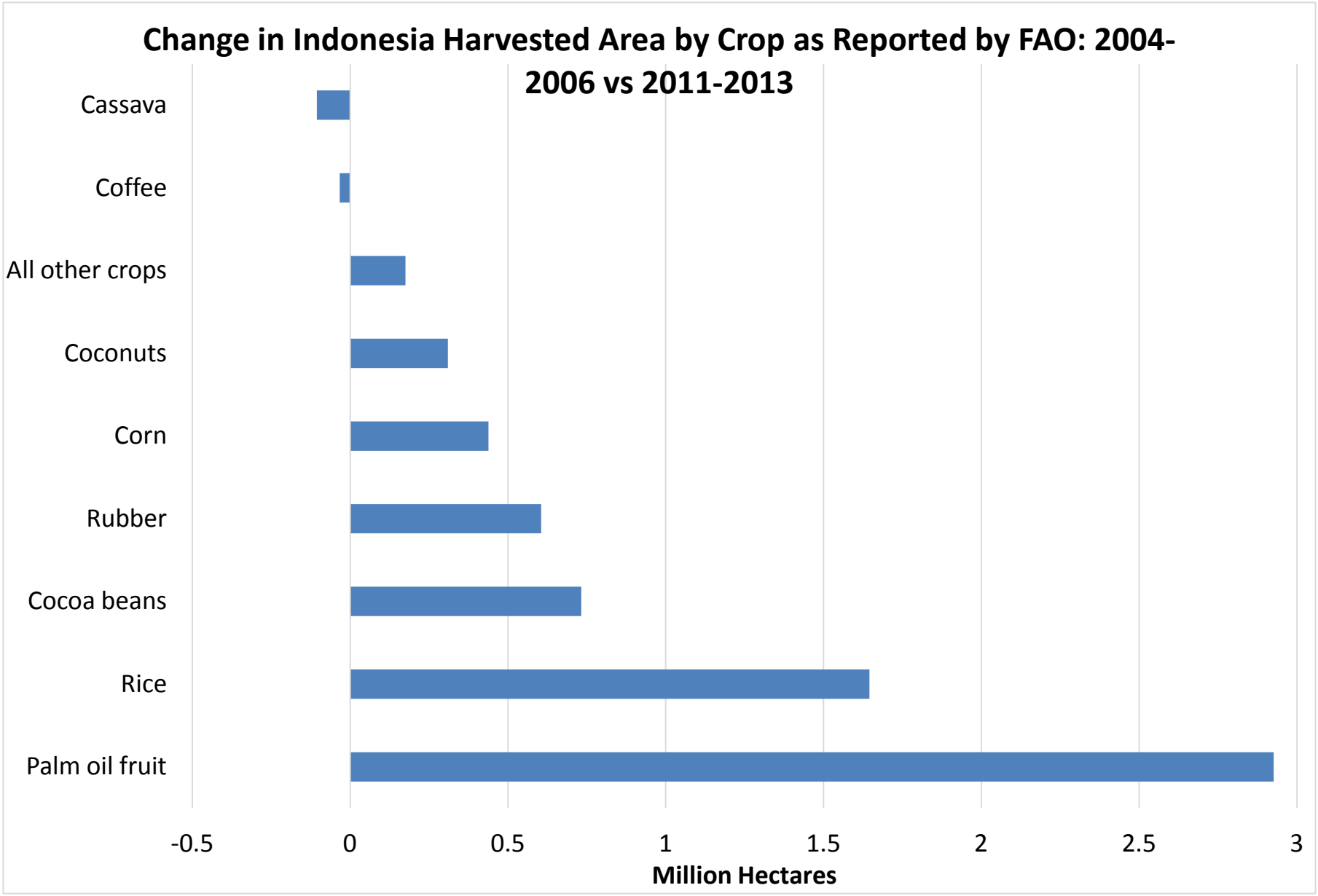

Total Planted and Multiple Crop Area in India
Planted
Double Cropped
Million Hectares
Million Hectares
199
198
197
196
195
194
193
192
191
190
189
188
59
58
57
56
55
54
53
52
51
50
49
48
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

