MODELING SOYBEAN EXPANSING INTO AMAZON BASIN

Institutions:







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Funding:





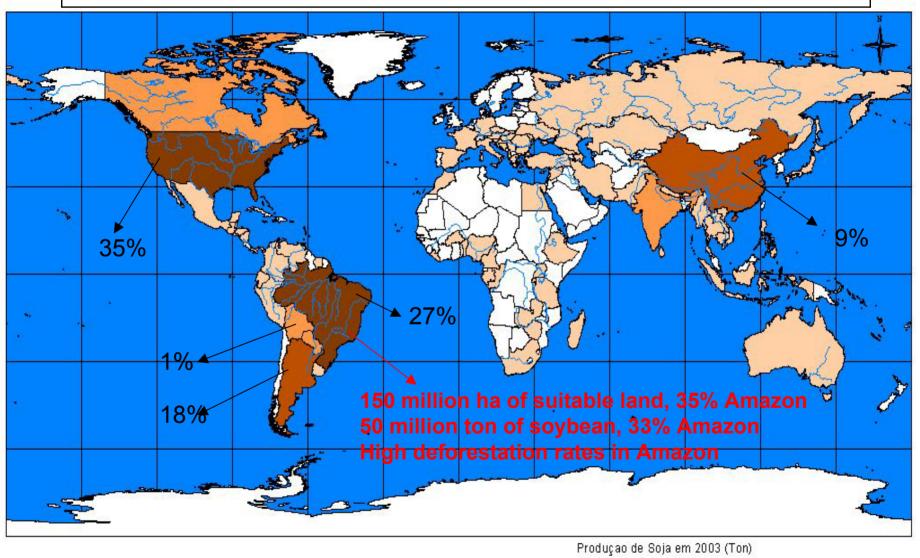




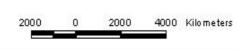
LBA-ECO 9th Science Team Meeting Conference Center of the American Chamber of Commerce (AmCham), São Paulo, 10-12 November, 2005

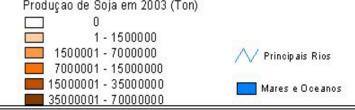


AGRIBUSINESS GLOBAL TENDENCY, 2003







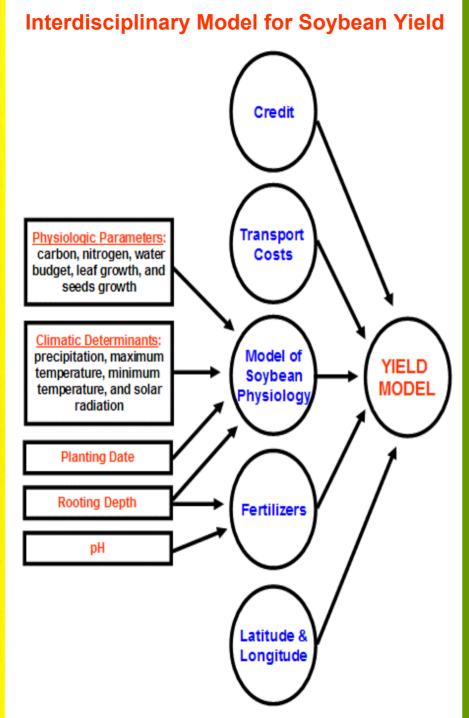




DRIVING FORCES

- ✓ Growth of global soybean demand.
 117 million tons (1992)
 190 million tons (2004)
- ✓ High growth Chinese economy (9% year), greater consumption of poultry and pork, which are fed with soybean meal.
- ✓ Devaluation of Brazilian Real (270% from 1997).
- ✓ Increase of soybean international prices (CBOT).
- ✓ Mad cow disease led to higher demand of soybean meal from European markets. Brazilian soybean exports to Europe increased 50% from 2000 to 2004 (6 – 9 million ton).
- ✓ Transport infrastructure projects (roads, railroads, ports and and waterways) that reduce cost of shipping soybeans and increase economic viability to raise soybean crops.
- ✓ Technology and research new cultivars suited to hot and humid tropical conditions.





