

# PART OF A LOGISTICS SIMULATION MODEL OF THE WORLD SOY COMPLEX

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# General Objective

- o Develop a model to analyse the short and long term competitiveness of the world's soybean producing subregions

Look at:

- Changes in logistics infrastructures
- Changes in demand patterns
- Changes in production areas
- Inherent Protein and Oil Level Differences

# ULTIMATE RESEARCH QUESTION

How competitive are US soybeans in world markets?

I.E. US Producers are at the  
Technological Frontier

South American Expansion is at the No  
Rent Frontier

or,

Can US soybean producers pay the rent??

# OCEAN TRANSPORTATION MODEL

- 6 US EXPORTING PORTS
- 6 BRAZILIAN EXPORTING PORTS
- 2 ARGENTINE EXPORTING PORTS
- 8 IMPORTING PORTS
- CAPTURES 88% of WORLD TRADE IN BEANS AND MEAL
- (ANOTHER 9% IS INTRA-CONTINTAL TRADE)
- INTRA-EUROPE TRADE IGNORED
- (SOY OIL WAS NOT INCLUDED)

# Status to date

- Ocean transportation model completed with results
- US producing areas and processing plant location model in test phase
- Collaborators have completed model of Brazil

# IMPORT PORT ASSIGNMENTS

PORT AREA	IMPORT AREA	BUSHEL	PERCENT	CUM PERCENT
Rotterdam	North Europe	1,459,124,333	47.53%	47.53%
Kobe	Japan	316,855,000	10.32%	57.86%
Xiamen	South China	258,509,167	8.42%	66.28%
Qingdao/tsingtao	North China	256,543,833	8.36%	74.63%
Port Kelang	Southeast Asia	254,881,000	8.30%	82.94%
Port Said	Med & Near East	204,321,333	6.66%	89.59%
Vera Cruz/Rail	Mexico	176,642,000	5.75%	95.35%
Kaohsiung	Tawain	142,783,667	4.65%	100.00%
Wilmington	Southeast USA	1	0.00%	100.00%

# EXPORT QUANTITIES BY PORT

PORT AREA	COUNTRY	BUSHEL	PERCENT	CUM PERCENT
GULF	USA	943,354,854	30.47%	30.47%
<b>ROSARIO AREA</b>	<b>ARGENTINA</b>	<b>748,553,610</b>	<b>24.18%</b>	<b>54.65%</b>
<b>PARA/SFDS/SAN</b>	<b>BRAZIL</b>	<b>654,011,661</b>	<b>21.13%</b>	<b>75.78%</b>
PACNW	USA	163,769,095	5.29%	81.07%
<b>RIO GRANDE</b>	<b>BRAZIL</b>	<b>163,515,073</b>	<b>5.28%</b>	<b>86.35%</b>
MEXBORDER	USA	98,872,329	3.19%	89.55%
<b>VITORIA</b>	<b>BRAZIL</b>	<b>74,539,900</b>	<b>2.41%</b>	<b>91.95%</b>
DULUTH	USA	47,956,032	1.55%	93.50%
<b>BAHIA BLANCA</b>	<b>ARGENTINA</b>	<b>43,985,390</b>	<b>1.42%</b>	<b>94.92%</b>
<b>MANAUS</b>	<b>BRAZIL</b>	<b>41,324,617</b>	<b>1.33%</b>	<b>96.26%</b>
NORFOLK	USA	39,553,141	1.28%	97.54%
TOLEDO	USA	29,222,549	0.94%	98.48%
<b>ILHEUS</b>	<b>BRAZIL</b>	<b>24,131,462</b>	<b>0.78%</b>	<b>99.26%</b>
<b>SAO LUIS</b>	<b>BRAZIL</b>	<b>22,928,952</b>	<b>0.74%</b>	<b>100.00%</b>
WILMINGTON	USA	0	0.00%	100.00%

