



Issues of Bio-fuel and Food Security in South Asia

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Terminology

- **Bioalcohols** - biologically produced alcohols, most commonly ethanol
- **Biodiesel**
 - most common biofuel in Europe
 - produced from oils or fats - a liquid similar to fossil/mineral diesel
 - consists mostly of fatty acid methyl (or ethyl) esters
- **Green diesel** - produced through hydro-cracking biological oil feed-stocks (e.g., veg oils and animal fats)
- Used **vegetable oil** is increasingly being processed into biodiesel
- **Bioethers** - cost-effective compounds - act as octane rating enhancers – contribute air quality
- **Biogas** - methane produced by the process of anaerobic digestion
- **Syngas** - partial combustion of biomass

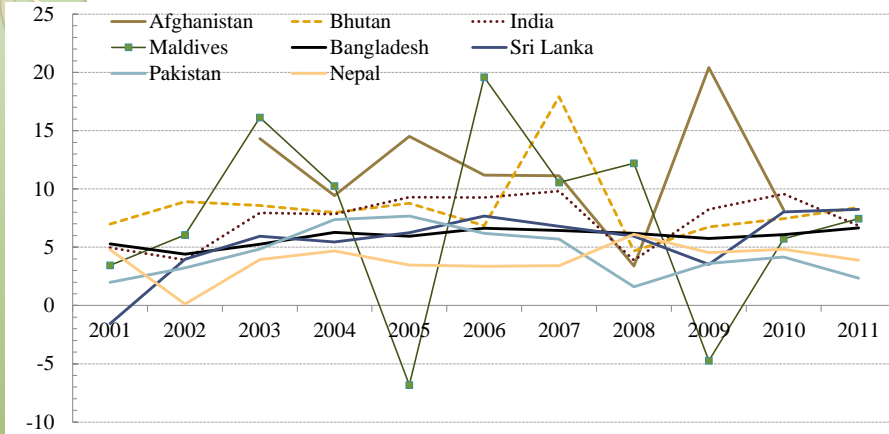
Food – running human body and transport



Background

- Energy plays an essential role in an economy on both demand and supply
- Demand side
 - energy is one of the products a consumer decides to buy to maximize utility
- Supply side
 - energy is a key factor of production in addition to capital, labor and materials and is seen to play a vital role in the economic and social development of countries, being a key factor in increasing economic growth and living standards
- SA achieved impressive economic growth
- Growing size of the economy and rising energy demand go hand in hand without few exceptions

Growth in SA

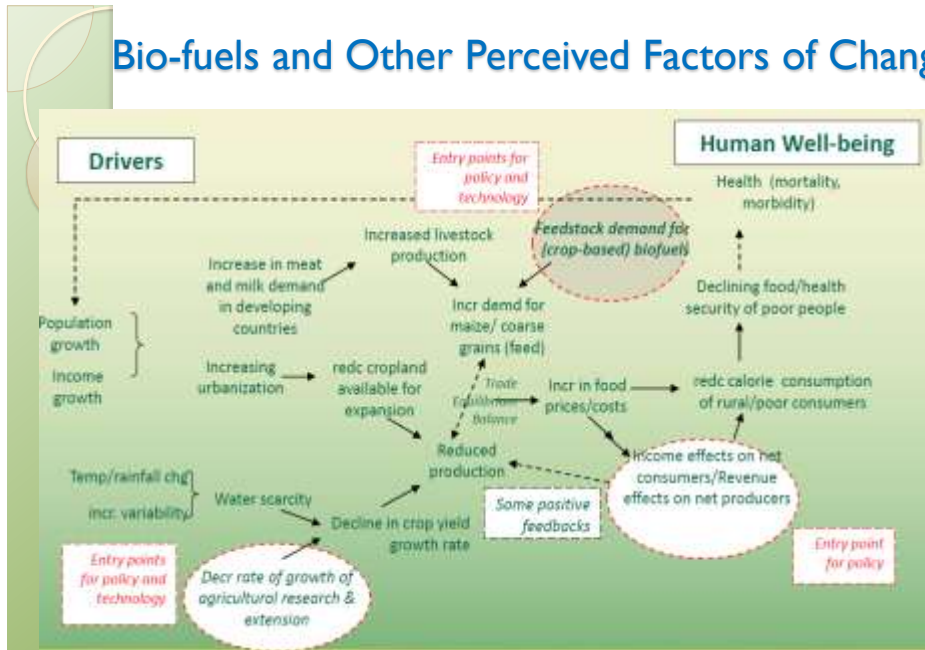


Energy & Economic Growth in SA

	Cointegration	Causality		
		Y \rightarrow E	E \rightarrow Y	Y \leftrightarrow E
Bangladesh	No		√	
India	No			
Nepal			√	
Pakistan	No			
Sri Lanka	No			

- SA is energy deficient/energy hungry
- Energy is a limiting factor of economic growth in Bangladesh and Nepal
- SA – Brand new growth-oriented poverty reduction and economic advancement
- Energy diversification – energy security – bio source

Bio-fuels and Other Perceived Factors of Change



Source: Siwa Msangi, Simla Tokgoz, and Wei Zhang (2012), IFPRI.