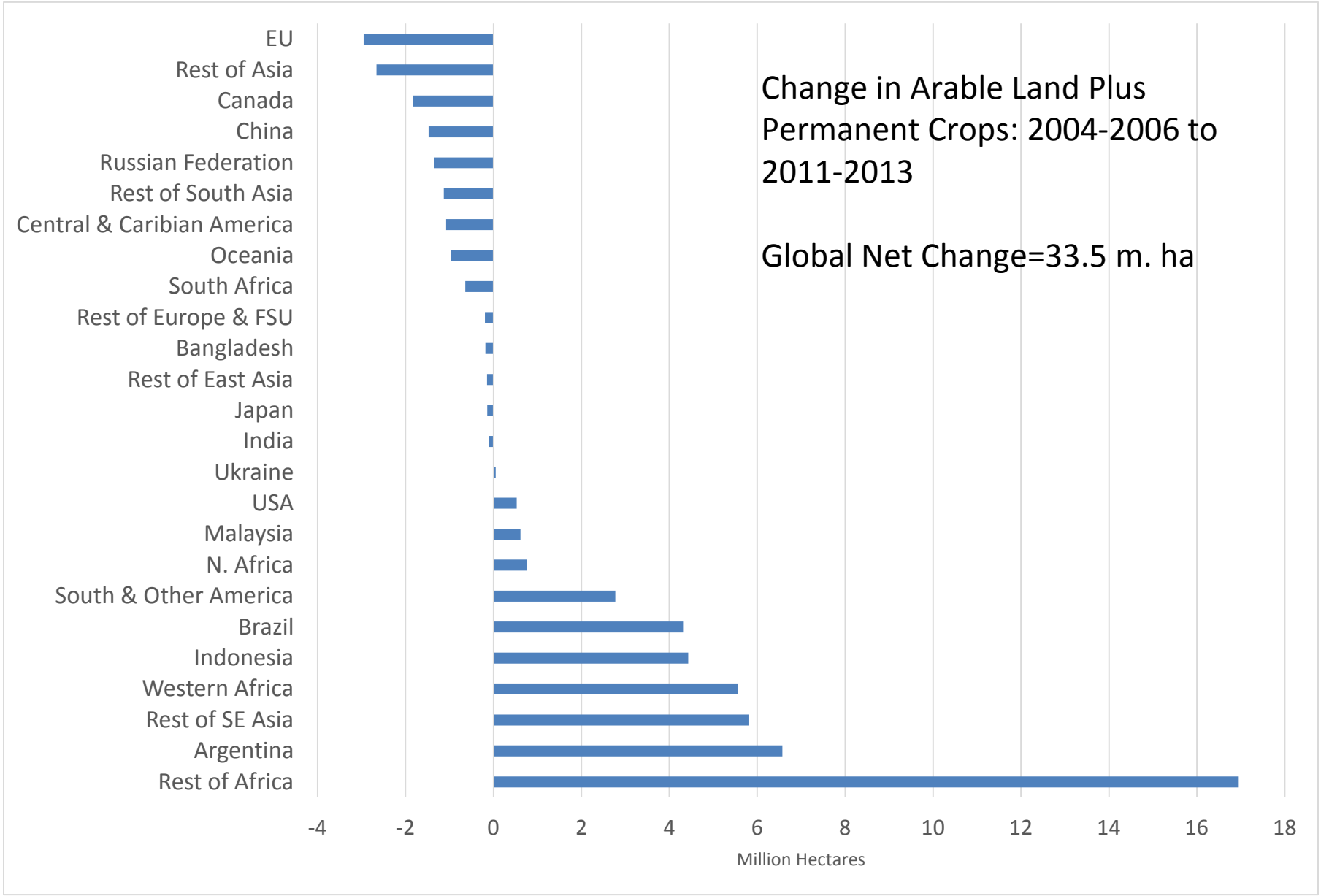

Cropland Area in India since 2004
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
million ha
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