Soybean Yield, that is, physical output per unit area (kg/ha).

Soybean Physiology Model

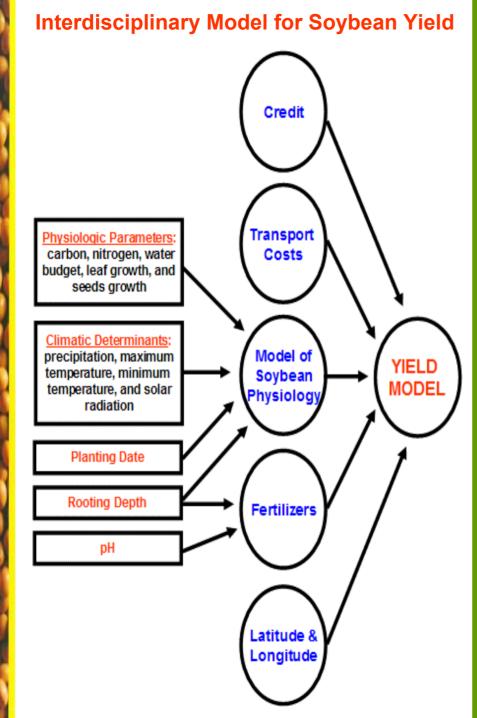
To capture the effect of the climatic and edaphic environment on yield. Effect nonlinear, varying over the phenological development of the soybean plant. Crop simulation model (Sinclair, 1986) to study soybean yield response to weather variations.

Credit

Application of inputs that lead to increase on yield is influenced by the availability of credit, which is issued by transnational companies and national banks.

Transport Cost

High transport costs reduce profit received by soybean farmers, it in turn reduces the economic viability of applying inputs such as fertilizers, which reduce yield. Local prices of these inputs also are affected by high transportation costs.



Fertilizers

Instrumental variables rooting depth and pH are used to predict fertilizer values.

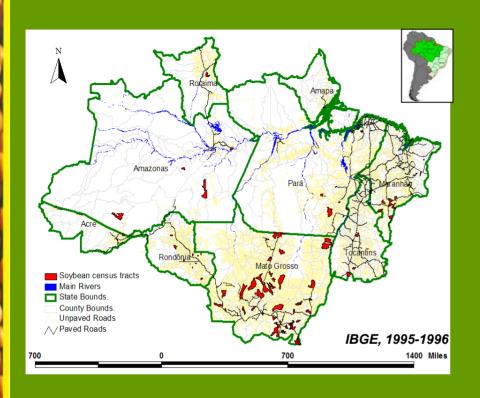
Latitude ~ Photoperiod

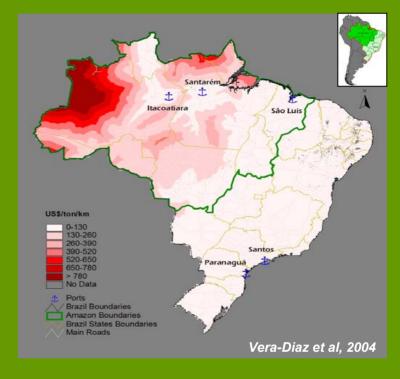
Yield is affected by photoperiod or day-length. Low latitudes close to the Equator present greater day-length, which accelerate flowering of soybean plants, resulting short plants and low yield. Recent soybean expansion in low latitudes is possible by cultivars that include long –juvenile genes.

Longitude

Represent spatial variations in omitted variables.

DATA





Agricultural Census of 1995-1996:

88 Amazon census tract where soybean was the main economic activity.

Economic Variables: Planting date, fertilizers, credit/ha

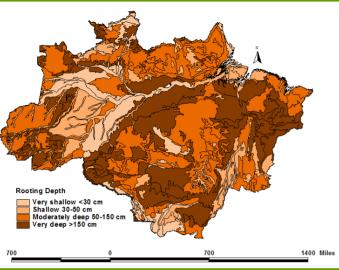
Transport Cost Surface

Least cost approach to determine the nearest soybean export port, as defined by the lowest cost path (US\$ per ton).

