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Biofuels and Rural Economic Development in Latin America and the Caribbean

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Selected Paper #470282 prepared for presentation at the American Agricultural Economics Association Annual Meeting, Orlando, FL, July 27-29, 2008

Objectives

- Examine current agricultural capacity in the Latin American and the Caribbean (LAC) countries to supply materials or feedstocks and thus obtain estimates for the production of biofuels.

- Examine potential impacts that large-scale expansion of biofuels production in LAC countries would have on food and energy balances, food security, the environment and the welfare of the rural poor in the region.

Components

1. Indicator approach to measure feedstock production, biofuel “theoretical” potential and institutional limitations to biofuel expansion
2. Quantitative –forward looking- approach using IFPRI’s IMPACT-WATER model

List of Latin American and Caribbean Countries and their associated groupings

Regional definitions in model	Countries within aggregate regions in IFPRI's IMPACT-WATER model and analysis
Argentina	
Brazil	
Chile	
Colombia	
Ecuador	
Mexico	
Peru	
Uruguay	
Central America and Caribbean*	Costa Rica, Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Nicaragua, Panamá
Central-South America	Bolivia, Paraguay
Northern-South America	Guyana, Suriname, Venezuela

Notes: * other countries include Barbados, Bahamas, Belize, Cuba, Jamaica, Trinidad & Tobago, Saint Lucia, St. Vincent and the Grenadines.

Diagnostic of the Current Crop Situation in LAC: An Indicator Approach

Feedstock	Production LAC (Tons)	Ethanol / Biodiesel yield per ton of feedstock (lts/ton)	Ethanol / Biodiesel yield per hectare (lts / ha)	LAC Share of Total Production (%)	Largest LAC Producer's Share of Total Production (%)	Share of Largest World's Producer (%)
Ethanol						
Sugarcane	594,457,243	75-83	5,300- 9,000	45	29	29
Maize	72,417,355	300 - 375	2,500-3,100	13	6	40
Cassava	33,368,000	200	5,000-6,000	17	12	19
Potatoes	15,799,000	650-830		5	1	22
Sugar Beet	2,845	100	5,000-5,500	1.2	<1.2	13
Wheat	25,548	336	2,500	4	2	16
Biodiesel						
Palm Oil	1,548,032	335	4,000-6,000	5	2	46
Rapeseed	100,412	610	1,000–1,200	0.2	0.1	30
Soybeans	84,968,431	305	500-700	44	24	40
Cottonseed	2,373,298	275	350-600	6	5	29

Notes: a) Table is author's estimations based on data from FAOSTAT (2007), b) Includes all countries in Latin America and the Caribbean and is the average for the period 2001-2005.

Current productions and share of current production selected target crops to meet mandatory or stated ethanol standards using yield per ton of feedstock

Ethanol			Sugarcane		Cassava		Maize	
Country	Mandatory or stated blending standards (as %)	Ethanol required (1,000 lts)	100% production from targeted crop destined for ethanol (1,000 lts)	% of current production to meet blending standards	100% production from targeted crop destined for ethanol (1,000 lts)	% of current production to meet blending standards	100% production from targeted crop destined for ethanol (1,000 lts)	% of current production to meet blending standards
Argentina	5%	246,493	1,257,895	20	29,565	834	5,820,222	4
Bolivia	20%	137,797	172,254	80	63,088	218	232,708	59
Brazil	23%	3,704,658	26,832,202	14	4,150,064	89	14,465,627	26
Chile		-	-	-	-	-	465,036	0
Colombia	10%	538,032	2,547,799	21	336,048	160	594,013	91
Costa Rica	7%	55,065	247,328	22	54,940	100	4,745	1161
Dominican Rep.	5%	67,746	335,152	20	17,852	379	13,667	496
Ecuador		-	408,327	0	15,901	0	285,096	0
El Salvador	9%	50,657	303,234	17	3,214	1576	232,073	22
Guatemala	10%	106,874	1,172,087	9	2,783	3841	370,805	29
Honduras	30%	129,795	357,668	36	2,732	4752	165,473	78
Mexico	10%	3,411,838	3,014,932	113	4,174	81742	6,995,840	49
Nicaragua		-	259,947	0	18,471	0	182,842	0
Panama	10%	54,658	110,862	49	4,888	1118	30,904	177
Paraguay	20%	45,028	233,249	19	865,770	5	347,246	13
Peru	8%	86,430	478,869	18	167,246	52	439,756	20
Uruguay		-	9,672	0	-	-	76,431	0
Venezuela	10%	1,209,386	618,444	196	92,096	1313	716,819	169

