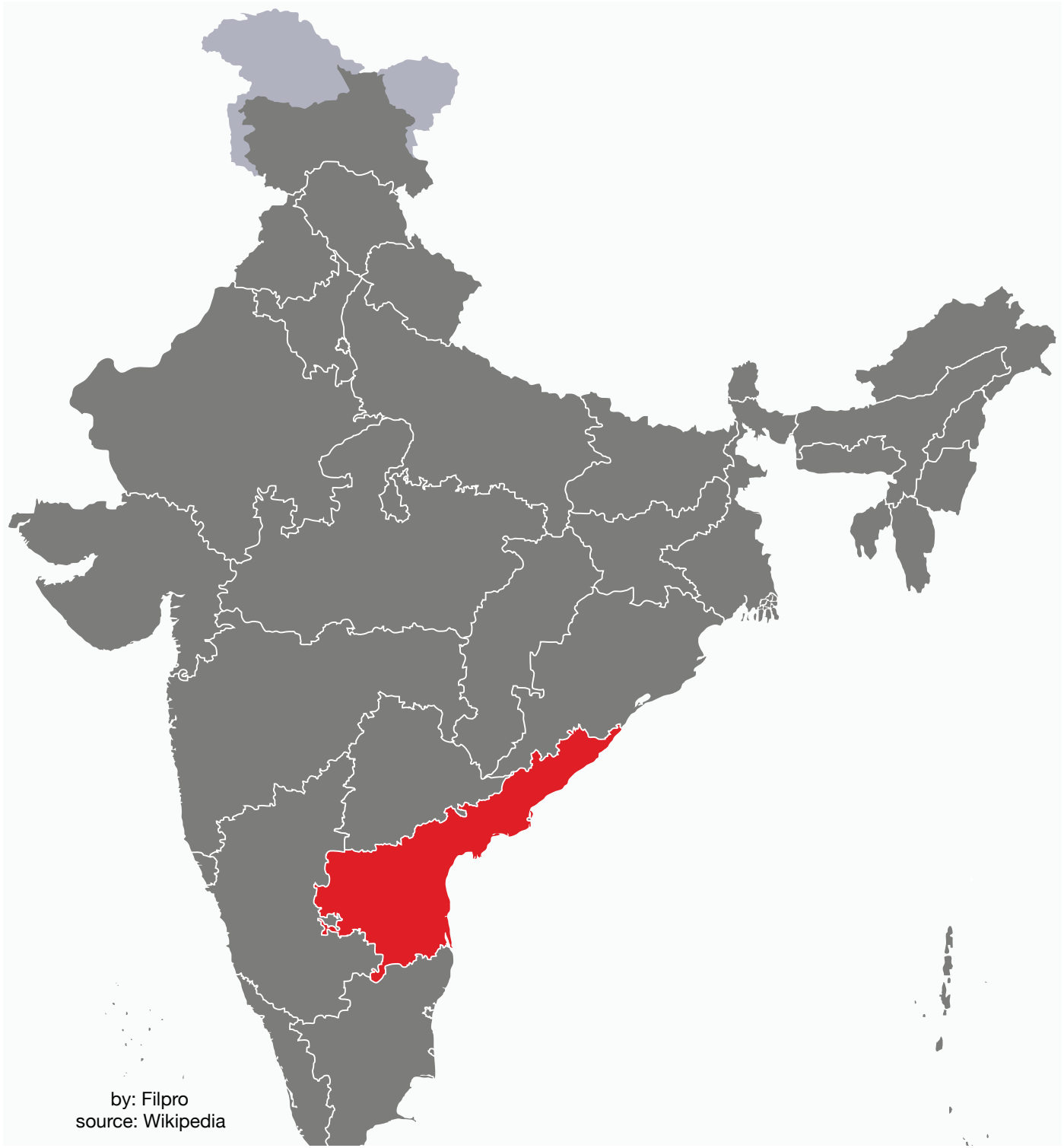
Drivers of Forest Plantation Establishment in Andhra Pradesh

Randolph H. Wynne, Valerie A. Thomas, Haripriya Gundimeda,
Gregory S. Amacher, Kelly M. Cobourn, Gunnar Köhlin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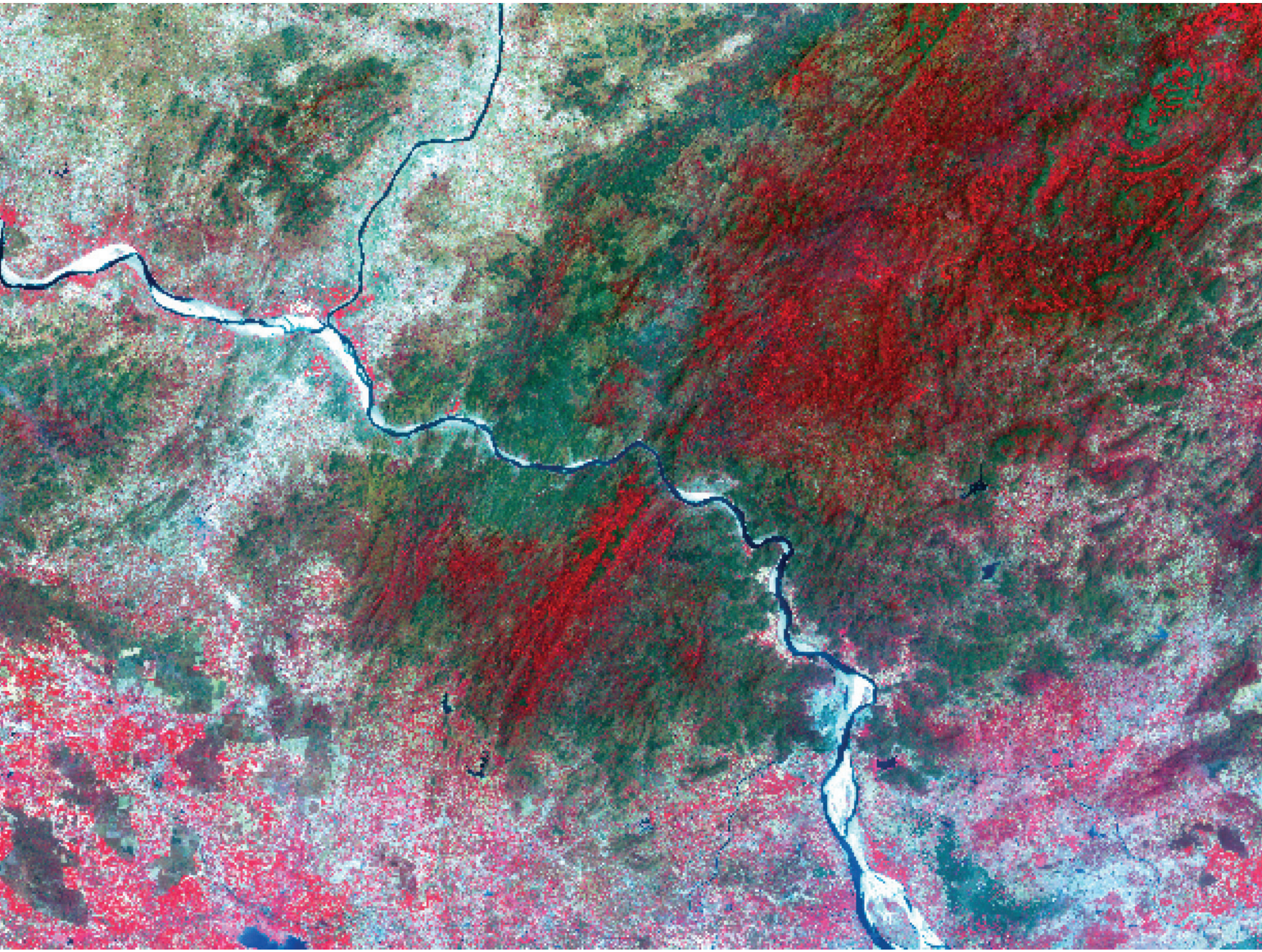

Green cheer: Forest cover increases in Telugu states

U Sudhakar Reddy| TNN | Feb 13, 2018, 05:52 IST

HYDERABAD: In terms of increase of forest and tree cover, Telangana stood fifth in the country by increasing its tree cover by 565 square kilometres. Neighbouring Andhra Pradesh stood first in the country with the maximum increase of forest and tree cover of over 2,141square kilometres.

Conversion from rice to typical clonal hybrid Casuarina plantation. The Forest Survey of India notes tree cover > 11,100 km^2 was added during the period 2001 to 2015.

Drivers of conversion from agriculture to forest plantations?

