

The resource outlook to 2050

By how much do land, water use and crop yields need to increase by 2050?

by

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What this presentation does....

- present the resource use implications to 2030 and 2050 of FAO's latest (2006) long-term base line outlook
- evaluate the expected increases in land / water use and crop yields against potential increases

... and what it does **not** do

- take into account additional production needed for eliminating under-nourishment or for bio-fuel production
- nor does it explicitly account for impacts of climate change

Outline presentation

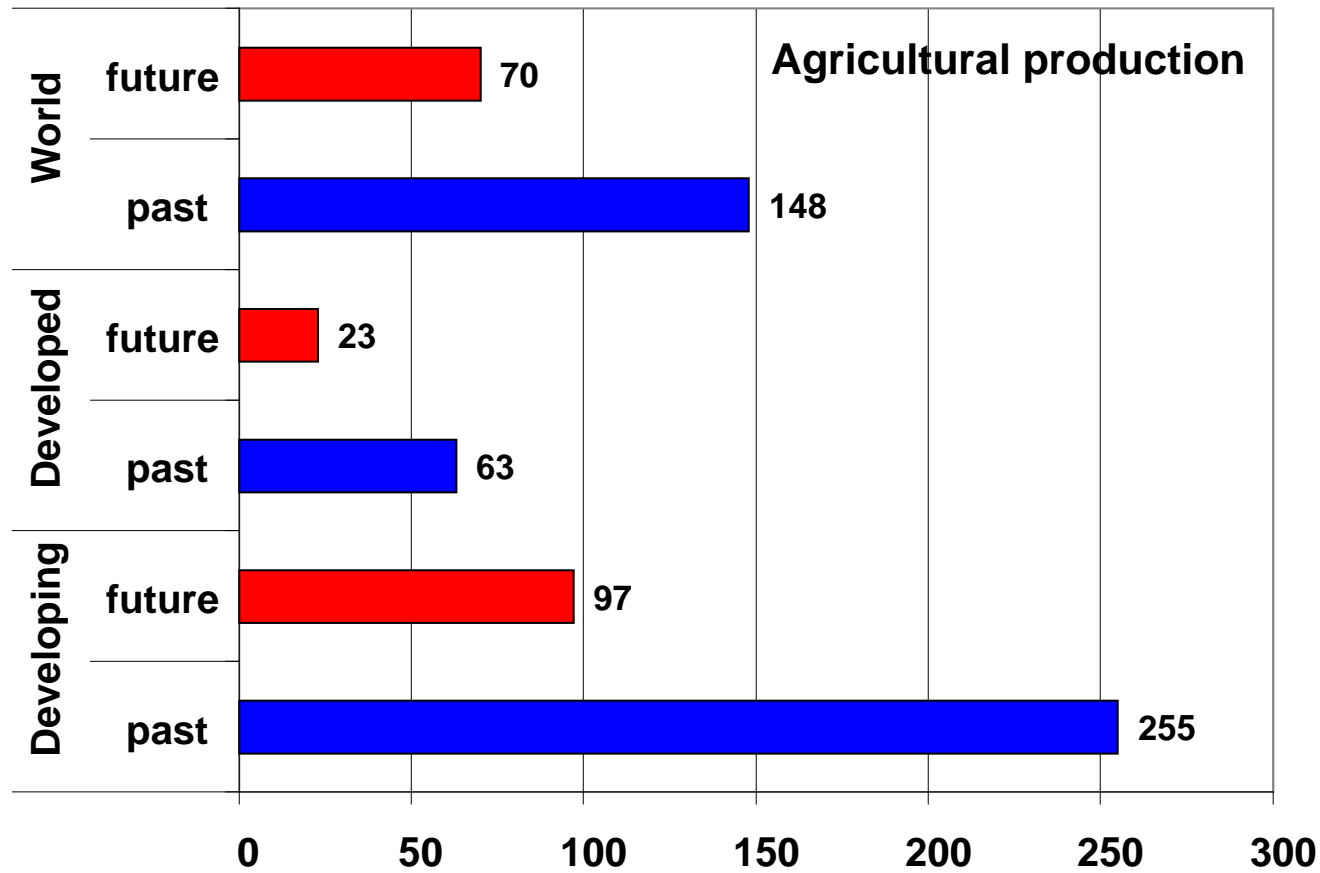
- How much more needs to be produced?
- Sources of growth
- Land potential and land expansion
- Irrigated land expansion and water use
- Yield increases and yield gaps
- Summary and conclusions