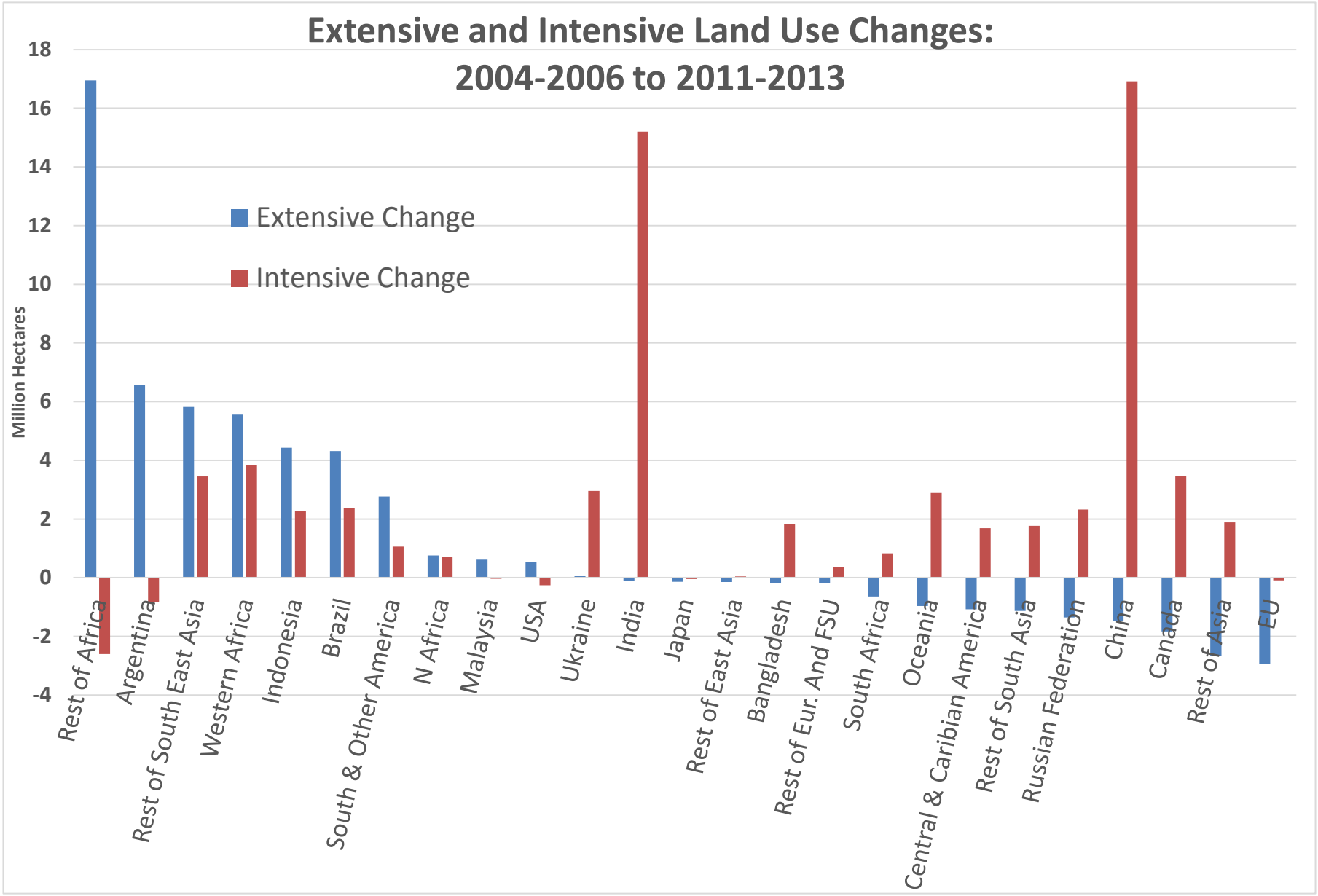

Brazil Harvested Land Since 2004
Million Hectares
76
71
66
61
56
51
46
41
36
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

# Brazilian Intensive and Extensive Land Use Change since 2004




Change in Indonesia Harvested Area by Crop as Reported by FAO: 2004-2006 vs 2011-2013
Cassava
Coffee
All other crops
Coconuts
Corn
Rubber
Cocoa beans
Rice
Palm oil fruit
-0.5
0
0.5
1
1.5
2
2.5
3
Million Hectares


EU
Rest of Asia
Canada
China
Russian Federation
Rest of South Asia
Central & Caribian America
Oceania
South Africa
Rest of Europe & FSU
Bangladesh
Rest of East Asia
Japan
India
Ukraine
USA
Malaysia
N. Africa
South & Other America
Brazil
Indonesia
Western Africa
Rest of SE Asia
Argentina
Rest of Africa
-4
-2
0
2
4
6
8
10
12
14
16
18
Million Hectares
Change in Arable Land Plus Permanent Crops: 2004-2006 to 2011-2013
Global Net Change=33.5 m. ha


Extensive and Intensive Land Use Changes:
2004-2006 to 2011-2013
Million Hectares
18
16
14
12
10
8
6
4
2
0
-2
-4
Extensive Change
Intensive Change
Rest of Africa
Argentina
Rest of South East Asia
Western Africa
Indonesia
Brazil
South & Other America
N Africa
Malaysia
USA
Ukraine
India
Japan
Rest of East Asia
Bangladesh
Rest of Eur. And FSU
South Africa
Oceania
Central & Caribian America
Rest of South Asia
Russian Federation
China
Canada
Rest of Asia
EU

# Observations

- Other than in African countries, extensive land use has totaled a net of 10 million ha
- Countries with extensive land use increases include
  - Argentina: (lost wheat land needed for double cropped soybeans)
  - Indonesia and Malaysia (palm oil plantations)
  - Other SE Asia (Vietnam, Thailand)
  - Other S. America (Uruguay and Paraguay soybeans)
  - Brazil (soybeans outstripping double cropped corn)

- All these countries have agricultural frontiers

# Observations

- Countries that expanded at the extensive margin have land available to expand
- Countries with low agricultural productivity and rapidly expanding populations (and income?) expand at the extensive margin.
- Countries with fully developed agricultural sectors expand at the intensive margin
- Countries with messed up ag policies (Argentina) expand at the extensive margins

# Implications

- Total factor productivity a much better measure of productivity than yield changes
- Past models of land use changes have over-estimated land use changes relative to what they would have done had they included land use intensification
- Observed land use changes place limits on the impact of higher prices on land use change
  - Countries that contracted would have contracted more
  - Countries that expanded would have expanded less or not at all
  - Countries that had not changes would have contracted
- Importance of government land use policy cannot be over-estimated