- Productive pest-resistant clones of Eucalyptus, Subabul and Casuarina
- Reduced human inputs compared to crops
- ‘Absentee’ landlords
- Marginal agricultural lands
- Desire to maintain land ownership
- Policies (National Forest Policy of 1988, state-specific)

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PROJECT

ANDHRA PRADESH FORESTRY

OVERVIEW DETAILS FINANCIALS PROCUREMENT RATINGS RESULTS MAP DOCUMENTS NEWS & MEDIA

ABSTRACT*

The report discusses how this project will finance a 6-year program to support: (a) forestry works on about 355,000 ha. This will consist of regenerating or afforesting degraded forest areas on about 173,000 ha with multi-tier coverage under

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A.P. Forest Development Corporation Ltd.,

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Eucalyptus

Eucalyptus Plantations

India BSE 314.50 NSE 313.95

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No.3A/86-FP
Ministry of Environment and Forests
(Department of Environment, Forests & Wildlife)

Paryavaran Bhavan, CGO Complex,
Lodi Road, New Delhi - 110 003.
Dated the 7th December, 1988.

RESOLUTION

National Forest Policy, 1988

THE HINDU

JUST IN
15 6hrs Tamil Nadu farmers detained outside PM's residence
1 5mins Roger Federer wins record eighth Wimbledon title
2 43mins Cow vigila dog filters, a goat th more - top stories fo

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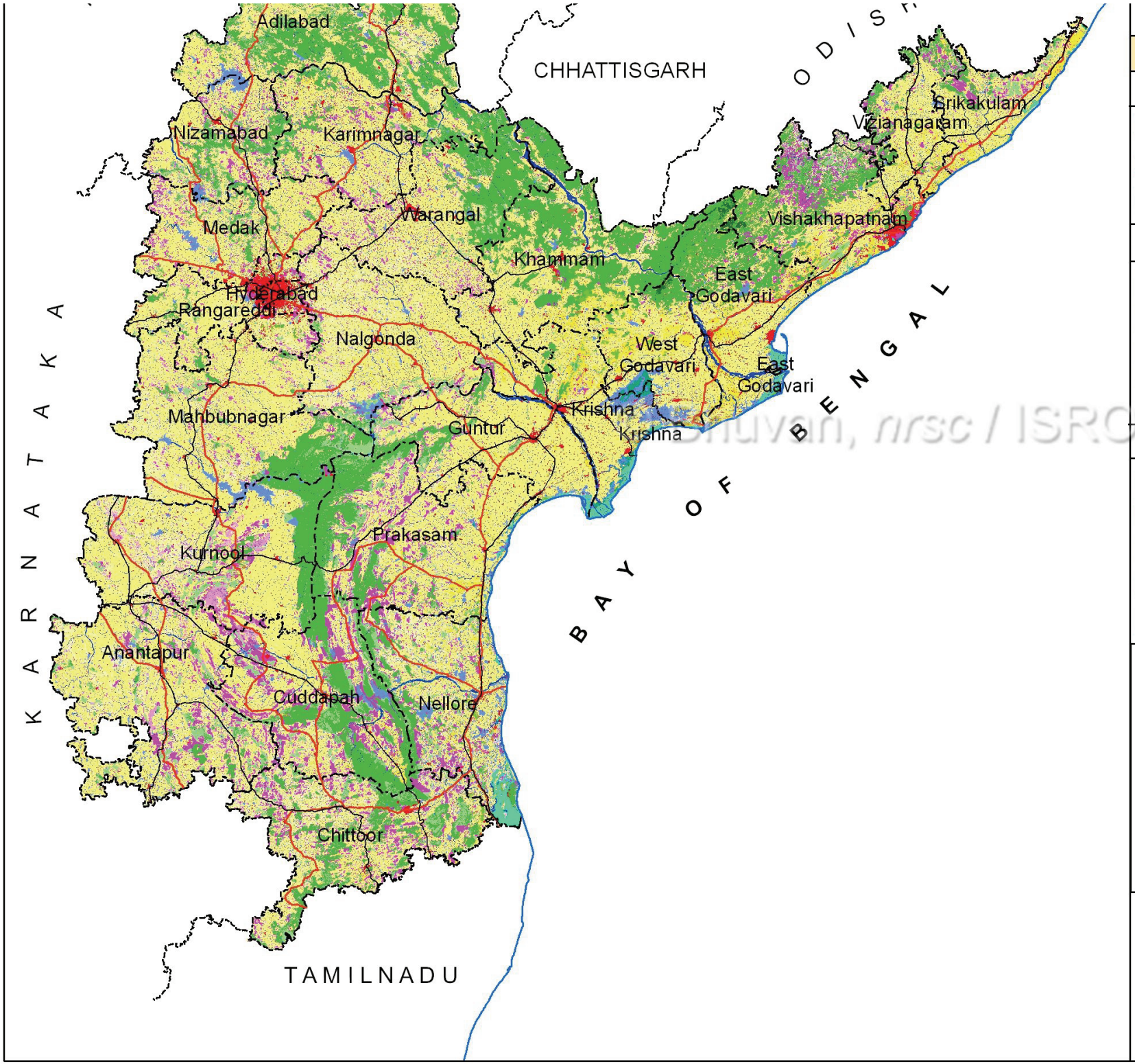
ANDHRA PRADESH

Casuarina plantations offer multiple benefits

Ravi P. Benjamin

VISAKHAPATNAM:,MAY 11, 2012 00:00 IST
UPDATED: JULY 11, 2016 16:04 IST



Classes

Built Up

- Urban
- Rural
- Mining

Agricultural Land

- Crop Land
- Agricultural Plantation
- Fallow Land
- Current Shifting Cultivation

Forest

- Evergreen/ Semi Evergreen
- Deciduous
- Forest Plantation
- Scrub Forest
- Swamp/ Mangroves

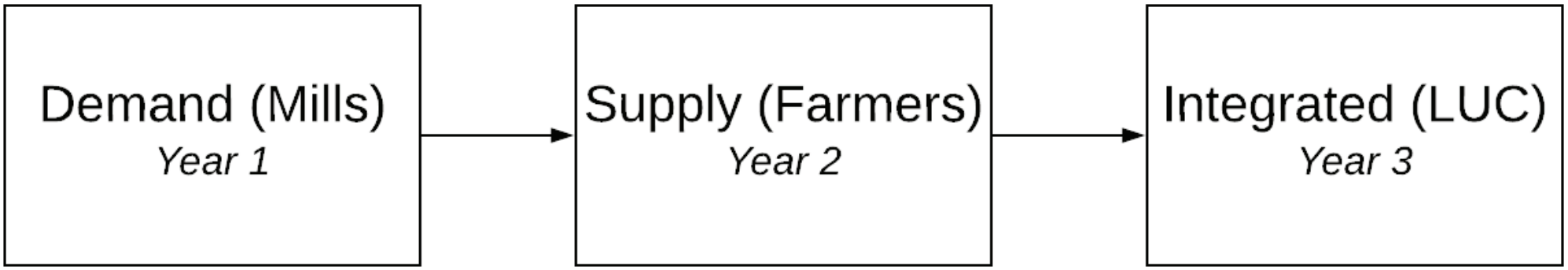
Location Map

Coordination:

National Remote Sensing Centre,
Indian Space Research Organization,
Department of Space, Govt. of India
Balanagar, Hyderabad
Telangana, India 500 037