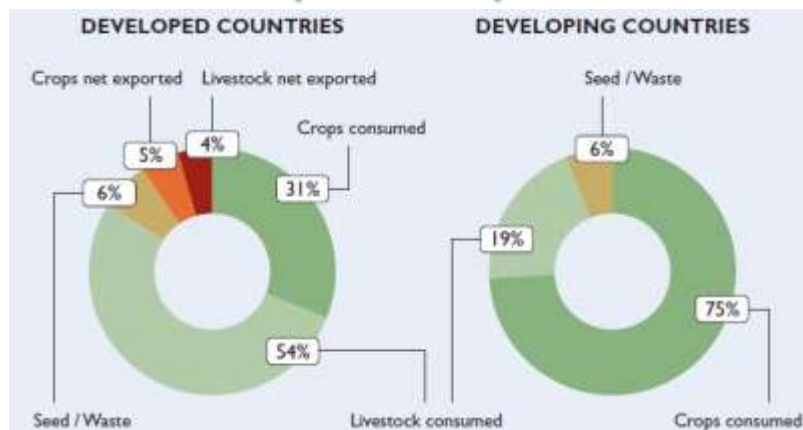
Debates

- Social, economic, environmental and technical effects
 - moderating oil prices
 - poverty reduction potential
 - carbon emissions levels
 - sustainable bio-fuel production
 - deforestation and soil erosion
 - loss of biodiversity
 - impact on water resources – used water, water for input prodⁿ
 - energy balance and efficiency
 - electric plant in Łódź importing over 7,000 tons of wood biomass
- Food vs. fuel
 - bio-fuel production accounted for 3-30% of the increase in food prices in 2008
 - market-driven expansion of ethanol in the US increased corn prices by 21% in 2009

Higher demand for biofuels can influence food prices

- Direct purchase of food stocks
 - for each 1% rise in food prices, caloric intake among the poor drops 0.5%
- Livestock feed costs
 - Grains and oilseeds make up a large part of livestock feeds, so the price of meat, dairy and eggs all rises
- Crop and land substitution
- Use of marginal land
 - 'Low quality' land
 - In India, these are lands used for grazing, harvesting of forest resources, or wildlife

Net utilization of arable land (2000-02)



Source: Fischer et. al. (n.d.), *Biofuels and Food Security*, OFID, Vienna.

Scenarios

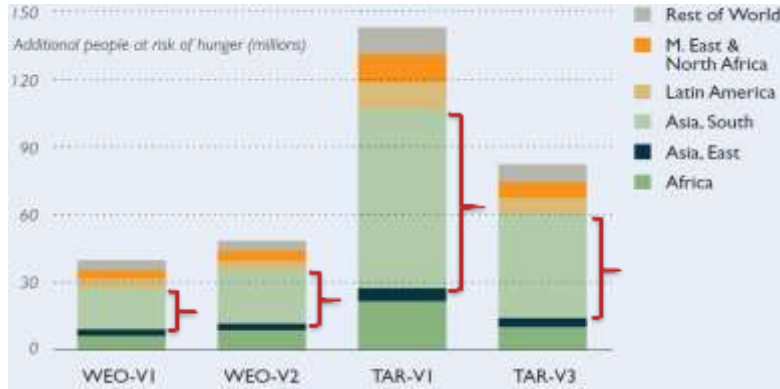
- **REF-01:** Assumes historical biofuel development until 2008; feedstock demand kept constant after 2008
- **WEO-VI:** Assumes transport energy demand and regional biofuel use; Second-generation conversion technologies become commercially available after 2015;
- **WEO-VI2:** Assumes transport energy demand and regional biofuel use as projected by IEA in its WEO 2008 Reference Scenario. Assumes that due to delayed arrival of second-generation conversion technologies all biofuel production until 2030 is based on first-generation feedstocks;
- **TAR-VI:** Assumes transport energy demand 2008 Reference Scenario. Assumes that mandatory, voluntary or indicative targets for biofuel use announced by major developed and developing countries will be implemented by 2020, resulting in about twice the biofuel consumption. Second-generation conversion technologies become commercially available after 2015; deployment is gradual
- **TAR-V3:** Assumes transport energy demand 2008 Reference Scenario. Assumes that mandatory, voluntary or indicative targets for biofuel use announced by major developed and developing countries will be implemented by 2020. Accelerated development of second-generation conversion technologies permits rapid deployment; 33% and 50% of biofuel use in developed countries from second-generation in 2020 and 2030 respectively.