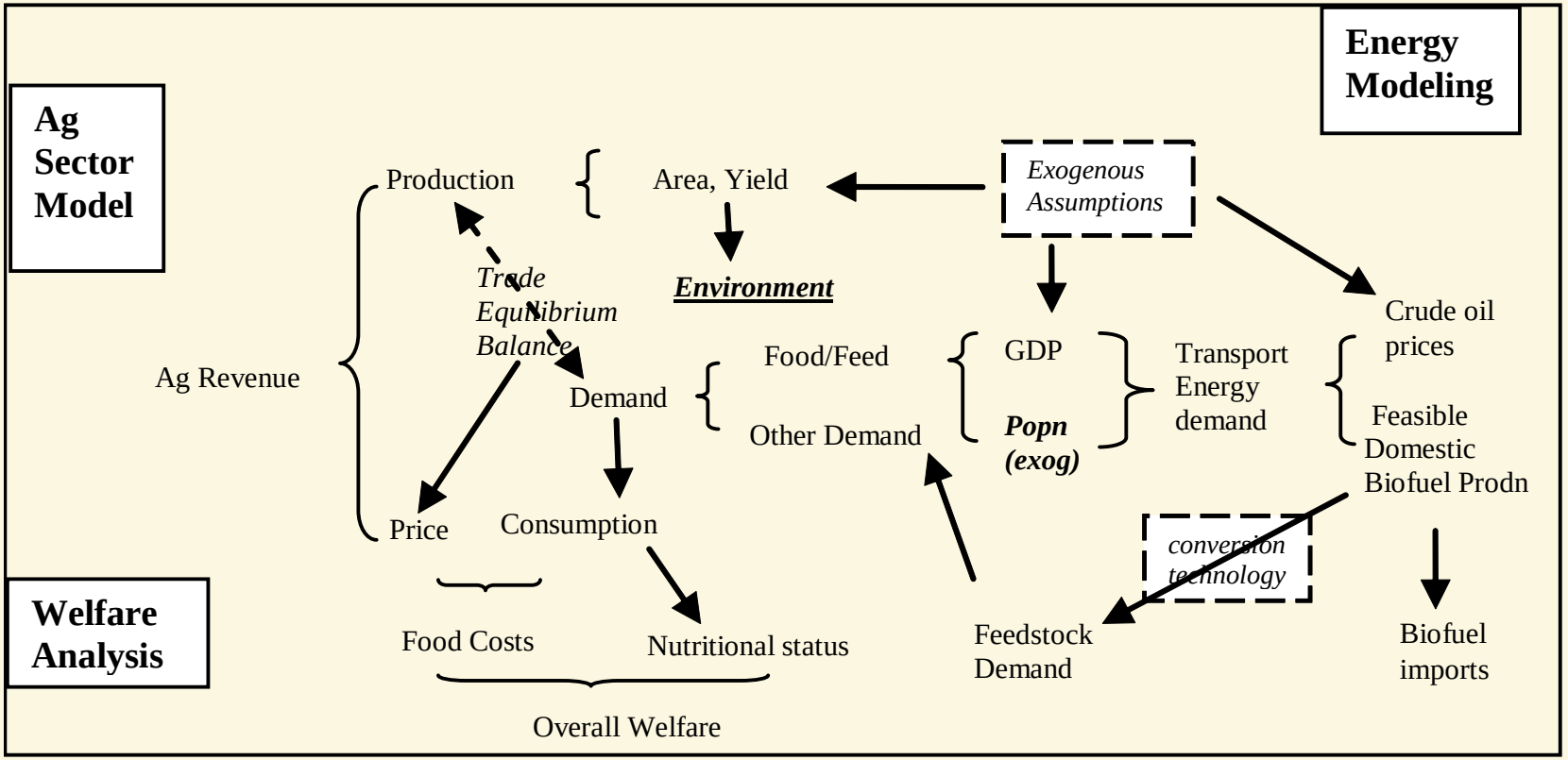
Current productions and share of current production selected target crops to meet mandatory or stated biodiesel standards using yield per ton of feedstock