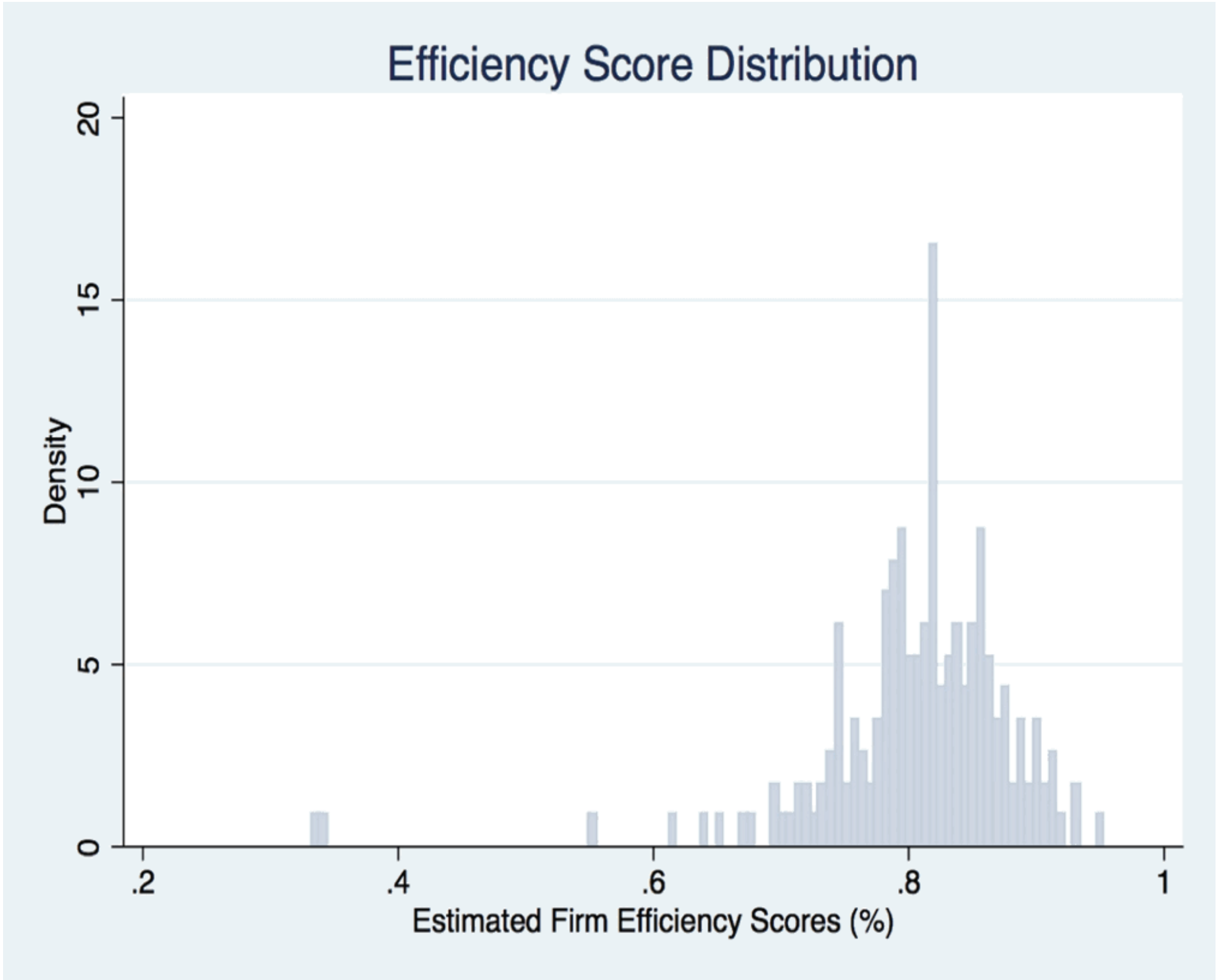
Economic Analysis

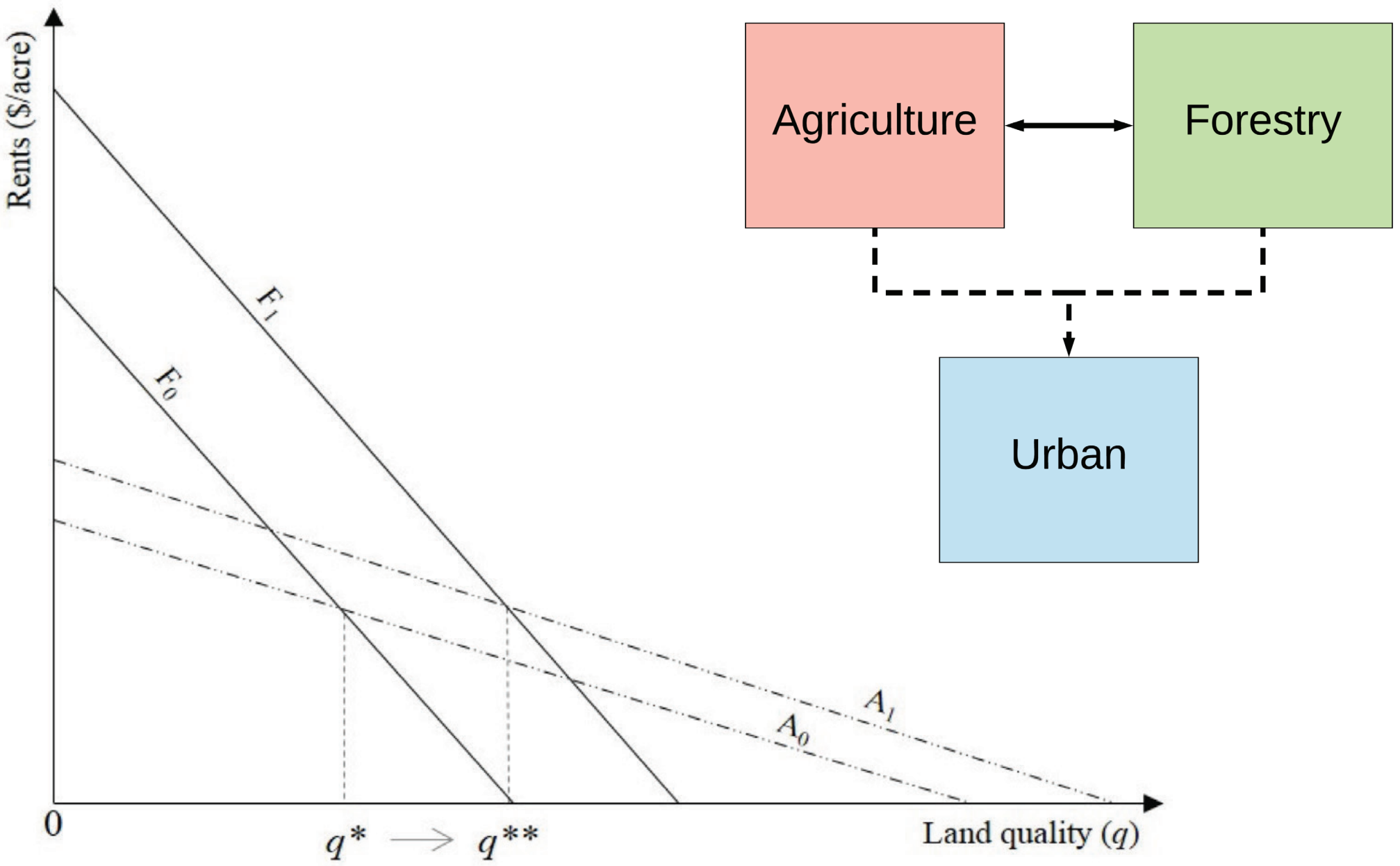
The primary expected outcome is an empirical realization of forest plantation establishment in village-based economies where smallholders establish forest plantations on previously degraded lands for both timber and non-timber use, using a unique data set developed over time and space through the period covered by the proposal.



Andhra Pradesh Mills

Categorical variable	Observations	Proportion
Rural location	638	51.2
Urban location		48.4
Privately-owned	463	42.8
Individual proprietorship		17.7
Government-owned		57.2
Not ISO 14000 certified	127	91.3
ISO 14000 certified		8.7


Efficiency Score Distribution
Density
0
5
10
15
20
.2
.4
.6
.8
1
Estimated Firm Efficiency Scores (%)



Agriculture

Forestry

Urban

Plantation Wood Importance

- Production function for firm *i* (y_{Fi} = value of production at time *t)*

$$y_{Fi} = \gamma_{Fi} f_i(T_F, \psi_F, S; \varepsilon_i, \beta)$$

γ_{Fi}	efficiency score parameter (1 = perfect efficiency)
T_F	labor input
ψ_F	wood input
S	other factors important to production
ε_i	stochastic error
β	coefficients to estimate

- Production function is estimated with firm level data on inputs and outputs, using stochastic frontier methods in econometrics