People at risk of hunger, baseline projection REF-01

REF-01	Millions	2000	2010	2020	2030	2050
Africa		198	253	289	319	326
Asia, East		172	142	111	80	35
Asia, South		359	361	303	219	72
Latin America		58	61	55	51	30
Middle East & N. Africa		43	50	49	50	39
Rest of World		53	51	47	46	33
World		884	918	854	765	536

Source: Fischer *et al.* (n.d.), *Biofuels and Food Security*, OFID, Vienna.

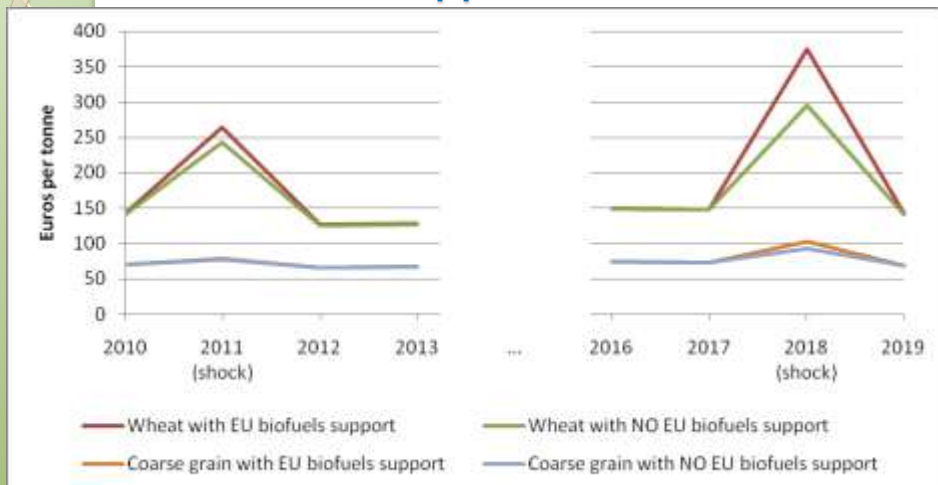
Additional people at risk of hunger relative to baseline REF-0I, in 2020



]- = South Asia

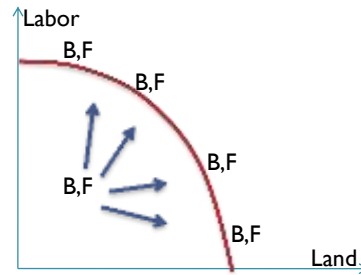
Source: Fischer et al. (n.d.), *Biofuels and Food Security*, OFID, Vienna.

Effect on world price of removing EU biofuels support

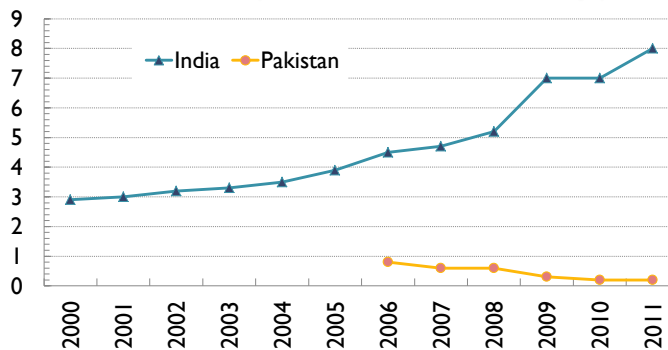


Food-fuel trade-off

- Land devoted for food production used for BF input
- Less food – more people hungry
- Market and profit – increased production to ever-expanding frontier
- Water – alternative use
- Food for environment
- Air quality vs. food
- Recycling and substitution vs. environmental degradation
- Food price vs. non-bio fuel price



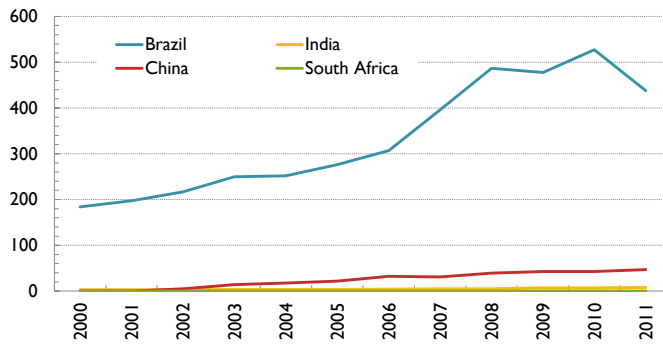
South Asia (000 Barrels/Day)