# OCEAN RATE COMPUTATIONS

- **90 Observations of Panamax Vessels from Aug-01 to Jan-02**  
**Regressed against Nautical miles**

$$Y = .0023NM + 1.1638$$

**Will Fine Tune Later**

**Ship size**

**Routes**

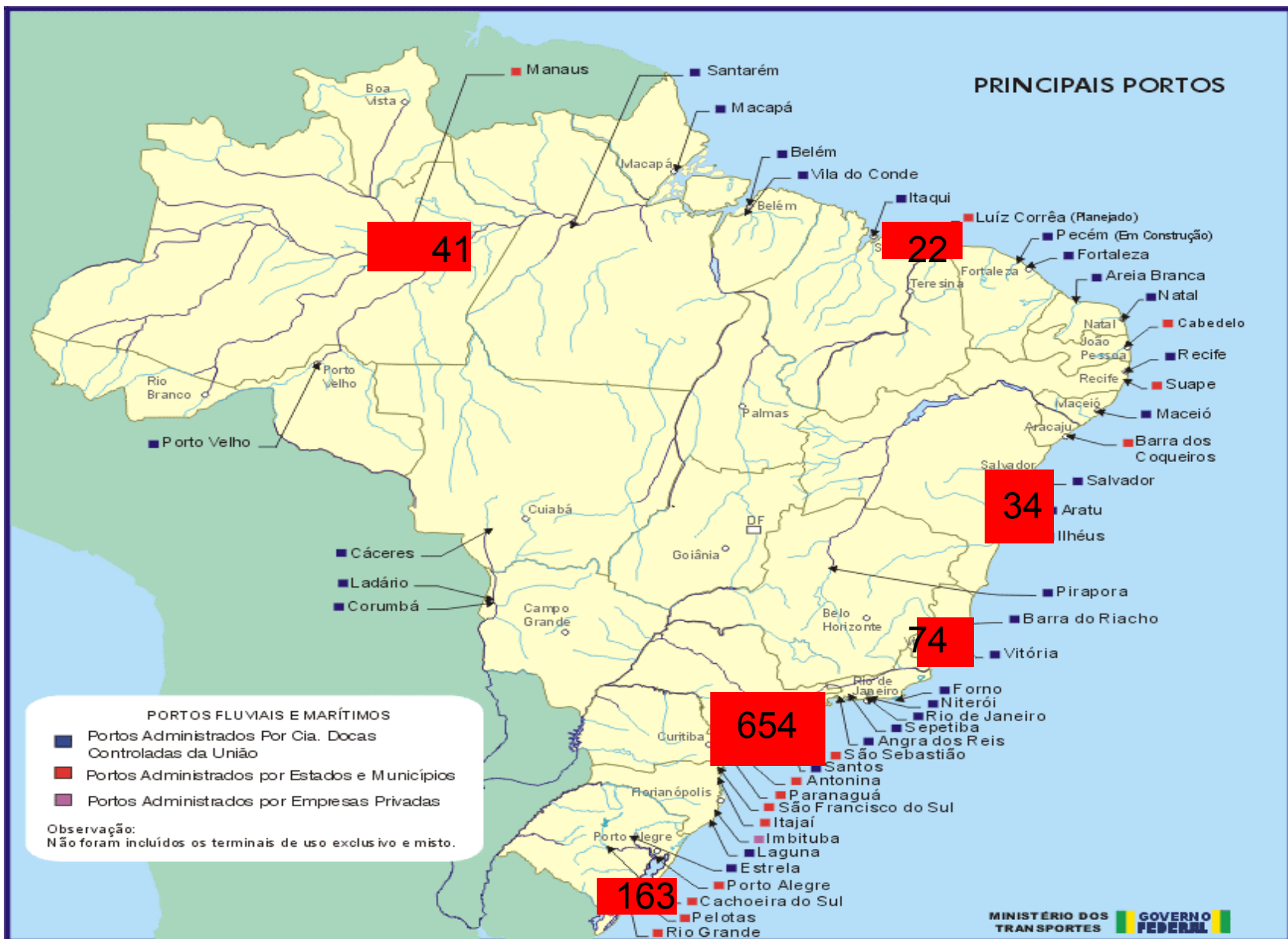
**Load Discharge Limitations**



# EXAMPLES OF OCEAN RATES

EXPORTER	IMPORTER	N. MILES	M.TON RATE	BUSHEL RATE
GULF	Xiamen	9116	\$22.13	\$0.604
GULF	Rotterdam	4879	\$12.39	\$0.338
GULF	Qinqdao/tsing	10010	\$24.19	\$0.660
PACNW	Xiamen	5524	\$13.87	\$0.378
PACNW	Rotterdam	8748	\$21.28	\$0.580
PACNW	Qinqdao/tsing	5092	\$12.88	\$0.351
<b>ROSARIOAREA</b>	<b>Xiamen</b>	<b>12299</b>	<b>\$29.45</b>	<b>\$0.803</b>
<b>ROSARIOAREA</b>	<b>Rotterdam</b>	<b>6469</b>	<b>\$16.04</b>	<b>\$0.438</b>
<b>ROSARIOAREA</b>	<b>Qinqdao/tsing</b>	<b>12907</b>	<b>\$30.85</b>	<b>\$0.841</b>
<b>PARA/SANTOS</b>	<b>Xiamen</b>	<b>11610</b>	<b>\$27.87</b>	<b>\$0.760</b>
<b>PARA/SANTOS</b>	<b>Rotterdam</b>	<b>5657</b>	<b>\$14.17</b>	<b>\$0.387</b>
<b>PARA/SANTOS</b>	<b>Qinqdao/tsing</b>	<b>12218</b>	<b>\$29.27</b>	<b>\$0.798</b>
<b>MANAUS</b>	<b>Xiamen</b>	<b>11915</b>	<b>\$28.57</b>	<b>\$0.779</b>
<b>MANAUS</b>	<b>Rotterdam</b>	<b>4797</b>	<b>\$12.20</b>	<b>\$0.333</b>
<b>MANAUS</b>	<b>Qinqdao/tsing</b>	<b>12042</b>	<b>\$28.86</b>	<b>\$0.787</b>
<b>SAO LUIZ</b>	<b>Xiamen</b>	<b>11116</b>	<b>\$26.73</b>	<b>\$0.729</b>
<b>SAO LUIZ</b>	<b>Rotterdam</b>	<b>4122</b>	<b>\$10.64</b>	<b>\$0.290</b>
<b>SAO LUIZ</b>	<b>Qinqdao/tsing</b>	<b>11272</b>	<b>\$27.09</b>	<b>\$0.739</b>

# PRINCIPAIS PORTOS









# BASELINE PORT TO PORT FLOWS

	OBJECTIVE FUNCTION	\$1,414,546,426
EXPORTING PORT	IMPORTING PORT	BUSHEL
GULF	Xiamen (South China)	258,509,167
GULF	Rotterdam(Northern Europe)	54,662,610
GULF	Vera Cruz(Mexico)	77,769,671
GULF	Qinqdao(North China)	92,774,739
GULF	Kobe(Japan)	316,855,000