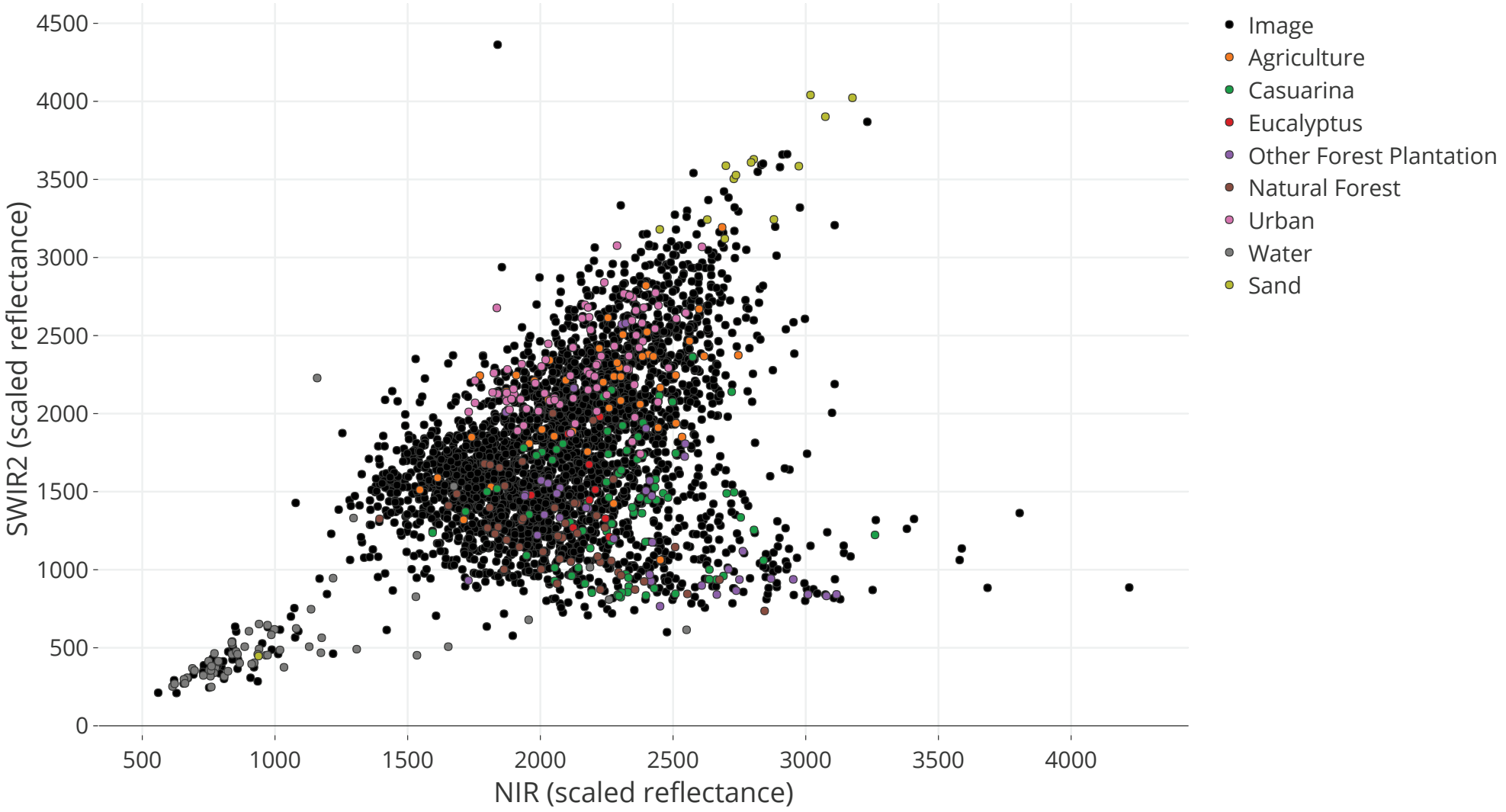
Stochastic Production Frontier Estimation Results						
Log likelihood	-32.241898		N. Observations =		187	
Wald chi2(5) =	11133.680		Prob > chi2 =		0.000	
Dependent variable: ln(gross value of outputs)	**Coefficient**	**Std. Err.**	**z**	**P>z**	**[95% Conf.**	**Interval]**
Independent variables:						
ln(value of fuel)	0.118	0.023	5.17	0.000	0.073	0.163
ln(value of materials)	0.622	0.036	17.13	0.000	0.550	0.693
ln(total value of salaries)	0.114	0.039	2.93	0.003	0.038	0.190
ln(value of working capital)	0.074	0.020	3.78	0.000	0.036	0.112
ln(gross value of fixed capital)	0.116	0.035	3.27	0.001	0.046	0.185
Constant	0.727	0.249	2.92	0.004	0.239	1.216
Error terms:	**Coefficient**	**Std. Err.**	**t**	**P>t**	**[95% Conf.**	**Interval]**
sigma_u_sqr	0.086	0.030	2.82	0.005	0.043	0.172
sigma_v_sqr	0.053	0.011	4.99	0.000	0.036	0.078
Likelihood ratio test	6.3456					

Stochastic Production Frontier Estimation

Materials = > 90% Wood Inputs

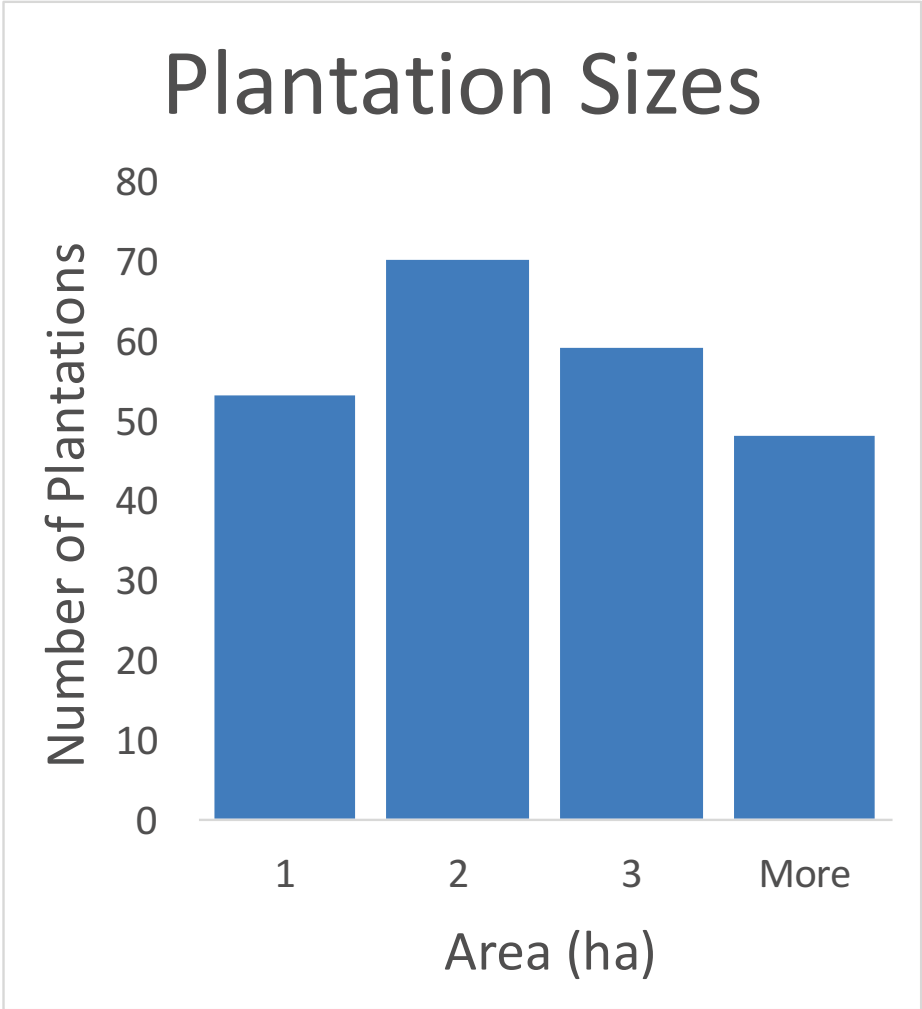
Economic Analysis Phase I Results

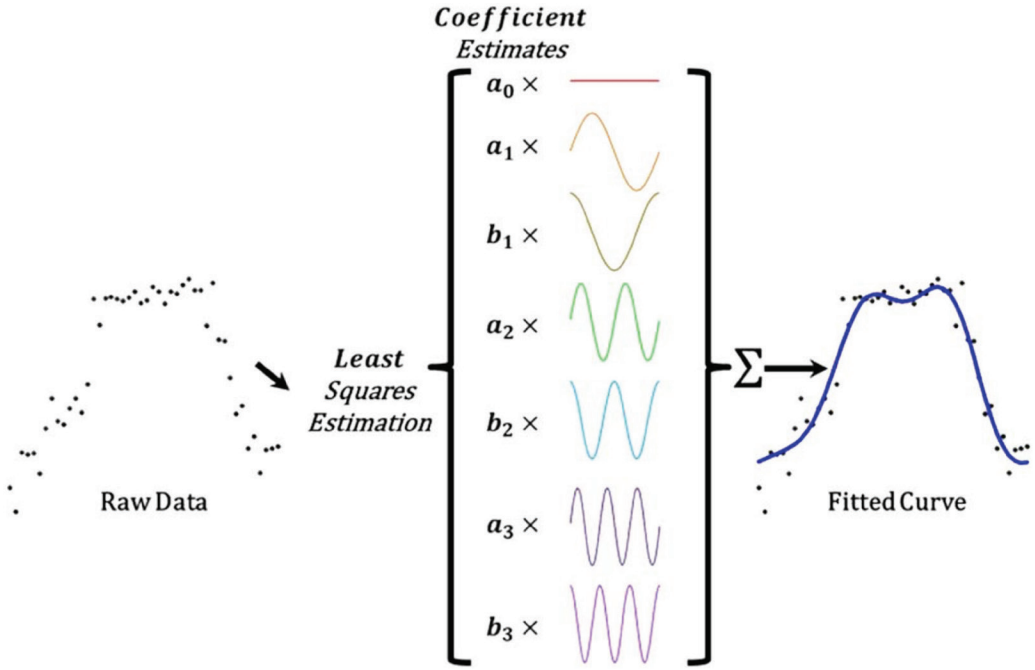
- We have estimated a prediction equation for firm level willingness to pay for wood as function of inputs (value marginal product function)
- We find wood to be the most statistically significant and important input to production for Andhra Pradesh forest product firms
- On average, each additional $R of wood increases the value of production by 0.62 $R ($Rs = 0.015 USD)
- Firms on average are operating at about 75-85% of the theoretically efficient level (γ_{Fi}, efficiency score parameter, = 1)
- Question still to evaluate is whether firms with plantation agreements have higher efficiency scores than firms without