			Oil Palm		Soybeans		Cotton seed	
Country	Mandatory / projected standards (as %)	Biodiesel requirements (Million lts/year)	100% production from targeted crop destined for biodiesel (Million lts)	% of current production to meet blending standards	100% production from targeted crop destined for biodiesel (Million lts)	% of current production to meet blending standards	100% production from targeted crop destined for biodiesel (Million lts)	% of current production to meet blending standards
Argentina	0.05	331.85	-	-	6,668	5	33.3	996
Bolivia	0.1	46.3	-	-	323	14	8.2	563
Brazil	0.05	1366.25	114.9	1189	9,776	14	221.1	618
Chile		0	-	-	-	-	-	-
Colombia	0.05	102.9	624.2	17	15	704	10.9	943
Costa Rica		0	141.3	0.0	-	-	0.03	0.0
Dominican Rep.		0	33.1	0.0	-	-	-	-
Ecuador		0	374.0	0	18	-	0.3	0.0
El Salvador		0	-	-	0	-	0.2	0.0
Guatemala		0	123.6	0	7	-	0.3	0.0
Honduras		0	238.6	0	31	-	0.2	0.0
Mexico		0	46.6	0	1	-	30.9	0.0
Nicaragua		0	11.8	0	0	-	0.3	0.0
Panama		0	13.4	0	259	-	-	-
Paraguay		0	26.4	0	1	-	23.7	0.0
Peru		0	40.5	0	0	-	6.9	0.0
Uruguay	0.05	26.1	-	-	71	37	-	-
Venezuela	0.05	83.8	61.0	137	1	11,963.3	2.01	4029