GULF	Kaohsiung (Tawain)	142,783,667
GULF	Wilmington FLOWS	1
PACNW	Qinqdao(North China)	163,769,095
DULUTH	Rotterdam(Northern Europe)	47,956,032
TOLEDO	Rotterdam(Northern Europe)	29,222,549
NORFOLK	Rotterdam(Northern Europe)	39,553,141
MEXBORDER	MexicoRail	98,872,329
ROSARIOAREA	Rotterdam(Northern Europe)	675,114,742
BAHIA BLANCA	Port Kelang SE Asia	17,927,059
PARA/SFDS/SAN	Rotterdam(Northern Europe)	513,943,896
PARA/SFDS/SAN	Port Said(Med & Near East)	140,067,764
RIO GRANDE	Port Kelang SE Asia	163,515,073
VITORIA	Rotterdam(Northern Europe)	74,539,900
MANAUS	Port Said(Med & Near East)	41,324,617
ILHEUS-SALVADOR	Rotterdam(Northern Europe)	24,131,462
SAO LUIZ	Port Said(Med & Near East)	22,928,952

# BASELINE SLACK VARIABLE

Cell	Name	Cell Value	Formula	Status	Slack
\$G\$10	BAHIA BLANCA ARGENTINA	17,927,059	\$G\$10<=\$I\$10	Not Binding	26,058,331

# BASELINE PORT TO PORT FLOWS BY VOLUME

IMPORTING PORT	EXPORTING PORT	BUSHEL
Rotterdam(Northern Europe)	ROSARIOAREA	675,114,742
Rotterdam(Northern Europe)	PARA/SFDS/SAN	513,943,896
Kobe(Japan)	GULF	316,855,000
Xiamen (South China)	GULF	258,509,167
Qinqdao(North China)	PACNW	163,769,095
Port Kelang SE Asia	RIO GRANDE	163,515,073
Kaohsiung (Tawain)	GULF	142,783,667
Port Said(Med & Near East)	PARA/SFDS/SAN	140,067,764
MexicoRail	MEXBORDER	98,872,329
Qinqdao(North China)	GULF	92,774,739
Vera Cruz(Mexico)	GULF	77,769,671
Rotterdam(Northern Europe)	VITORIA	74,539,900
Rotterdam(Northern Europe)	GULF	54,662,610
Rotterdam(Northern Europe)	DULUTH	47,956,032
Port Said(Med & Near East)	MANAUS	41,324,617
Rotterdam(Northern Europe)	NORFOLK	39,553,141
Rotterdam(Northern Europe)	TOLEDO	29,222,549
Rotterdam(Northern Europe)	ILHEUS-SALVADOR	24,131,462
Port Said(Med & Near East)	SAO LUIZ	22,928,952
Port Kelang SE Asia	BAHIA BLANCA	17,927,059
Wilmington FLOWS	GULF	1