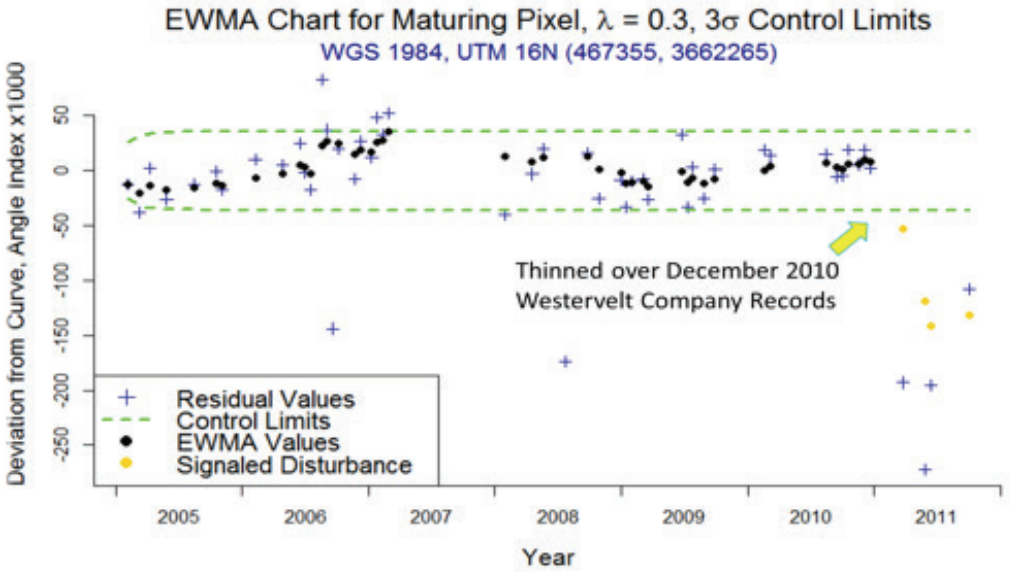

4500
4000
3500
3000
2500
2000
1500
1000
500
0
SWIR2 (scaled reflectance)
500
1000
1500
2000
2500
3000
3500
4000
NIR (scaled reflectance)
Image
Agriculture
Casuarina
Eucalyptus
Other Forest Plantation
Natural Forest
Urban
Water
Sand

Small!

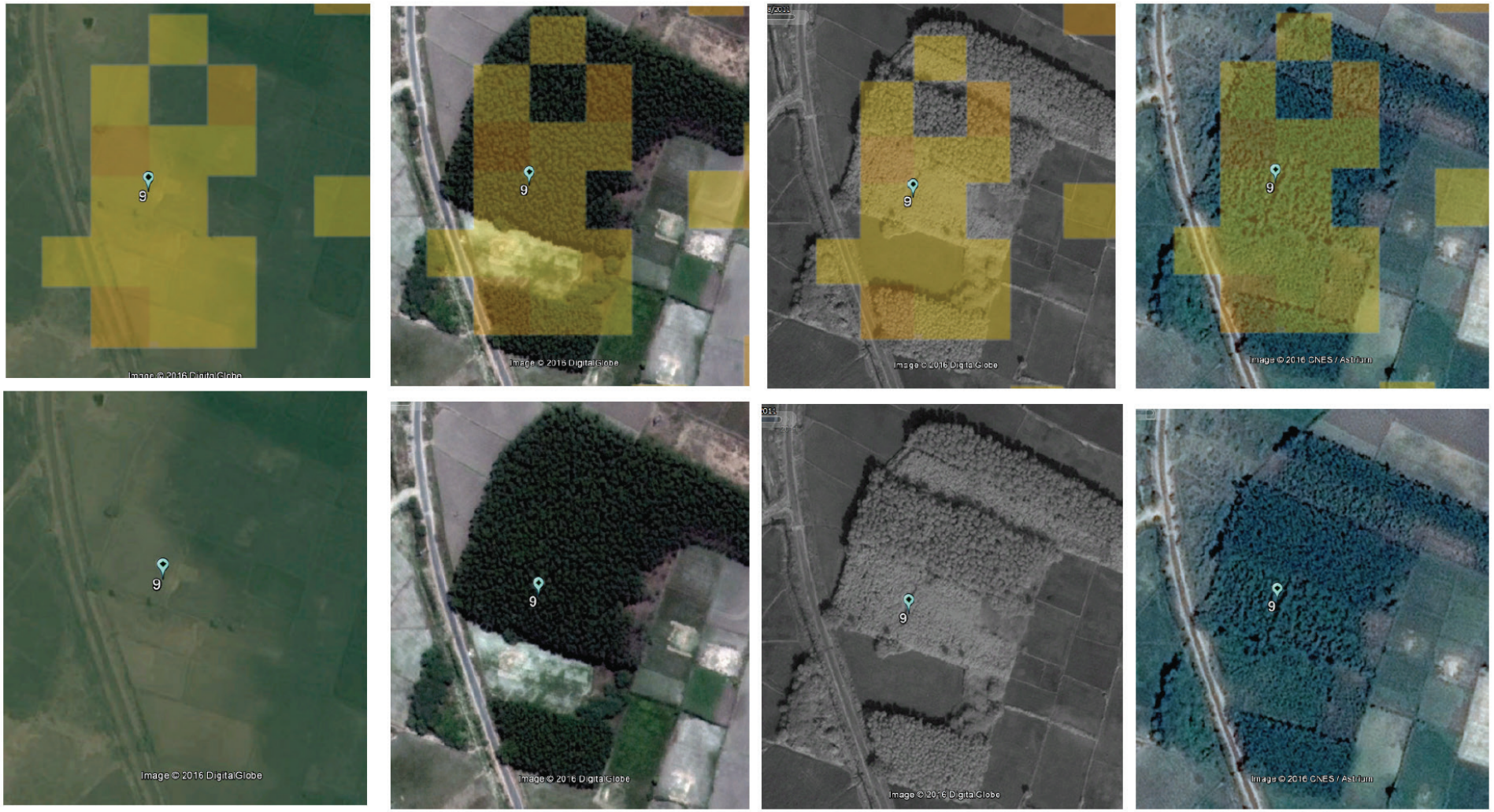
n	230
Min	0.4
Max	9.7
Mean	2.1
First Quartile	1.0
Median	1.8
Third Quartile	2.6
Standard Deviation	1.4
Variance	2.1
Standard Error	0.1




Coefficient Estimates
$a_0 \times$
$a_1 \times$
$b_1 \times$
$a_2 \times$
$b_2 \times$
$a_3 \times$
$b_3 \times$
Least Squares Estimation
Raw Data
Fitted Curve

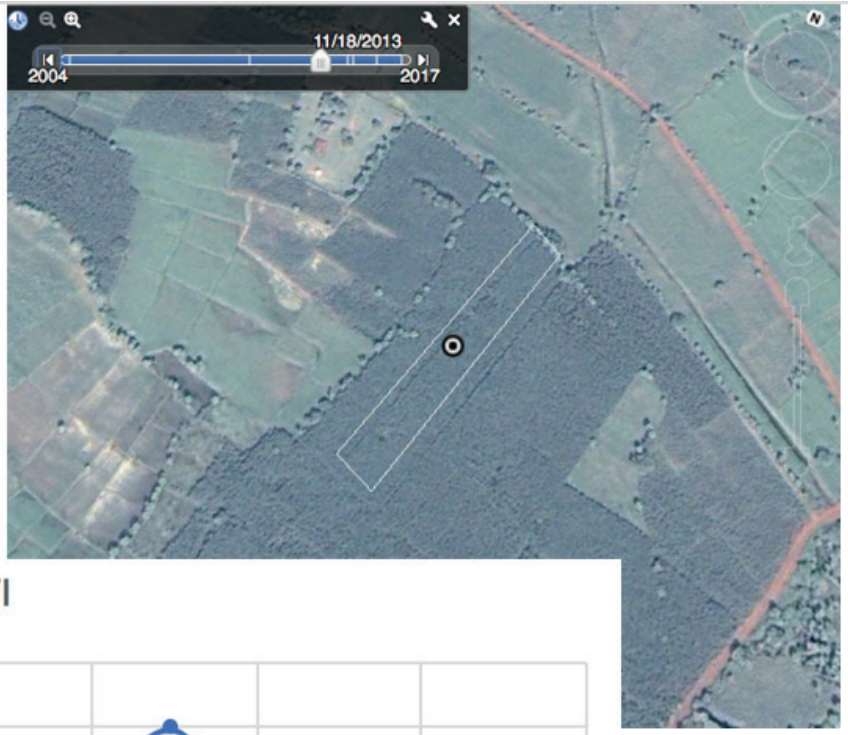

EWMA Chart for Maturing Pixel, λ = 0.3, 3σ Control Limits
WGS 1984, UTM 16N (467355, 3662265)
Deviation from Curve, Angle Index x1000
50
0
-50
-100
-150
-200
-250
2005
2006
2007
2008
2009
2010
2011
Year
Thinned over December 2010
Westervelt Company Records
Residual Values
Control Limits
EWMA Values
Signaled Disturbance