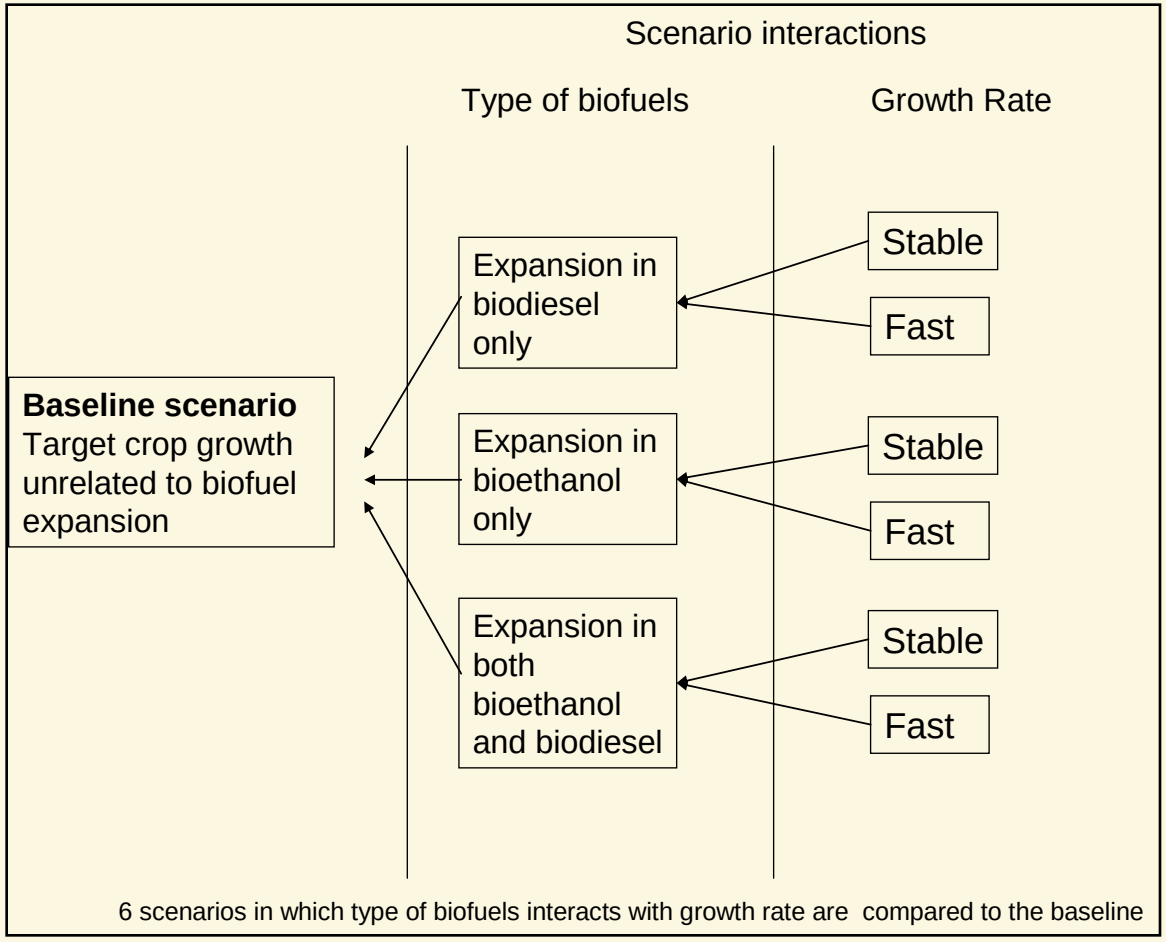
Current production and maximum share of ethanol demand satisfied with selected crops using yield per ton of feedstock

		Sugarcane		Cassava		Maize	
Country	Ethanol requirements (1,000 lts/year)	If 100% production from targeted crop was destined for ethanol (1,00 lts)	% of current ethanol demand potentially met with current production	If 100% production from targeted crop was destined for ethanol (1,00 lts)	% of current ethanol demand potentially met with current production	If 100% production from targeted crop was destined for ethanol (1,00 lts)	% of current ethanol demand potentially met with current production
Argentina	4,929,870	1,257,895	26%	29,565	1%	5,820,222	118%
Bolivia	688,985	172,254	25%	63,088	9%	232,708	34%
Brazil	16,107,211	26,832,202	167%	4,150,064	26%	14,465,627	90%
Chile	2,823,754	-	0%	-	0%	465,036	16%
Colombia	5,380,323	2,547,799	47%	336,048	6%	594,013	11%
Costa Rica	786,637	247,328	31%	54,940	7%	4,745	1%
Dominican Rep.	1,354,914	335,152	25%	17,852	1%	13,667	1%
Ecuador	2,429,080	408,327	17%	15,901	1%	285,096	12%
El Salvador	562,852	303,234	54%	3,214	1%	232,073	41%
Guatemala	1,068,741	1,172,087	110%	2,783	0%	370,805	35%
Honduras	432,650	357,668	83%	2,732	1%	165,473	38%
Mexico	34,118,379	3,014,932	9%	4,174	0%	6,995,840	21%
Nicaragua	225,141	259,947	115%	18,471	8%	182,842	81%
Panama	546,577	110,862	20%	4,888	1%	30,904	6%
Paraguay	225,141	233,249	104%	865,770	385%	347,246	154%
Peru	1,108,073	478,869	43%	167,246	15%	439,756	40%
Uruguay	337,711	9,672	3%	-	0%	76,431	23%
Venezuela	12,093,860	618,444	5%	92,096	1%	716,819	6%