# FREE FLOW

## EACH EXPORT PORT SUPPLY EQUAL TO TOTAL DEMAND

	<b>TOTALCOST</b>	<b>\$909,763,115</b>
	<b>Name</b>	<b>Final Value</b>
<b>GULF</b>	<b>Vera Cruz FLOWS</b>	<b>77,769,671</b>
<b>PACNW</b>	<b>Xiamen FLOWS</b>	<b>258,509,167</b>
<b>PACNW</b>	<b>Qinqdao/tsingtao FLOWS</b>	<b>256,543,833</b>
<b>PACNW</b>	<b>Port Kelang FLOWS</b>	<b>254,881,000</b>
<b>PACNW</b>	<b>Kobe FLOWS</b>	<b>316,855,000</b>
<b>PACNW</b>	<b>Kaohsiung FLOWS</b>	<b>142,783,667</b>
<b>NORFOLK</b>	<b>Rotterdam FLOWS</b>	<b>1,459,124,333</b>
<b>MEXBORDER</b>	<b>MexicoRail FLOWS</b>	<b>98,872,329</b>
<b>SAO LUIZ</b>	<b>Port Said FLOWS</b>	<b>204,321,333</b>

**TOTAL SHIPMENTS  
EACH EXPORT PORT SUPPLY  
EQUAL TO TOTAL DEMAND**

<b>PORT</b>	<b>SHIPMENTS</b>
<b>NORFOLK</b>	<b>1,459,124,333</b>
<b>PACNW</b>	<b>1,229,572,667</b>
<b>SAO LUIZ</b>	<b>204,321,333</b>
<b>MEXBORDER</b>	<b>98,872,329</b>
<b>GULF</b>	<b>77,769,671</b>
<b>TOTAL</b>	<b>3,069,660,333</b>

# INCREASED SUPPLY COMPARISONS BY PORT

	BUSHEL SHIPPED	RECEIVING PORTS	OB FUNCT	SHIPPING PORTS	% of OPTIMUM
OBJ. FUNC. OPTIMUM		NA	1,414,546,426	14	100.00%
FREE FLOW MIN OB FUNC.		NA	\$909,763,115	5	64.31%
PORT AREA					
PACNW	1,229,572,667	5	1,071,436,612	11	75.74%
NORFOLK	1,459,124,334	1	1,181,556,356	11	83.53%
TOLEDO	1,600,963,575	2	1,193,681,342	9	84.39%
WILMINGTON	1,571,741,025	2	1,209,231,725	10	85.49%
SAO LUIS	1,750,879,616	3	1,228,668,884	7	86.86%
DULUTH	1,530,416,408	2	1,264,948,161	11	89.42%
ILHEUS	1,662,801,475	3	1,285,310,761	10	90.86%
MANAUS	1,523,784,992	2	1,296,507,554	11	91.66%
GULF	2,347,021,157	7	1,309,631,950	11	92.58%
VITORIA	1,658,547,303	3	1,324,402,101	9	93.63%
PARA/SFDS/SAN	1,584,007,403	3	1,374,217,194	11	97.15%
RIO GRANDE	929,995,743	2	1,396,014,263	12	98.69%
ROSARIO AREA	766,480,669	3	1,414,419,356	13	99.99%
BAHIA BLANCA	17,927,059	1	1,414,546,426	14	100.00%