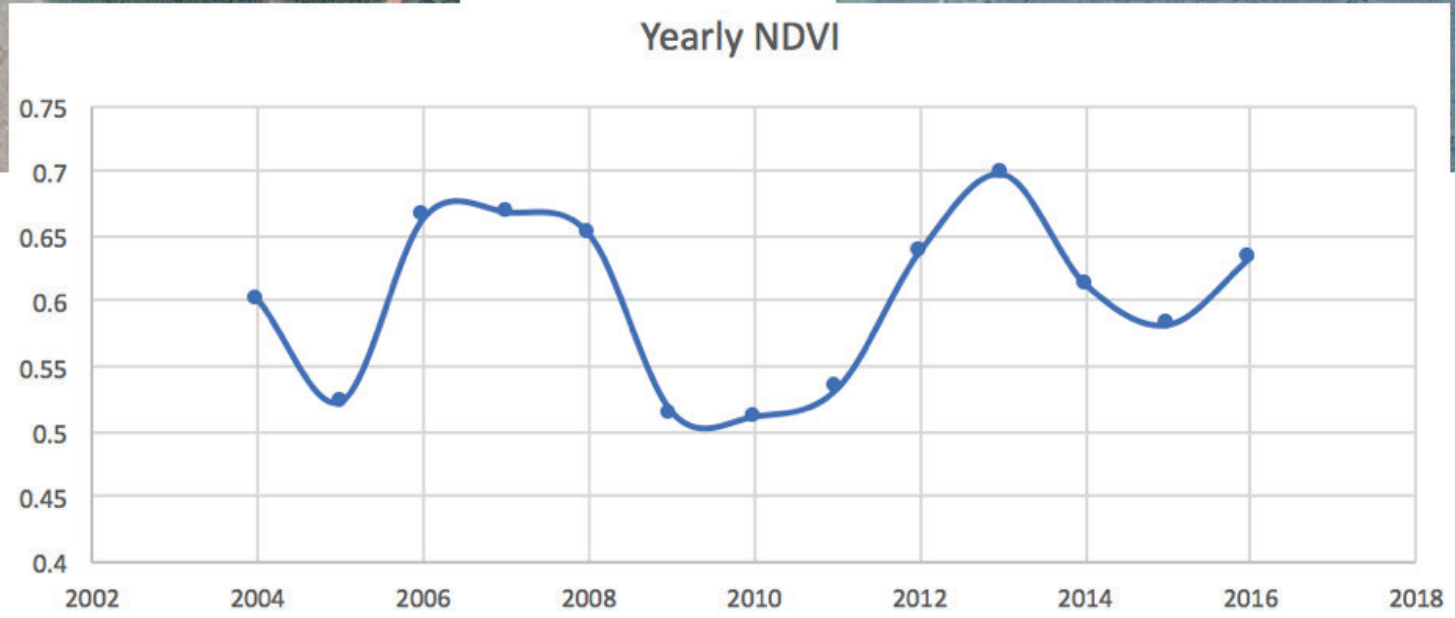

2009
2011

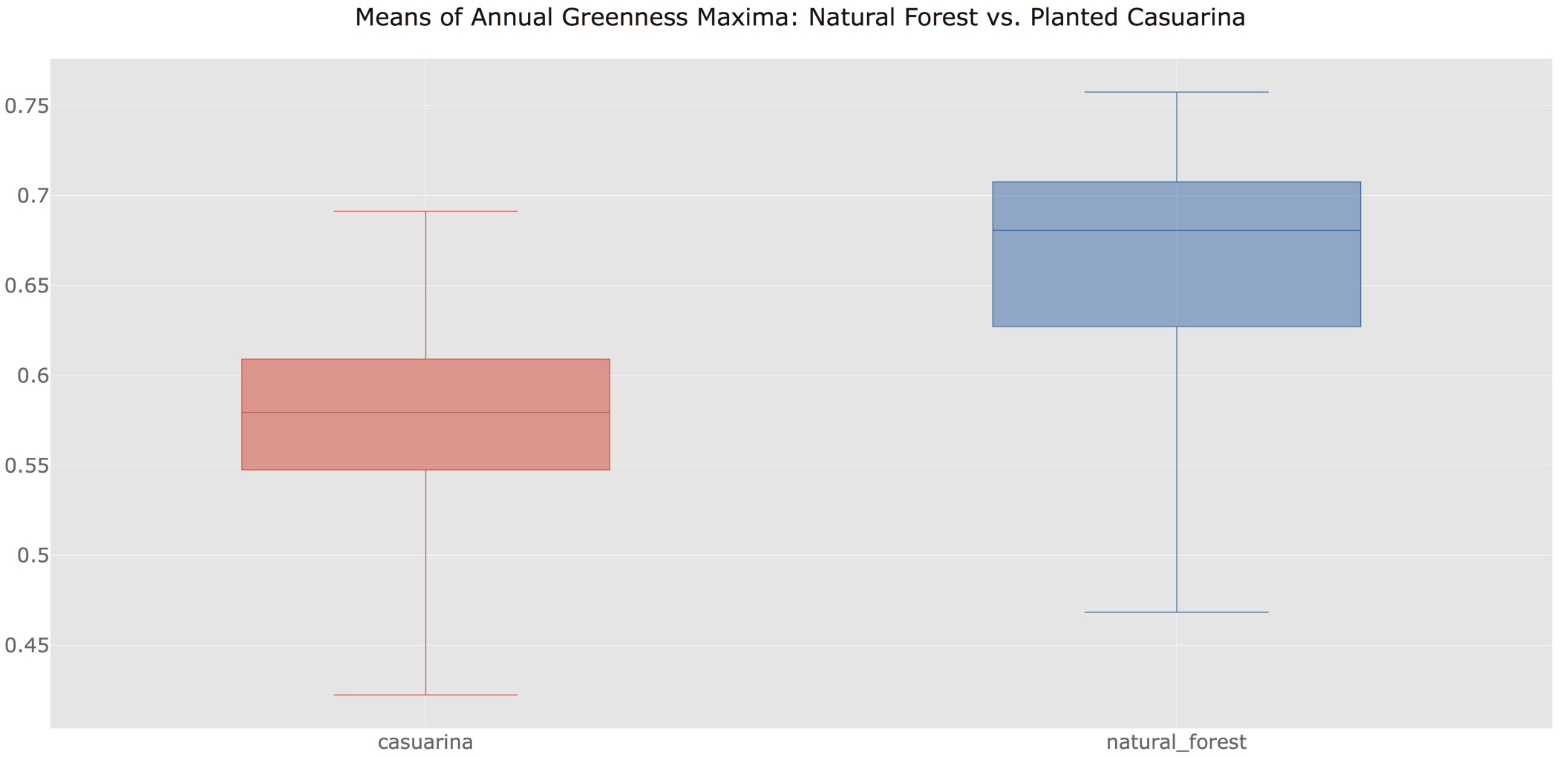


Example of harmonic coefficient-based classification of a forest plantation in Andhra Pradesh. 166 Landsat 7 and 8 images from path 143 row 49 spanning from 2000 to 2016 were used in this analysis. Results shown used SWIR2. Note that while the plantation is identified that there are remnant issues with both omission and commission errors.


2/27/2011
2004
2017


11/18/2013
2004
2017


Yearly NDVI
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
2002
2004
2006
2008
2010
2012
2014
2016
2018


Means of Annual Greenness Maxima: Natural Forest vs. Planted Casuarina
0.75
0.7
0.65
0.6
0.55
0.5
0.45
casuarina
natural_forest