Approach followed

- starting point: 2006 crop production projections
- base year 2005/07 (latest FAOSTAT data)
- fair amount of detail:
 - 108 countries / country groups (93 developing and 53 developed = industrial and transition)
 - 34 crops and 1 “other harvested land”
 - rain-fed and irrigated (data problems)
- no formal model
 - initial projection inspected and adjusted
 - taking in all info available (e.g. AEZ)
 - and relying on expert-judgement

How much more needs to be produced by 2050?

Absolute increments in percent



past = 1961/63 to 2005/07; **future** = 2005/07 to 2050

How much more needs to be produced by 2050?

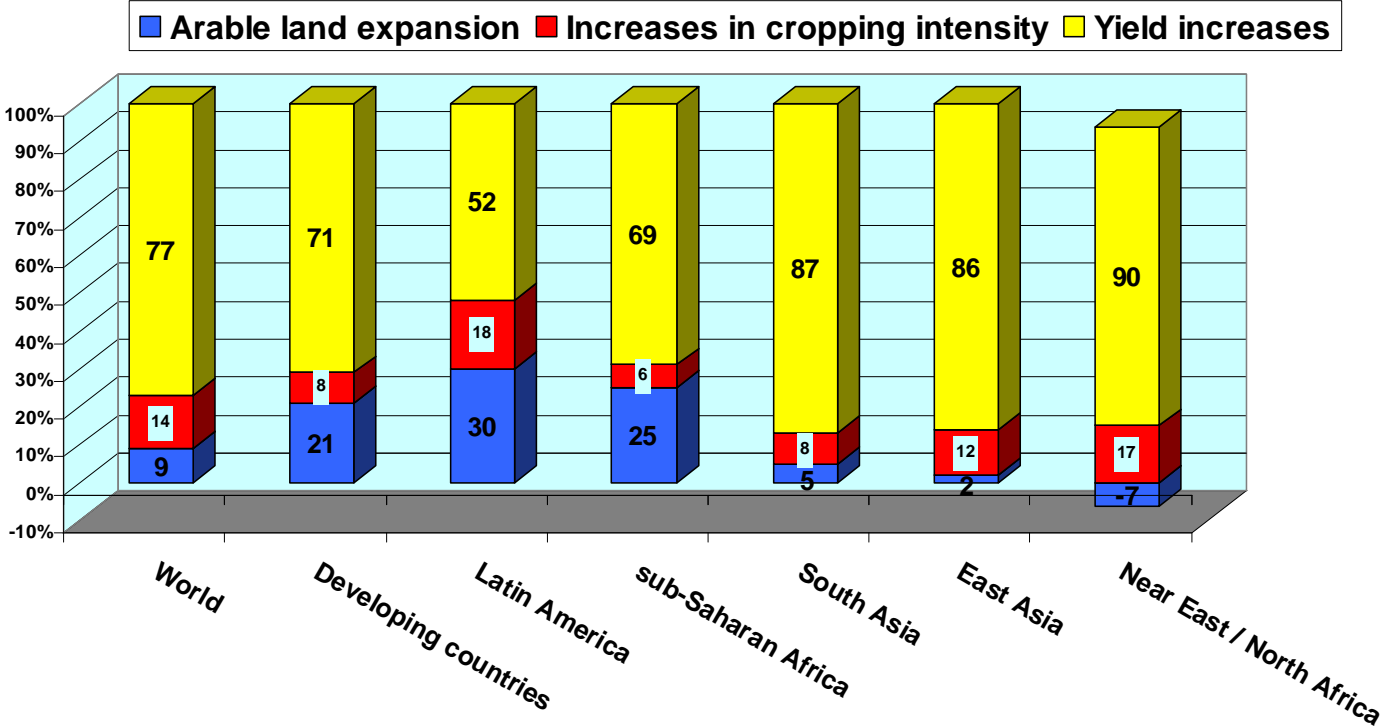
- crop production growth from 2.2% to 1.1% p.a.