Graphical Schematic of Quantitative Modeling Components



Scenarios biofuel expansion



Percent differences with respect to baseline prices of feedstock commodities expressed as 2025 World Prices

Commodity	Ethanol Stable Growth in LAC	Ethanol Fast Growth in LAC	Biodiesel Stable Growth in LAC	Biodiesel Fast Growth in LAC	Ethanol and Biodiesel Stable Growth in LAC	Ethanol and Biodiesel Fast Growth in LAC
Wheat	55.0	55.9	0.1	0.1	55.4	56.4
Maize	86.5	85.4	0.2	0.2	84.2	86.3
Cassava	253.1	311.9	0.2	0.2	295.4	318.4
Sugar	87.3	87.7	0.1	0.1	87.3	88.0
Oils*	8.5	8.2	2.3	2.5	10.5	10.9

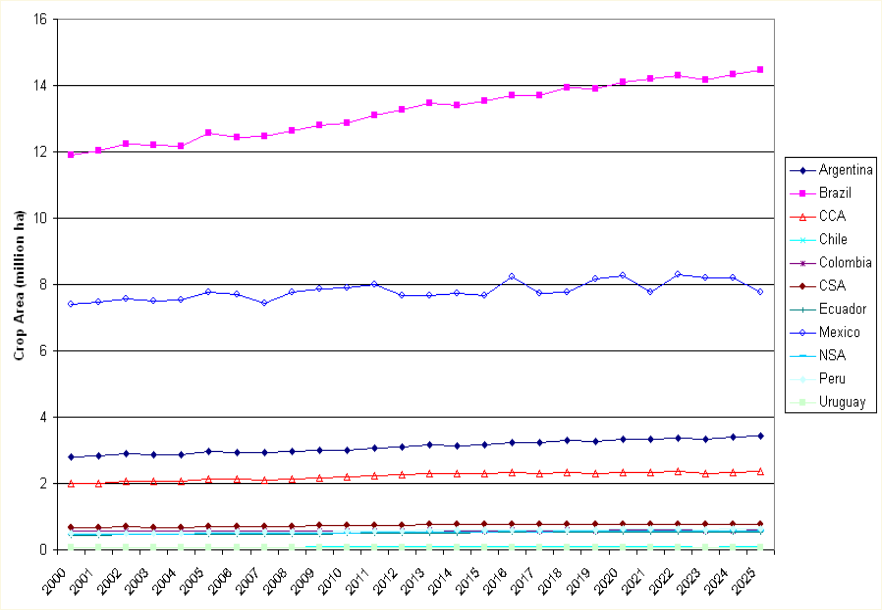
Notes: 1) Source: IMPACT-WATER projections, 2) In the case Oils, what is shown is a composite price of various oil commodities

Percentage difference with respect to baseline in irrigated production of ethanol feedstock crops under stable ethanol growth in LAC (in year 2025)

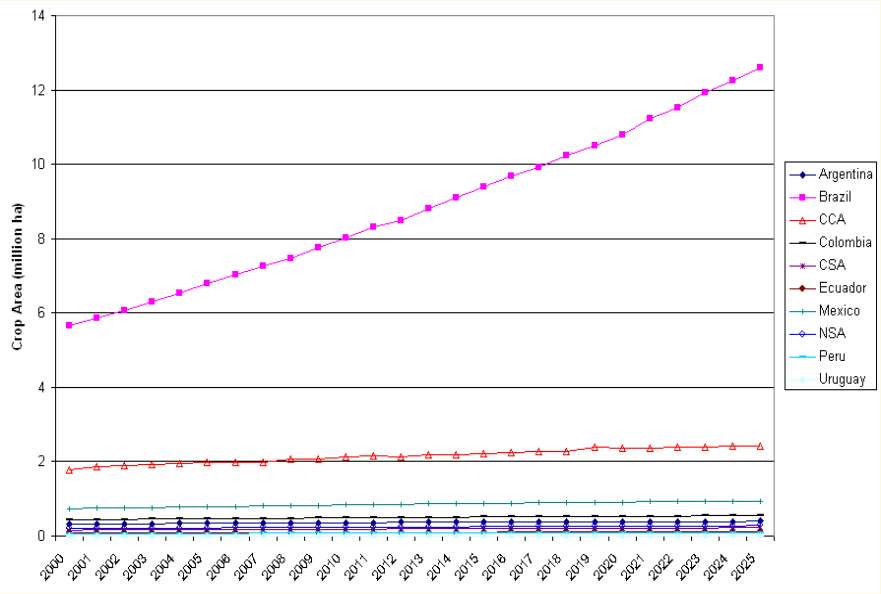
Country	Wheat	Maize	Sugarcane
Argentina	6.7	8.8	15.5
Brazil	7.3		7.4
Central America and the Caribbean	4.1	9.4	11.0
Central – South America			11.0
Chile	4.1	10.5	
Colombia	4.8	10.1	13.9
Ecuador	4.1	10.5	11.0
Mexico	1.9	6.9	14.0
Northern – South America	4.1	10.5	11.0
Peru	4.1	10.5	7.0
Uruguay	4.1	10.5	11.0