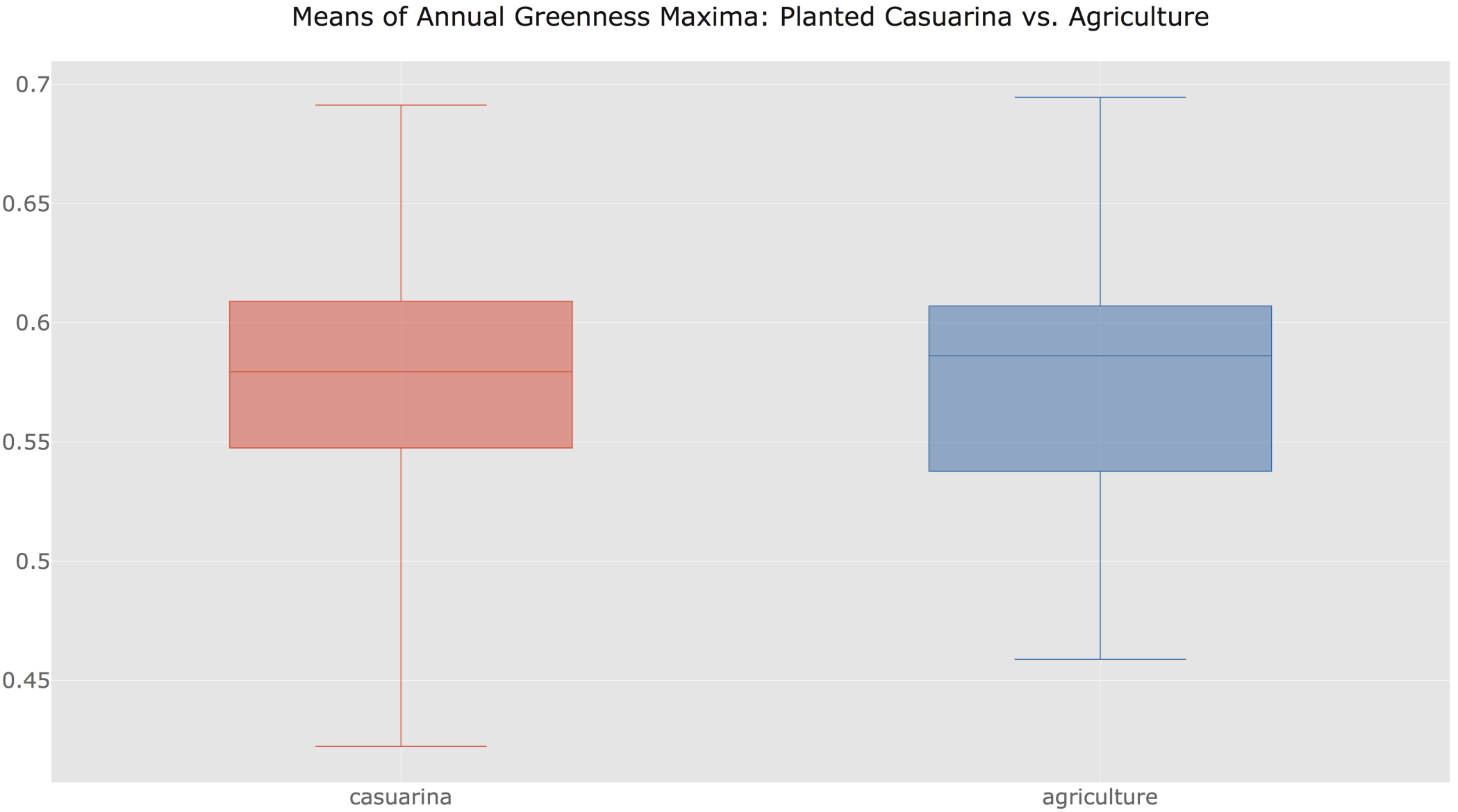
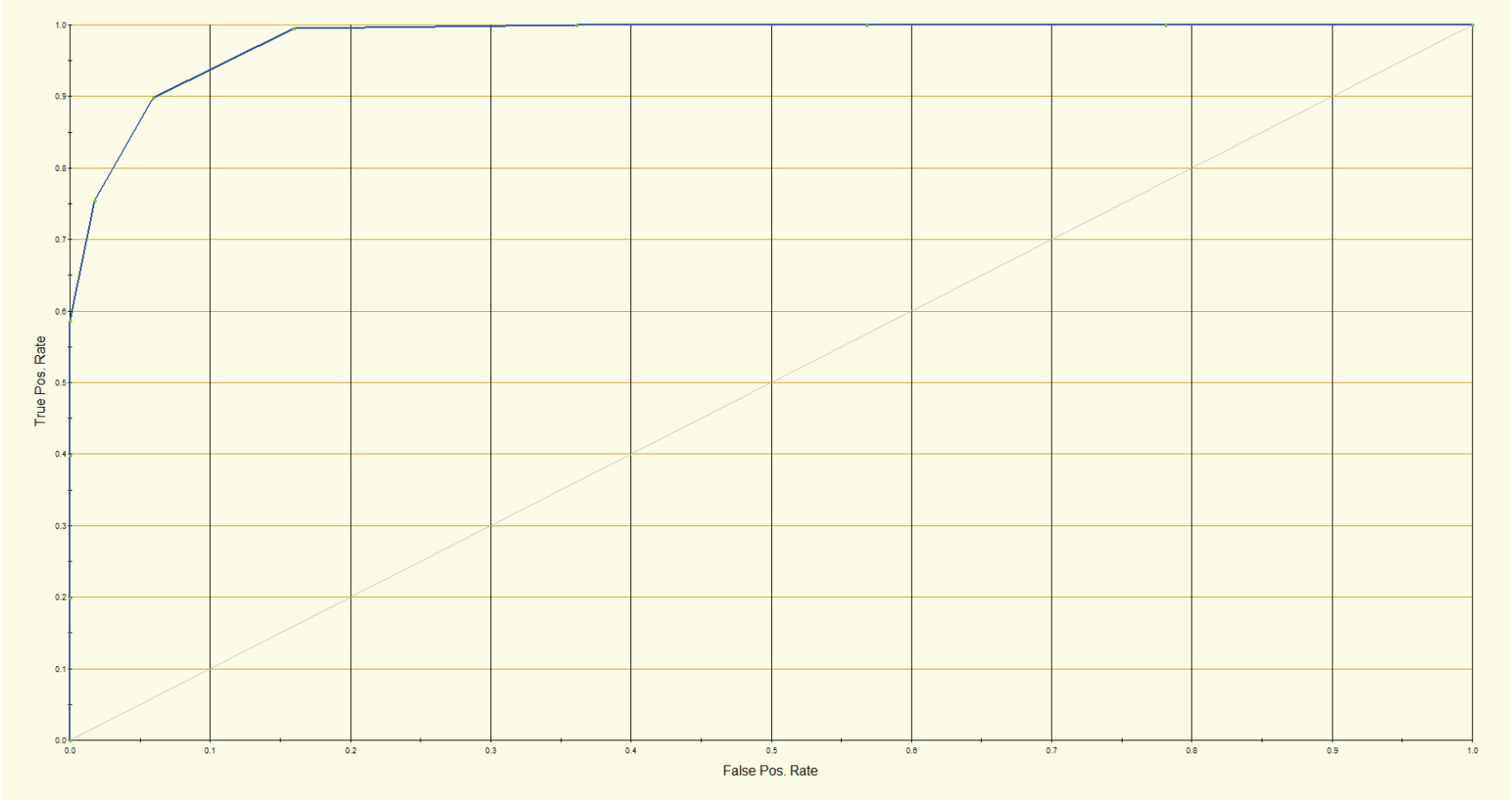
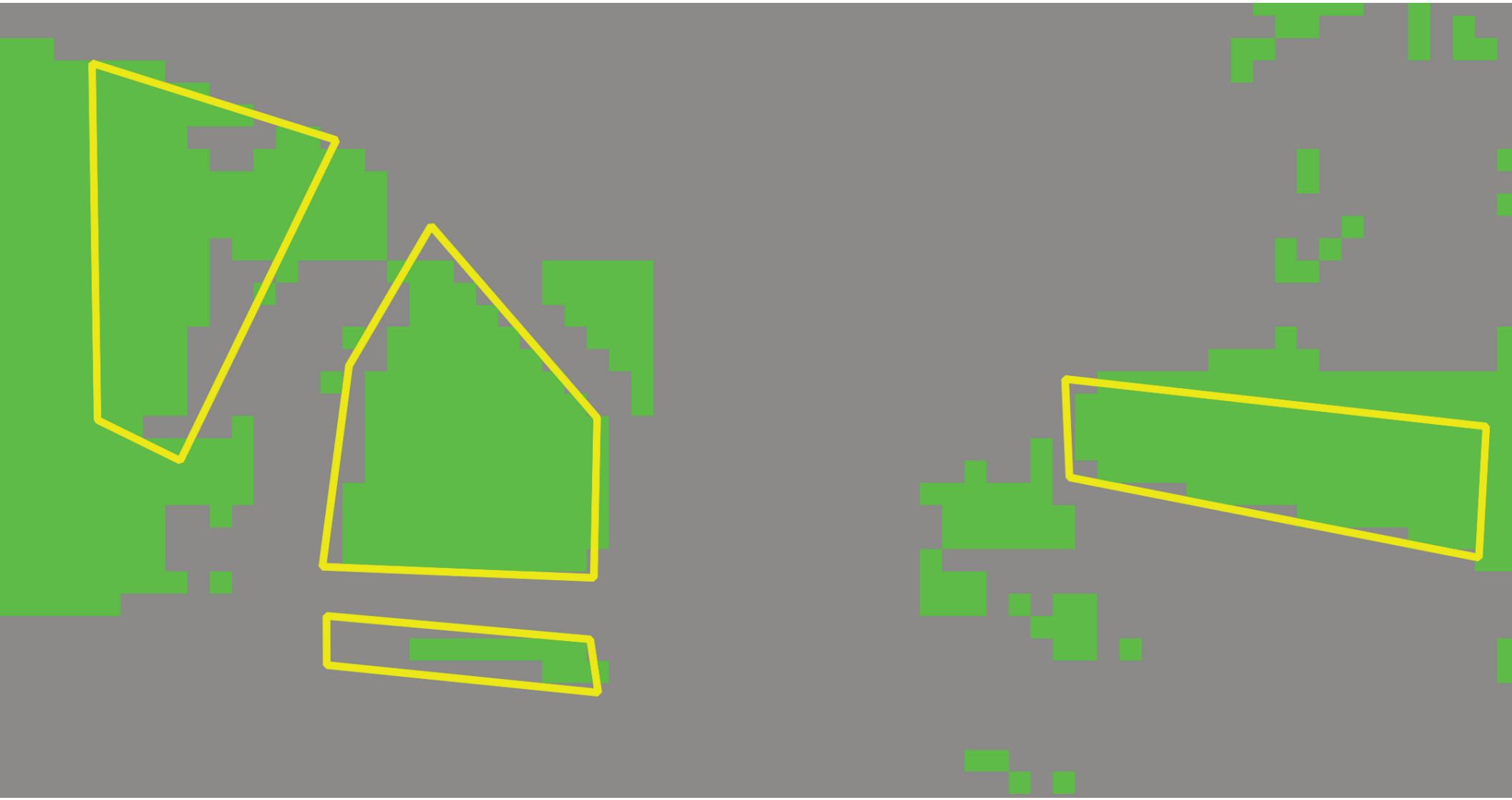
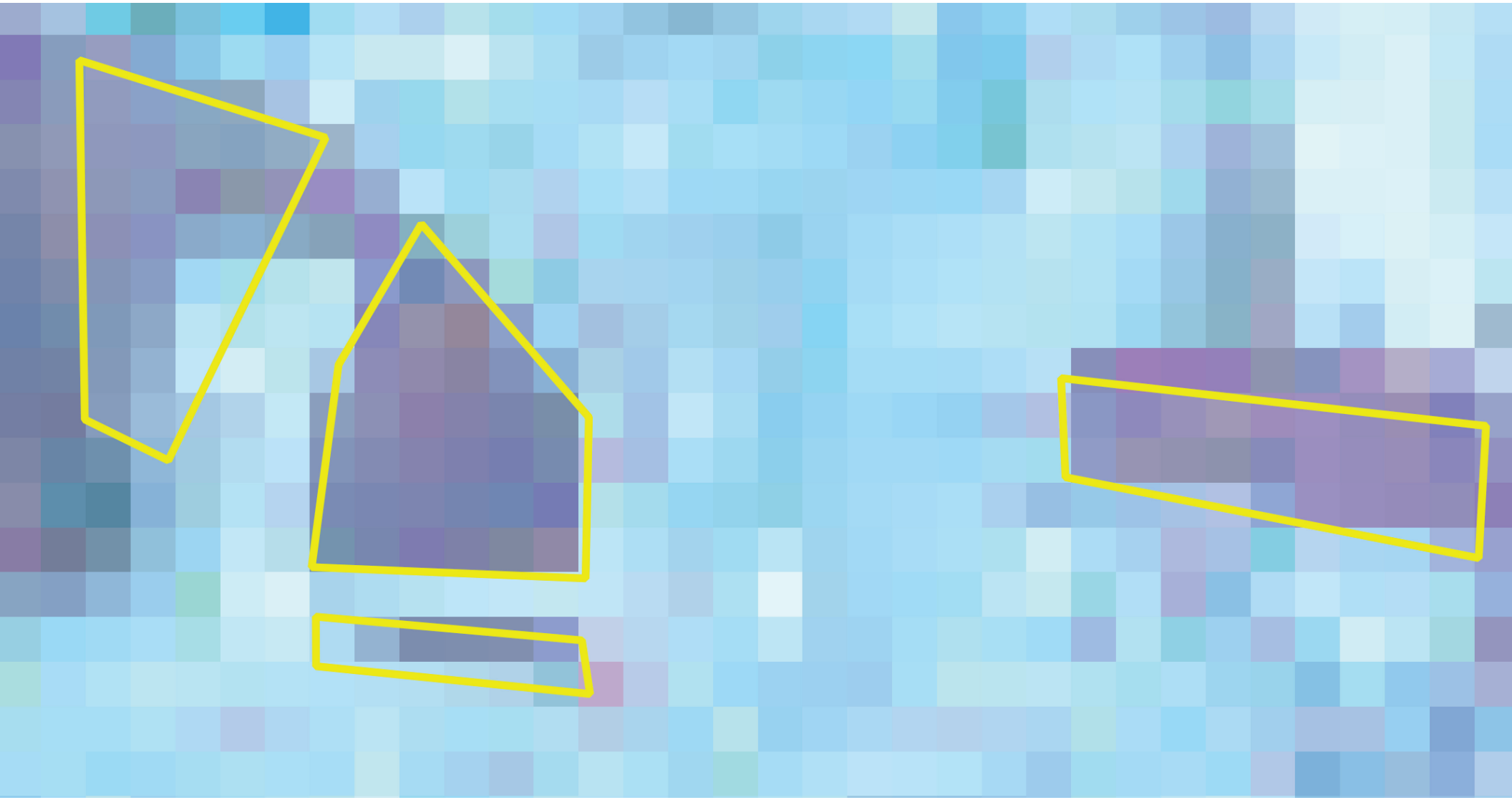