	2000	2006	2011
India	2.9	4.5	8
Pakistan	0	0.8	0.2

Source: EIA

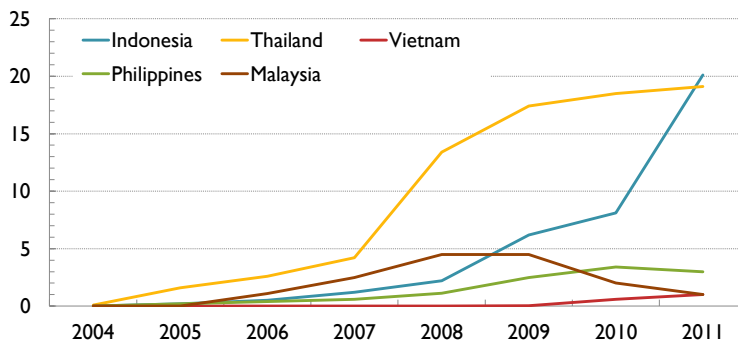
BRICS (000 Barrels/Day)



	2000	2005	2011
Brazil	183.8867	276.4178	438.058
Russia	0	0	0
India	2.9	3.9	8
China	0	21.5	46.8
South Africa	0	0	0.13

Source: EIA

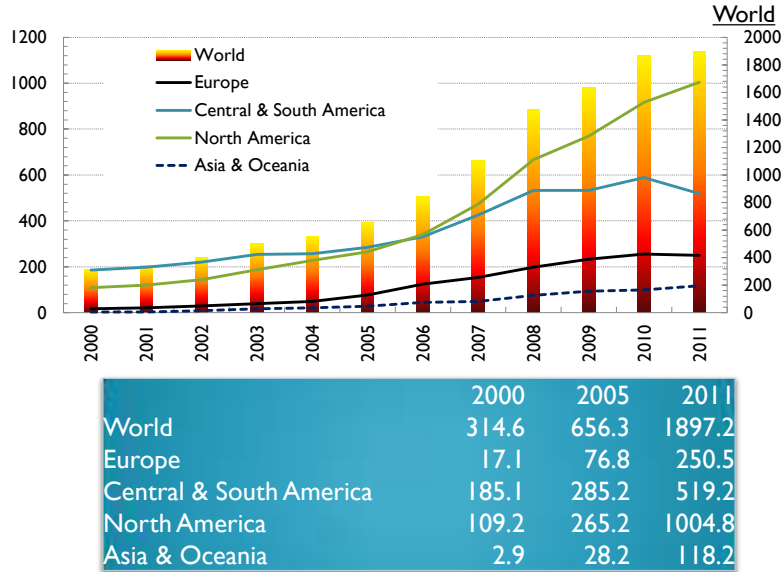
Other Asia – Developing (000 Barrels/Day)



	2004	2008	2011
Indonesia	0	2.2	20.1
Thailand	0.1	13.4	19.1
Vietnam	0	0	1
Philippines	0	1.1	3
Malaysia	0	4.5	1

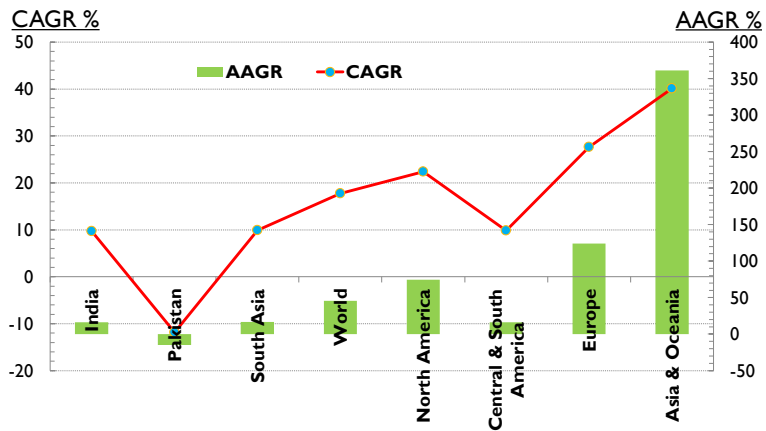
Source: EIA

Regions (000 Barrels/Day)



Source: EIA

Growth of Bio-fuel Production, 2000-2011



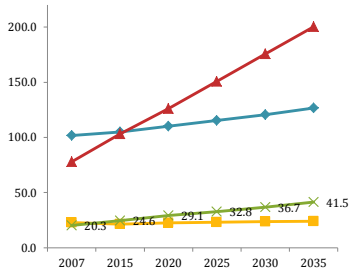
AAGR = Average Annual Growth Rate, CAGR = Compounded Annual Growth Rate

Source: Calculation based on EIA data.