This still means that:

- an additional billion tonnes of cereals needs to be produced annually by 2050
- and 210 million tonnes of meat
- soybean production to increase by 140% to 515 million tonnes

Sources of growth in crop production (2005/07 to 2050)

The resource outlook to 2050



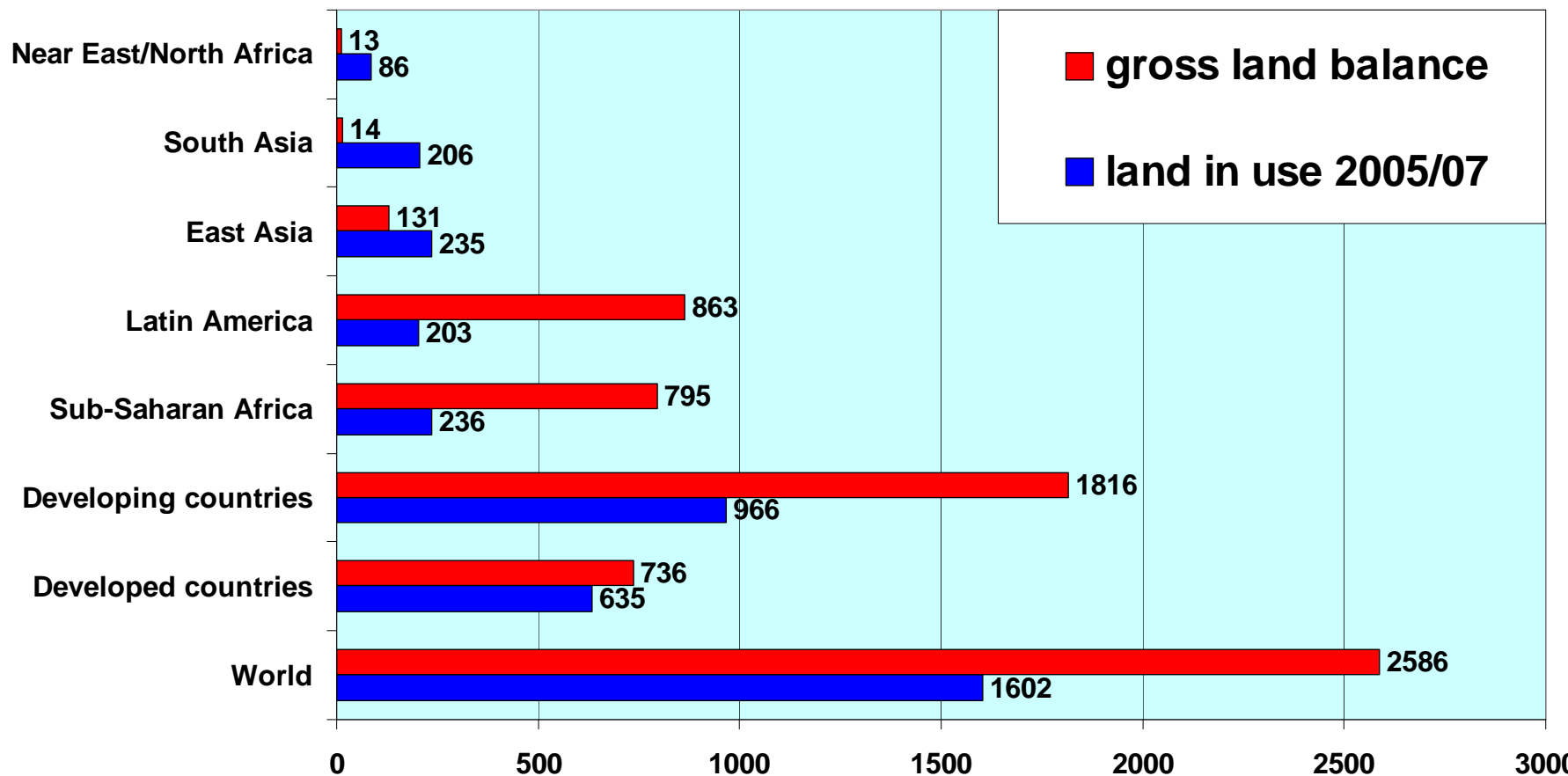
Arable land expansion

Land with (rainfed) crop production potential (million ha)
Source: AEZ 2002

	Total land suitable	Very suitable	Suitable	Moderately suitable	Land in use in 2005/07	Gross land balance
attainable yield as % of MCFY		80-100	60-80	40-60		