Note: IMPACT-WATER projections

Projection of Maize and Sugarcane Area in Latin America (Baseline Growth



Maize



Sugarcane

Note: IMPACT-WATER projections

Changes in net trade from baseline for year 2025 of Ethanol and Biodiesel feedstock commodities under various scenarios (000 mt)

Countries	Ethanol				Biodiesel
Stable Growth scenarios	Wheat	Maize	Cassava	Sugar	Oils
Argentina	3231	1397	-1509	937	68
Brazil	2040	21362	17361	-83096	-398
Central America and the Caribbean	353	1654	714	3997	40
Central – South America	184	804	3656	500	10
Chile	482	413	0	292	16
Colombia	179	-3538	446	1913	34
Ecuador	79	124	158	462	12
Mexico	1315	3359	48	5386	65
Northern – South America	201	1253	442	963	17
Peru	268	899	686	801	20
Uruguay	101	130	1	46	2
	Ethanol				Biodiesel
Fast Growth scenarios	Wheat	Maize	Cassava	Sugar	Oils
Argentina	3286	-431	-16644	863	-60
Brazil	2065	21090	20143	-83703	-384
Central America and the Caribbean	354	666	826	3932	4
Central – South America	186	781	4226	497	11
Chile	488	389	0	290	-1
Colombia	182	-8006	-705	1681	-62
Ecuador	80	113	184	460	13
Mexico	1339	3773	54	5394	70
Northern – South America	204	1219	511	957	18
Peru	271	431	794	779	21
Uruguay	103	127	1	45	2

Note: IMPACT-WATER projections

Baseline Child Malnourishment levels in year 2025 and Differences from Baseline under Scenarios

Countries	Baseline (000 children)	Ethanol expansion (%)	Biodiesel Expansion (%)	Combined Ethanol + Biodiesel expansion (%)
Argentina	476	10.8	0.3	11.2
Brazil	2415	13.1	0.4	13.6
Central America and the Caribbean	965	24.9	0.4	25.3
Central – South America	346	16.2	0.3	16.8
Chile	135	81.1	2.1	83.9
Colombia	201	16.6	0.6	17.3
Ecuador	261	121.0	1.4	121.4
Mexico	276	29.2	0.6	29.9
Northern – South America	92	83.5	1.4	86.3
Peru	41	13.2	0.3	13.5

Note: IMPACT-WATER projections

Baseline per capita calorie availability in year 2025 and percentage difference from baseline under scenarios

Countries	Baseline (Kcal/cap/day)	Ethanol expansion (%)	Biodiesel expansion (%)	Combined Ethanol + Biodiesel expansion (%)
Argentina	3454	-6.0	-0.2	-6.2
Brazil	3483	-7.3	-0.2	-7.6
Central America and the Caribbean	2679	-11.0	-0.2	-11.2
Central – South America	2437	-10.0	-0.2	-10.3
Chile	3137	-10.9	-0.2	-11.1
Colombia	2893	-9.1	-0.2	-9.4
Ecuador	2990	-9.4	-0.4	-9.7
Mexico	3637	-12.6	-0.2	-12.7
Northern – South America	2709	-10.2	-0.2	-10.5
Peru	2756	-9.6	-0.2	-9.9
Uruguay	3149	-7.9	-0.2	-8.1