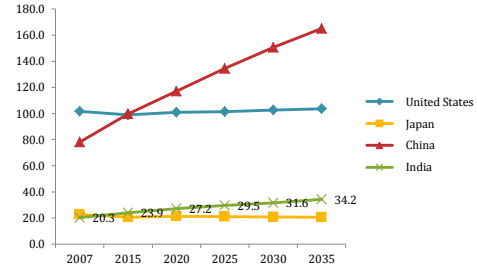


World primary energy consumption (Quadrillion Btu)

World primary energy consumption (high gr)



World primary energy consumption (low gr)



World liquids consumption by region, Reference case, 2005-2035 (Million barrels per day)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	25.2	25.0	25.1	24.6	25.0	25.7	26.4	27.4	0.3
United States ^a	20.8	20.7	20.6	20.2	20.6	21.0	21.5	22.1	0.2
Canada	2.3	2.3	2.3	2.2	2.2	2.2	2.3	2.4	0.1
Mexico	2.1	2.1	2.1	2.2	2.3	2.4	2.7	2.9	1.1
OECD Europe	15.7	15.7	15.3	14.0	13.4	13.4	13.6	13.7	-0.4
OECD Asia	8.6	8.5	8.4	7.7	8.0	8.1	8.3	8.4	0.0
Japan	5.3	5.2	5.0	4.2	4.3	4.3	4.2	4.1	-0.7
South Korea	2.2	2.2	2.2	2.4	2.5	2.7	2.9	3.1	1.1
Australia/New Zealand	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	0.4
Total OECD	49.5	49.1	48.8	46.3	46.4	47.2	48.3	49.5	0.0
Non-OECD									
Non-OECD Europe and Eurasia	4.9	5.0	5.1	4.9	4.9	5.0	5.1	5.4	0.2
Russia	2.8	2.9	2.9	2.8	2.7	2.7	2.7	2.8	0.0
Other	2.1	2.2	2.2	2.1	2.2	2.3	2.4	2.5	0.5
Non-OECD Asia	15.4	16.2	16.8	20.1	22.7	25.9	29.1	32.3	2.4
China	6.7	7.3	7.6	10.0	11.6	13.5	15.3	16.9	2.9
India	2.5	2.7	2.8	3.2	3.6	3.9	4.3	4.7	1.8

Source: EIA, International Economic Outlook



World consumption of hydroelectricity and other **renewable energy** by region, Reference case, 2005-2035 (Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	10.9	11.1	11.0	14.6	16.0	17.4	18.4	19.8	2.1
United States ^a	6.1	6.4	6.2	9.3	10.1	11.0	11.5	12.4	2.5
Canada	4.2	4.1	4.2	4.5	5.0	5.4	5.8	6.1	1.4
Mexico	0.6	0.6	0.5	0.8	0.8	1.0	1.1	1.3	3.1
OECD Europe	7.9	8.1	8.7	11.0	12.4	13.8	14.5	15.1	2.0
OECD Asia	2.1	2.2	2.1	2.6	3.0	3.2	3.3	3.5	1.7
Japan	1.3	1.4	1.3	1.3	1.5	1.6	1.6	1.7	0.8
South Korea	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	3.0
Australia/New Zealand	0.7	0.7	0.7	1.2	1.3	1.4	1.5	1.5	2.8
Total OECD	20.9	21.4	21.7	28.2	31.4	34.3	36.3	38.3	2.0
Non-OECD									
Non-OECD Europe and Eurasia	3.2	3.2	3.1	3.3	3.6	3.8	4.1	4.5	1.4
Russia	1.9	1.9	1.9	2.0	2.2	2.4	2.6	2.8	1.5
Other	1.4	1.3	1.2	1.4	1.4	1.5	1.6	1.7	1.3
Non-OECD Asia	9.3	9.9	10.2	16.2	20.4	24.2	28.5	32.5	4.2
China	4.1	4.5	4.5	8.7	11.2	13.8	16.4	18.5	5.2
India	2.3	2.4	2.5	3.2	4.0	4.5	5.1	5.8	3.0

Source: EIA, International Economic Outlook



World liquids consumption by region, High Economic Growth case, 2005-2035 (Million barrels per day)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	25.2	25.0	25.1	25.4	26.2	27.5	29.1	30.7	0.7
United States ^a	20.8	20.7	20.6	20.9	21.6	22.5	23.6	24.7	0.6
Canada	2.3	2.3	2.3	2.3	2.3	2.4	2.5	2.7	0.5
Mexico	2.1	2.1	2.1	2.2	2.4	2.6	2.9	3.3	1.6
OECD Europe	15.7	15.7	15.3	14.3	13.9	14.2	14.6	15.0	-0.1
OECD Asia	8.6	8.5	8.4	7.9	8.3	8.7	9.0	9.3	0.4
Japan	5.3	5.2	5.0	4.3	4.5	4.6	4.6	4.5	-0.4
South Korea	2.2	2.2	2.2	2.4	2.6	2.9	3.1	3.4	1.5
Australia/New Zealand	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.4	0.8
Total OECD	49.5	49.1	48.8	47.5	48.5	50.4	52.7	55.1	0.4
Non-OECD									
Non-OECD Europe and Eurasia	4.9	5.0	5.1	5.0	5.1	5.3	5.6	5.9	0.6
Russia	2.8	2.9	2.9	2.8	2.8	2.8	2.9	3.1	0.3
Other	2.1	2.2	2.2	2.2	2.3	2.5	2.6	2.8	0.9
Non-OECD Asia	15.4	16.2	16.8	20.5	23.9	27.9	32.1	36.5	2.8
China	6.7	7.3	7.6	10.2	12.1	14.5	16.9	19.1	3.4
India	2.5	2.7	2.8	3.3	3.8	4.2	4.7	5.3	2.3