Means of Annual Greenness Maxima: Planted Casuarina vs. Agriculture
0.7
0.65
0.6
0.55
0.5
0.45
casuarina
agriculture

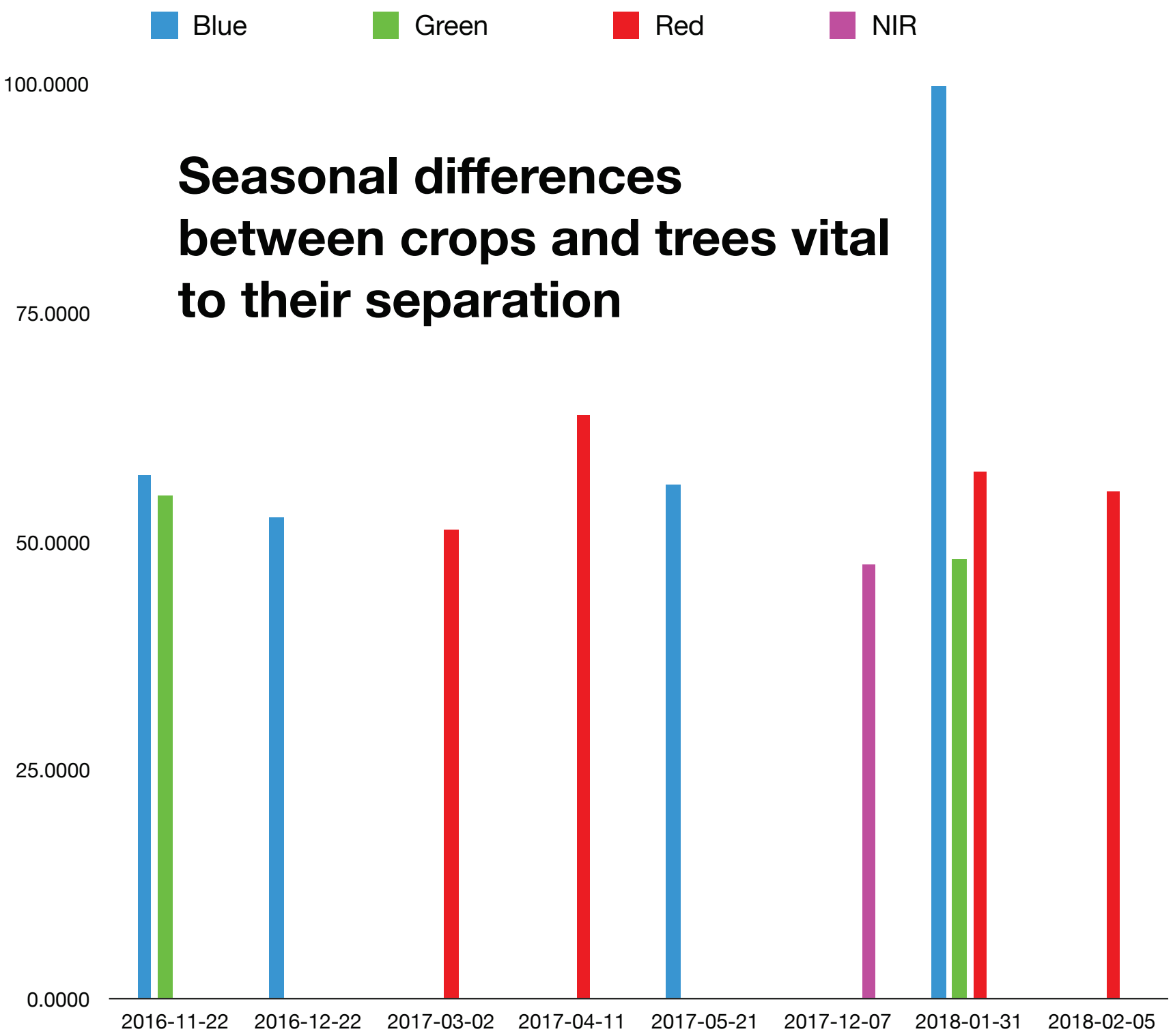
Table 2: Error matrix from pilot Sentinel 2 classification.

Actual Class	Natural Forest N = 54	Nonforest N = 170	Plantation N = 141
Natural Forest	38	0	8
Nonforest	3	166	27
Plantation	13	4	106








Blue
Green
Red
NIR
100.0000
75.0000
50.0000
25.0000
0.0000
Seasonal differences between crops and trees vital to their separation
2016-11-22
2016-12-22
2017-03-02
2017-04-11
2017-05-21
2017-12-07
2018-01-31
2018-02-05

Downsides

- Food security?
- Water use (trees and mills) and water quality (mills)
- Even-aged monocultures

Upsides

- Carbon accounting slightly positive (preliminarily)
- Potential decrease in radiative forcing
- Improved local and national economies
- Uptick in other forest-based ecosystem services
- Smallholder land tenure

Conclusions

- Plantation forestry rapidly expanding in Asia
- Small spatial extent and rapid harvest-regeneration cycle present interesting — but resolvable — remote sensing challenges
- Understanding the drivers and ramifications of these new trees outside forests vital

Salamat

by: Kate Whittington
for: Endangered Species International