# INCREASE SUPPLIES AT MANAUS 1000 MILES UP THE AMAZON

	BASELINE	MAN300	MAN700	MAN800	MAN1000	MANALL
	1,414,546,426	1,381,286,003	1,339,526,004	1,330,875,556	1,318,602,386	1,296,507,554
PERCENT OF BASELINE	100.00%	97.65%	94.70%	94.08%	93.22%	91.66%
GULF	943,354,854	943,354,854	943,354,854	943,354,854	943,354,854	888,692,244
PACNW	163,769,095	163,769,095	163,769,095	163,769,095	163,769,095	163,769,095
DULUTH	47,956,032	47,956,032	47,956,032	47,956,032	47,956,032	47,956,032
TOLEDO	29,222,549	29,222,549	29,222,549	29,222,549	29,222,549	29,222,549
NORFOLK	39,553,141	39,553,141	39,553,141	39,553,141	39,553,141	39,553,141
WILMINGTON	0	0	0	0	0	0
MEXBORDER	98,872,329	98,872,329	98,872,329	98,872,329	98,872,329	98,872,329
BAHIA BLANCA	17,927,059	0	0	0	0	0
ROSARIOAREA	748,553,610	466,480,669	66,480,669	0	0	0
RIO GRANDE	163,515,073	163,515,073	163,515,073	129,995,743	0	0
PARA/SFDS/SAN	654,011,661	654,011,661	654,011,661	654,011,661	584,007,403	156,209,638
VITORIA	74,539,900	74,539,900	74,539,900	74,539,900	74,539,900	74,539,900
ILHEUS-SALVADOR	24,131,462	24,131,462	24,131,462	24,131,462	24,131,462	24,131,462
SAO LUIZ	22,928,952	22,928,952	22,928,952	22,928,952	22,928,952	22,928,952
MANAUS	41,324,617	341,324,617	741,324,617	841,324,617	1,041,324,617	1,523,784,992
		SUBJECT PORT				
		DOMINATE-NO LOSSES				
		LOSES VOLUME				
This Table is constructed from the bottom part of the Answer tables from the may20-23 runs						



# INCREASE SUPPLIES AT SELECTED PORTS

	BASELINE	DOUBLE GULF	DOUBLE PACNW	DBLGULF&PACNW	TOTALGULF&P	MANPACNWALL
	1,414,546,426	1,328,179,762	1,347,884,684	1,269,986,594	1,047,393,731	1,035,751,827
PERCENT OF BASE	100.00%	93.89%	95.29%	89.78%	74.04%	73.22%
GULF	943,354,854	1,886,709,708	943,354,854	1,886,709,708	1,461,558,686	77,769,672
PACNW	163,769,095	163,769,095	327,538,190	327,538,190	1,229,572,667	1,229,572,667
DULUTH	47,956,032	47,956,032	47,956,032	47,956,032	47,956,032	47,956,032
TOLEDO	29,222,549	29,222,549	29,222,549	29,222,549	29,222,549	29,222,549
NORFOLK	39,553,141	39,553,141	39,553,141	39,553,141	39,553,141	39,553,141
WILMINGTON	0	0	0	0	0	0
MEXBORDER	98,872,329	98,872,329	98,872,329	98,872,329	98,872,329	98,872,329
ROSARIOAREA	748,553,610	0	602,711,575	0	0	0
BAHIA BLANCA	17,927,059	0	0	0	0	0
PARA/SFDS/SAN	654,011,661	640,652,549	654,011,661	476,883,455	0	0
RIO GRANDE	163,515,073	0	163,515,073	0	0	0
VITORIA	74,539,900	74,539,900	74,539,900	74,539,900	74,539,900	0
MANAUS	41,324,617	41,324,617	41,324,617	41,324,617	41,324,617	1,499,653,530
ILHEUS-SALVADOR	24,131,462	24,131,462	24,131,462	24,131,462	24,131,462	24,131,462
SAO LUIZ	22,928,952	22,928,952	22,928,952	22,928,952	22,928,952	22,928,952
		SUBJECT PORT				
		DOMINATE-NO LOSSES				
		LOSES VOLUME				
This Table is constructed from the bottom part of the Answer tables from the may20-23 runs						







# FURTHER MODELING REQUIREMENTS

- Build 12-14 region Production and Transportation Model of US
- Add Argentine Production Regions
- Combine with Brazilian Model
- Refine Port Selection and Ocean rates
  - Paranagua/Santos (Roundup-NonRoundup)
  - Add Lakesize or Capesize vessels

# COMMENTS and CONCLUSIONS

- Manaus/Itacoatiara 1000 miles up the Amazon is closer to most markets than most other SA Ports.
- Manaus is a long way from new SB production area.
- Sao Luiz is well located for worldwide shipments.
- Potential Sao Luiz Production area is limited.

# COMMENTS and CONCLUSIONS

- Brazil production may expand intensively near coast(FAS Study)
- Argentina's SB production area is favorably located vis-a-vie it's ports
- Argentina's ports are the most distant from SB markets

# COMMENTS and CONCLUSIONS

- US Soybean area is moving north and west
- PACNW ports are well positioned but protein and oil levels are measurably lower
- Duluth Shipments (Roundup)
- Jones Act is a major problem for US southeast markets

# COMMENTS and CONCLUSIONS

- Alternative to beans in US is corn
  - Still has comparative advantage
  - Higher yields than beans means more transportation infrastructure needed for exports!!