Source: EIA, International Economic Outlook



World consumption of hydroelectricity and other renewable energy by region, High Economic Growth case, 2005-2035 (Quadrillion Btu)

Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	10.9	11.1	11.0	16.1	17.5	19.1	20.9	23.0	2.7
United States ^a	6.1	6.4	6.2	10.7	11.4	12.4	13.7	15.2	3.3
Canada	4.2	4.1	4.2	4.6	5.2	5.6	6.0	6.5	1.5
Mexico	0.6	0.6	0.5	0.8	0.9	1.0	1.2	1.3	3.3
OECD Europe	7.9	8.1	8.7	11.3	12.6	14.1	15.1	15.7	2.2
OECD Asia	2.1	2.2	2.1	2.7	3.0	3.2	3.5	3.7	1.9
Japan	1.3	1.4	1.3	1.3	1.6	1.6	1.7	1.8	1.1
South Korea	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	3.3
Australia/New Zealand	0.7	0.7	0.7	1.2	1.3	1.4	1.5	1.6	3.0
Total OECD	20.9	21.4	21.7	30.1	33.1	36.4	39.5	42.4	2.4
Non-OECD									
Non-OECD Europe and Eurasia	3.2	3.2	3.1	3.3	3.6	3.9	4.3	4.8	1.6
Russia	1.9	1.9	1.9	2.0	2.2	2.4	2.7	3.0	1.7
Other	1.4	1.3	1.2	1.4	1.4	1.5	1.6	1.8	1.4
Non-OECD Asia	9.3	9.9	10.2	16.3	20.6	24.6	29.2	33.9	4.4
China	4.1	4.5	4.5	8.7	11.2	13.8	16.5	18.9	5.2
India	2.3	2.4	2.5	3.3	4.1	4.6	5.4	6.3	3.3

Source: EIA, International Economic Outlook



World population by region, Reference case, 2005-2035 (Millions)

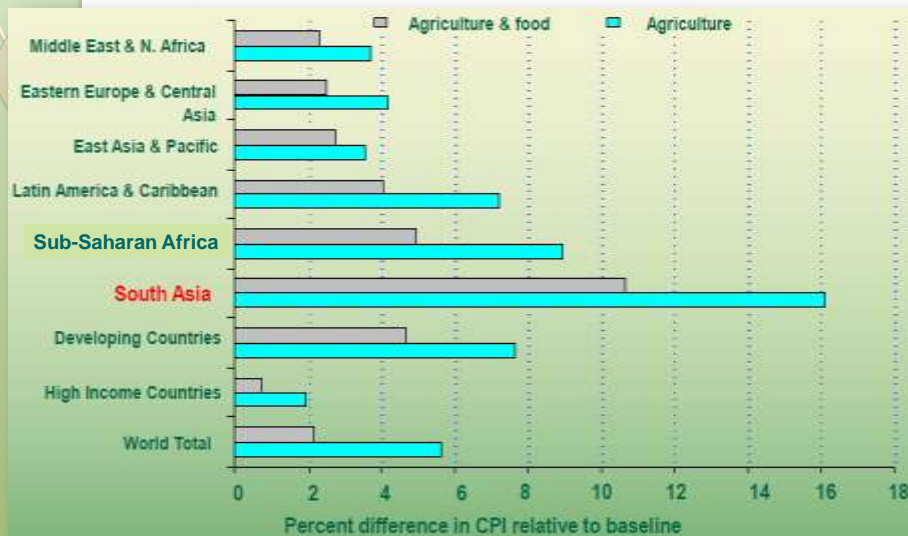
Region/Country	History			Projections					Average annual percent change, 2007-2035
	2005	2006	2007	2015	2020	2025	2030	2035	
OECD									
OECD North America	432	436	441	477	500	523	546	569	0.9
United States ^a	297	300	302	327	343	359	375	391	0.9
Canada	32	33	33	36	38	40	42	43	1.0
Mexico	103	104	105	114	120	125	130	135	0.9
OECD Europe	535	538	541	558	565	571	575	577	0.2
OECD Asia	200	200	201	203	202	201	199	196	-0.1
Japan	128	128	128	126	124	122	119	116	-0.3
South Korea	48	48	48	49	49	49	49	48	0.0
Australia/New Zealand	25	25	25	27	28	30	31	32	0.8
Total OECD	1,167	1,175	1,183	1,238	1,267	1,294	1,319	1,342	0.5
Non-OECD									
Non-OECD Europe and Eurasia	341	341	340	338	336	333	329	324	-0.2
Russia	143	143	142	138	135	132	129	125	-0.4
Other	198	198	198	200	200	201	200	198	0.0
Non-OECD Asia	3,446	3,486	3,525	3,841	4,021	4,175	4,299	4,398	0.8
China	1,308	1,314	1,321	1,386	1,421	1,443	1,452	1,452	0.3
India	1,131	1,148	1,165	1,294	1,367	1,431	1,485	1,528	1.0

Source: EIA, International Economic Outlook

Critical issues

- Slow climate change?
- Absorbing cereal production
- A factor in rising hunger
- Fueling deforestation
- Competition for agricultural land
- Environmental impact from biofuel feedstock production

Impacts of bio-fuel CPI growth



De Hoyos, Rafael E. & Medvedev, Denis (2009), "Poverty effects of higher food prices : a global perspective," Policy Research Working Paper 4887, World Bank.