Note: IMPACT-WATER projections

Conclusions: Indicator Approach

- Most countries in Latin America continue to lag behind in terms of productivity, with a few exceptions.
- From a technical and productivity standpoint, the best crops in which to base biofuel expansion will continue to be sugarcane and palm oil trees.
- Most countries in Latin America will not have a production constraint in terms of meeting mandatory blends requirements, however, if the goal is to obtain energy independence, this result only holds for a few countries,
- Biofuel expansion is not likely to have a binding land production constraint in Latin America, with a few exceptions.
- Contrast conclusions with potential social and economic consequences of expanding biofuel into fragile lands and ecosystems, potential impacts on land displacement of resource poor farmers and others
- Pressing need to:
  - Invest in agriculture and agricultural productivity
  - Research appropriate social policies to mitigate impact of food prices and biofuels expansion

Conclusions: Forward looking IMPACT quantitative approach

- Brazil will continue to be the major player in the ethanol market in the future as it is likely to expand its ethanol exports to meet growing demand in other countries including some in Latin America.
- Countries such as Argentina and Colombia will likely continue their biofuel expansion plans, although our estimate show that they will not likely meet their demand based on current production potential.
- Our simulations show that biofuel impacts on food security and malnutrition will likely happen in those countries where the feedstock used for biofuel production is a critical component of a major share of the population, other things equal.
  - An example of this potential is Mexico and most of the Central America region, where a high proportion of the diet is composed of maize.
  - These results do not consider potential gains from additional income from increased maize (or feedstock) prices in those households who may commercialize surplus production

Policy issues and recommendations

- Biofuel expansion may (still) bring significant benefits in terms of opening possibilities and production alternatives for farmers in Latin American.
- To maximize the benefits and to avoid the pitfalls, Latin American countries must carefully assess this policy alternative before embarking in an activity that has the potential to change its agriculture.
  - Consider food supplementation programs and other targeted programs to address the most vulnerable households in a country, if current feedstock production possibilities and conditions remain fairly constant.
  - Implement policies to adjust management of grain stocks to reduce price and quantity fluctuations that tend to affect most, vulnerable households
  - Accelerate plans to modernize agriculture even further and to expand its production and productivity at a much more accelerated growth rate than that needed to ensure food security.
- Production of biofuels needs to be examined within the broader context of economic and agricultural development policies, poverty alleviation efforts and compliance with the Millennium Development Goals, and sustainable improvements in the livelihoods of the poor; especially in rural areas.

Areas for Further Work

- Trade policies will continue to be an important issue for Latin American countries and their ability to supply the world's biofuels need – need to examine the impacts and quantify the benefits of trade liberalization towards biofuels product (esp with regard to US and EU policies).
- Need to consider whether increasing biofuels production for some countries will cause their output of traditional exports to fall/change.
  - This could mean a significant change in revenue streams for some – and have other implications for employment and value-added in the ag sector
  - See what the implications for balance of trade will be – need an economy-wide modeling approach to look at this closely.
- Haven't fully addressed the environmental issues – especially that of land use change, which has implications for greenhouse gas mitigation. The issues of 'leakage' brought up in other studies should be studied carefully (for Brazil as well as other major producers)
- An economy-wide modeling approach would also help to address issues of change in household income, poverty and change in sectoral value-added which we cannot address within the partial-equilibrium framework discussed.

Final Thought

- The extent to which biofuels production can contribute towards addressing or affecting broader contextual issues will depend on a series of strategic determinants of impact success, ranging from the characteristics of installed capacity and industrial organization and coordination to whether any nascent market for biofuels will be economically sustainable and financially viable without continuous government support or interventions