World	4188	1348	1509	794	1602	2586
Developing countries	2782	1109	1001	400	966	1816
Sub-Saharan Africa	1031	421	352	156	236	795
Latin America	1066	421	431	133	203	863
East Asia	366	146	119	53	235	131
Near East/North Africa	99	4	22	41	86	13
South Asia	220	116	77	17	206	14
Developed countries	1371	222	495	391	635	736

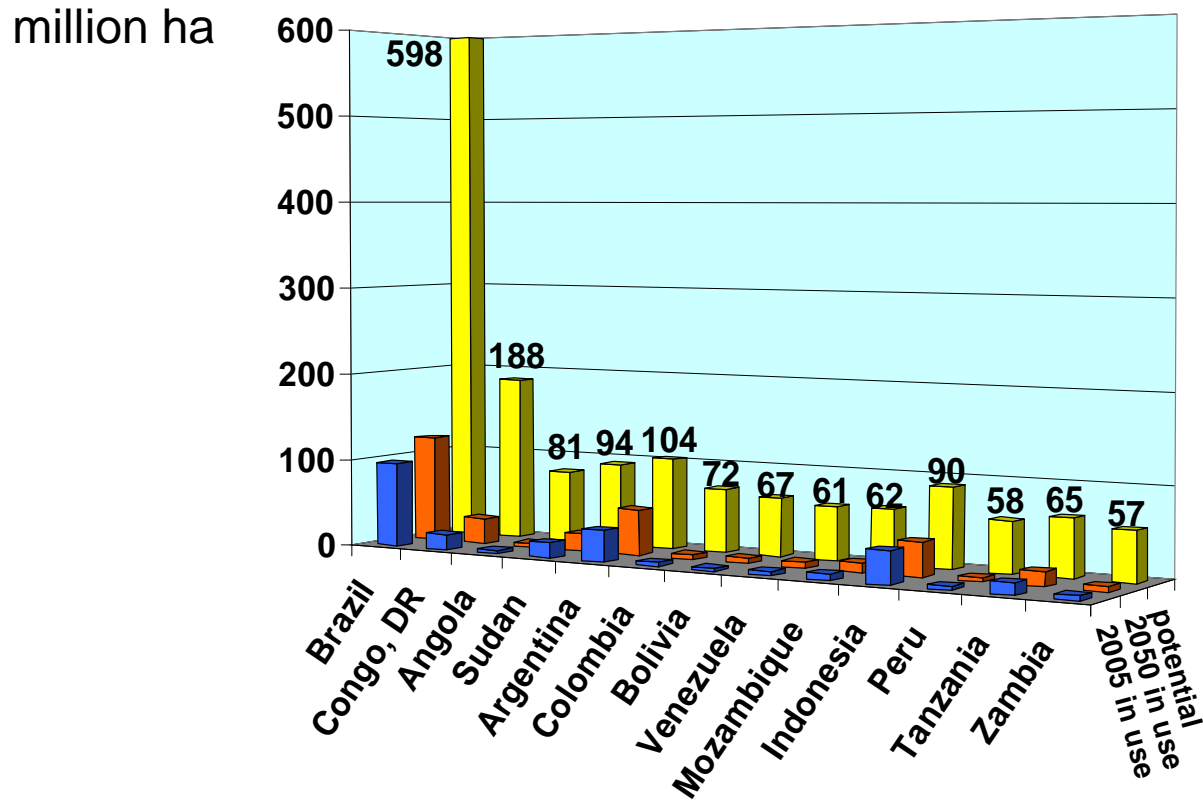
Arable land expansion

Land with (rainfed) crop production potential (million ha)
Source: AEZ 2002



Arable land expansion

Thirteen developing countries accounting for two-thirds of the (gross) land balance