Depth of hunger* (kilocalories/person/ day)

	1992	1997	2002	2008
Bangladesh	310	330	300	290
India	240	220	220	240
Maldives	170	180	180	190
Nepal	230	230	230	220
Pakistan	280	260	280	280
Sri Lanka	260	260	250	250

* how much food-deprived people fall short of minimum food needs in terms of dietary energy.

Higher than 300 = high; lower than 200 = low

Source: WDI.

Arable land (hectares per person)

	1980	1990	2000	2005	2009
Afghanistan	0.52	0.42	0.30	0.26	0.23
Bangladesh	0.11	0.09	0.06	0.06	0.05
Bhutan	0.30	0.23	0.23	0.19	0.11
India	0.23	0.19	0.15	0.14	0.13
Maldives	0.03	0.02	0.01	0.01	0.01
Nepal	0.15	0.12	0.10	0.09	0.08
Pakistan	0.25	0.18	0.15	0.13	0.12
Sri Lanka	0.06	0.05	0.05	0.06	0.06

Source: WDI.

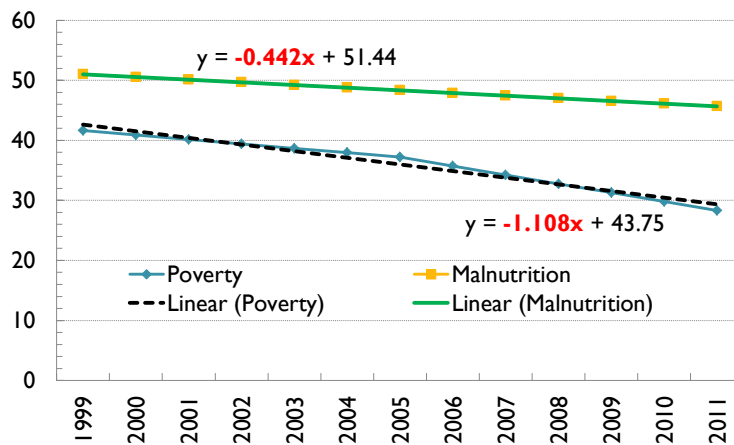
Food production index* (2004-2006 = 100)

	1980	1990	2000	2005	2010
Afghanistan	79.0	68.5	84.9	107.1	115.2
Bangladesh	51.0	63.9	89.3	102.8	129.4
Bhutan	48.7	63.4	67.9	106.6	95.2
India	47.8	70.5	91.7	100.1	118.2
Maldives	100.1	82.6	96.6	78.5	86.5
Nepal	40.3	64.6	86.3	100.4	112.2
Pakistan	39.5	60.6	88.4	100.5	113.8
Sri Lanka	86.9	85.3	94.9	103.1	125.1

* contains food crops that are considered edible and that contain nutrients.

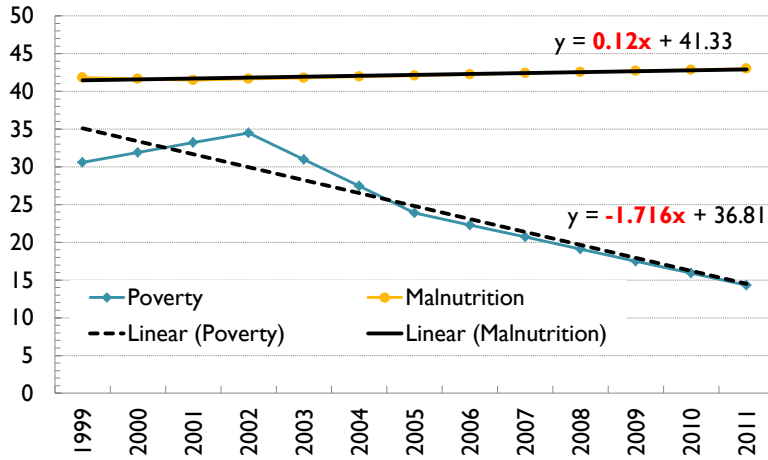
Source:WDI.

Poverty vs. Child Malnutrition - India



Source: Analysis based on WDI data.