Ports: Paranaguá, Santarém, Santos, Itacoatiara and São Luis.

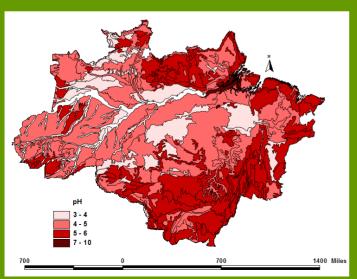
SOIL PARAMETERS

ISRIC, 1998



Rooting Depth

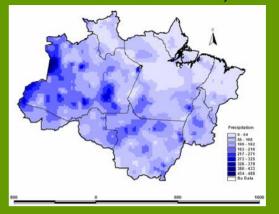
Estimated depth to which root growth is unrestricted by physical or chemical impediments.



pH = acid level of the soil

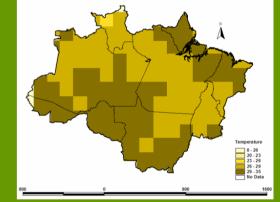
CLIMATE DATA

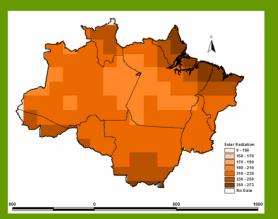
NASA / NCEP / NCAR, 2004



Daily Precipitation (1995-1996)

Daily Temperature (1995-1996)





Daily Solar Radiation (1995-1996)



RESULTS

Interdisciplinary Model for Soybean Yield

Dependent Variable:	YIELD		$R^2 = 0.56$
Independent Variables	Coefficient	t-statistic	Signif.
CONSTANT	-4113.26	-3.27	0.00
FERTIL	214.96	2.51	0.01
MYIELD	0.07	2.50	0.01
TCOST	-5.08	-3.25	0.00
CREDIT	1.57	3.05	0.00
LONG	99.72	3.05	0.00
LAT	47.89	1.68	0.09

The vector of climatic, edaphic, economic, and spatial variables account for about 56% of the variation in yield. Most of regression parameters are significant at $p \le 0.01$

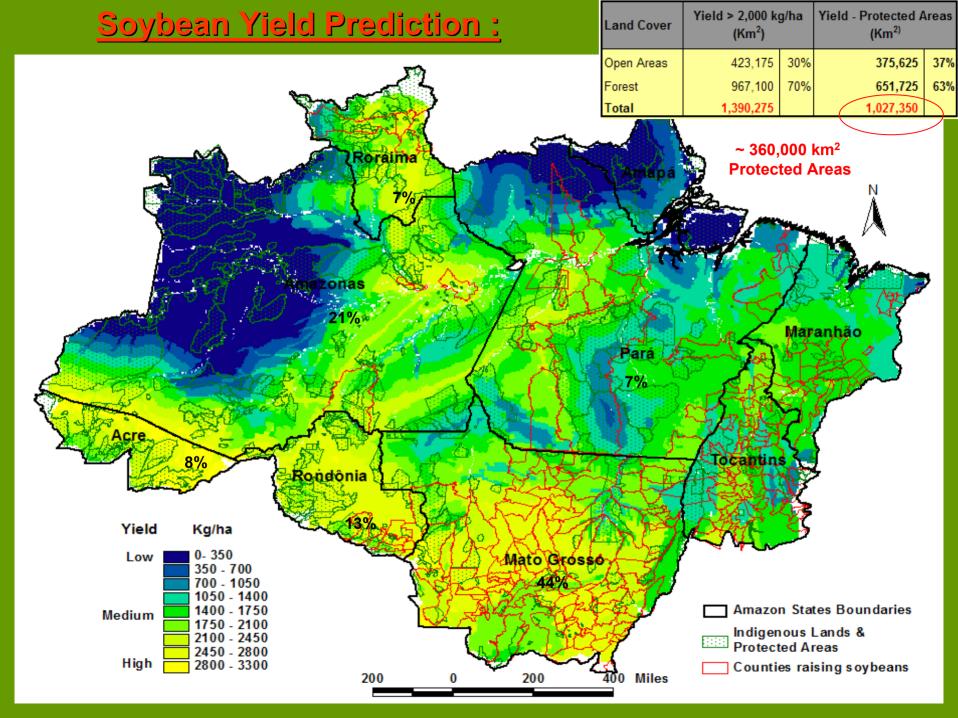
Coefficients all have signs that are consistent with theory:

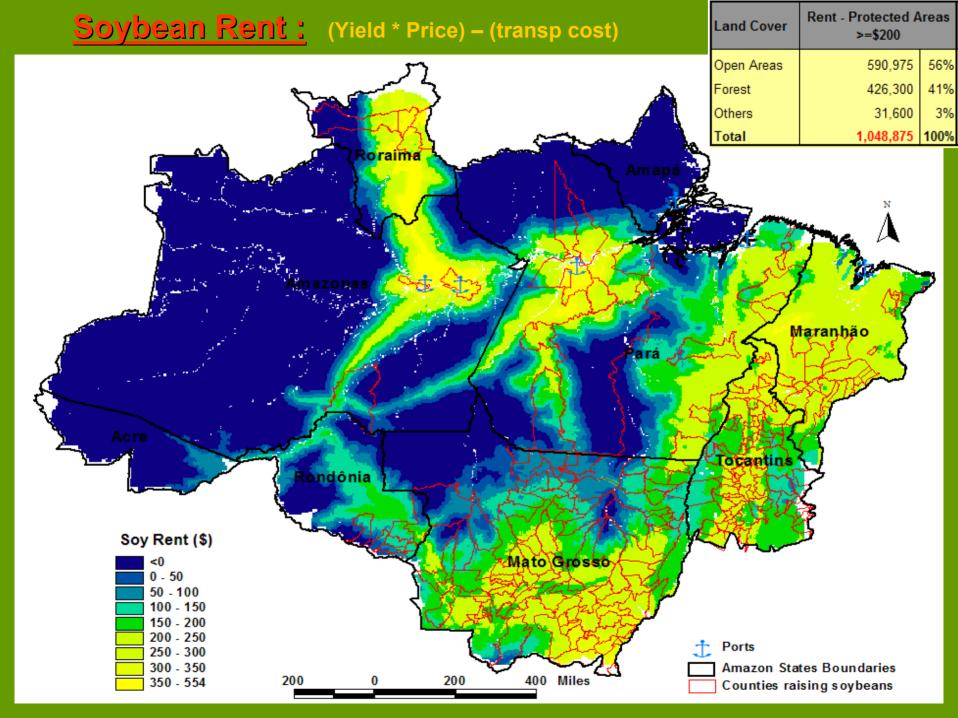
Fertil, MYield, Credit, Lat and Long have + effect; Tcost has – effect

Individual Prediction Power:

Climatic and edaphic variables embodied in MYield account for about 16% of variation in yield.

Fertilizers, transport costs and credit account for 5%, 16%, and 10%.







FINAL REMARKS

- * Soybean yields in the Amazon are determined by a combination of climatic, edaphic, and economic variables.
- * Soybean crops may be possible over a wide area of Amazon, but realizing this potential depends on economic forces such as transportation costs.
- * Implementation of infrastructure planned by federal and state governments (roads, ports) would lower transportation costs throughout the Amazon and greatly increase soybean yields.
- * Indigenous lands and protected areas are threaten with agribusiness. Urgent measurements must be taken to address and restrain soybean expansion.



Manuscript:

Vera-Diaz, Maria del Carmen, R. Kaufmann, D. Nepstad. An Interdisciplinary model of Soybean Yield in the Amazon Basin: the climatic, edaphic, and economic determinants. To be submitted November.

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Thank you