Poverty vs. Child Malnutrition - Pakistan

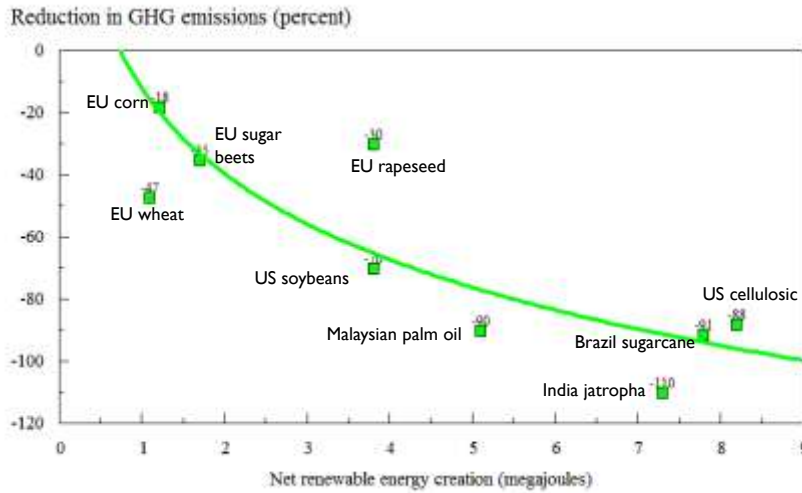


Source: Analysis based on WDI data.

Bio-fuel Agenda

Country/Region	Mandatory, voluntary or indicative target	Country/Region	Mandatory, voluntary or indicative target
Australia	At least 350 million liters biofuels by 2010	Brazil	Mandatory 25 percent ethanol blend with gasoline; 5 percent biodiesel blend by 2010.
Canada	5 percent renewable content in gasoline by 2010	China	2 million tons ethanol by 2010 increasing to 10 million tons by 2020; 0.2 million tons biodiesel by 2010 increasing to 2 million tons by 2020.
European Union	5.75 percent by 2010 10 percent by 2020	India	5 percent ethanol blending in gasoline in 2008, 10 percent as of 2009; indicative target of 20 percent ethanol blending in gasoline and 20 percent biodiesel blending by 2017.
Germany	6.25 percent by 2010 10 percent by 2020	Indonesia	2 percent biofuels in energy mix by 2010, 3 percent by 2015, and 5 percent by 2020.
France	7 percent by 2010, 10 percent by 2015, 10 percent by 2020	Thailand	2 percent biodiesel blend by 2008, 10 percent biodiesel blend by 2012; 10 percent ethanol blend by 2012.
Japan	0.6 percent of auto fuel by 2010; a goal to reduce fossil oil dependence of transport sector from 98% to 80% by 2030	South Africa	2 percent of biofuels by 2013
New Zealand	3.4 percent target for both gasoline and diesel by 2012		
United States	12 billion gallons by 2010, rising to 20.5 billion gallons by 2015 and to 36 billion gallons by 2022 (with 16 billion gallons from advanced cellulosic ethanol)		

Higher-Yielding Biomass Reduces Environmental Impacts



Source: IMF, World Economic Outlook

High Oil Prices



William T. Coyle (2011), Global Biofuel Production and Food Security: Implications for Asia Pacific

SA Perspective

- food importer – increased bio-fuel production of source countries would increase food insecurity
- net importer of many feed-stocks that are being used elsewhere (esp. oils, sugar)
- many of these shocks would come at the same time – since higher oil prices would lead to greater profitability (and demand for) bio-fuels elsewhere – which will push up feedstock prices
- boost in bio-fuel would reduce poverty more of non-agricultural hhs than of agricultural ones
- pressure on existing water scarcity and declining arable land
- nexus between environmental degradation-deforestation-climate change-food security

Positive vs. Normative

- Normative – Hunger, poverty, ecology, scarcity – why should move
- Positive – Why they are moving towards bio-fuel
 - Economics, price, market, R&D
 - Future of energy - Driving economy and human civilization
- Imperatives - Minimize loss of calorie
- 6,597 kcal non-renewable energy required to produce a litre of ethanol from corn containing 5,130 kcal of energy, leading to 22% loss
- More than 70% of Europe's farmland would be required for biofuel crops for only 10% of road transport fuel
- Even if high yield bio-energy crops were grown on all the arable land on earth, the biofuel produced would cater to only 20% of current demand



Way forward

- Need for greater understanding and awareness
 - Limit liquid bio-fuels for transport
 - pose risks to food security and environmental sustainability
 - Agriculture to be put as priority on development agenda
 - Discourage food-bio-fuel trade-off
 - Ensure that bio-fuels contribute to broad-based rural and agricultural development
 - Disentangling threatening bio-fuel
 - not all bio-fuel food-reducing
 - encourage bio-fuel from human-livestock/hh waste
 - Assess efficiency and societal value vis-à-vis other current and future energy options in the context of comprehensive national, SA and global energy strategies
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Thank You