Arable land expansion

Suitable land left, but.....qualifications:

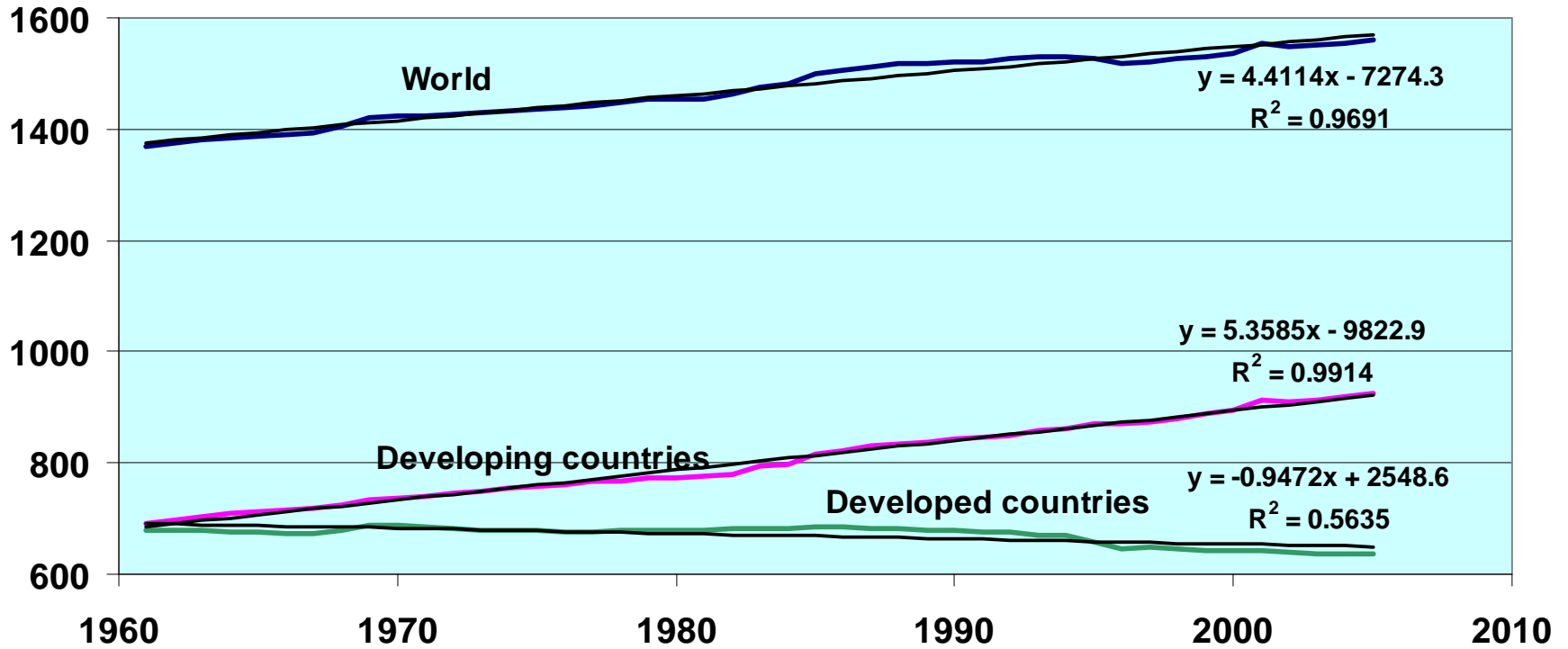
Much of the gross land balance (2.6 bln ha) is

- very unevenly distributed
- under forests (800 mln ha), protected (200 mln ha), under settlements (60 mln ha)
- suitable for only a few crops
- suffering from one or more constraints

Arable land expansion

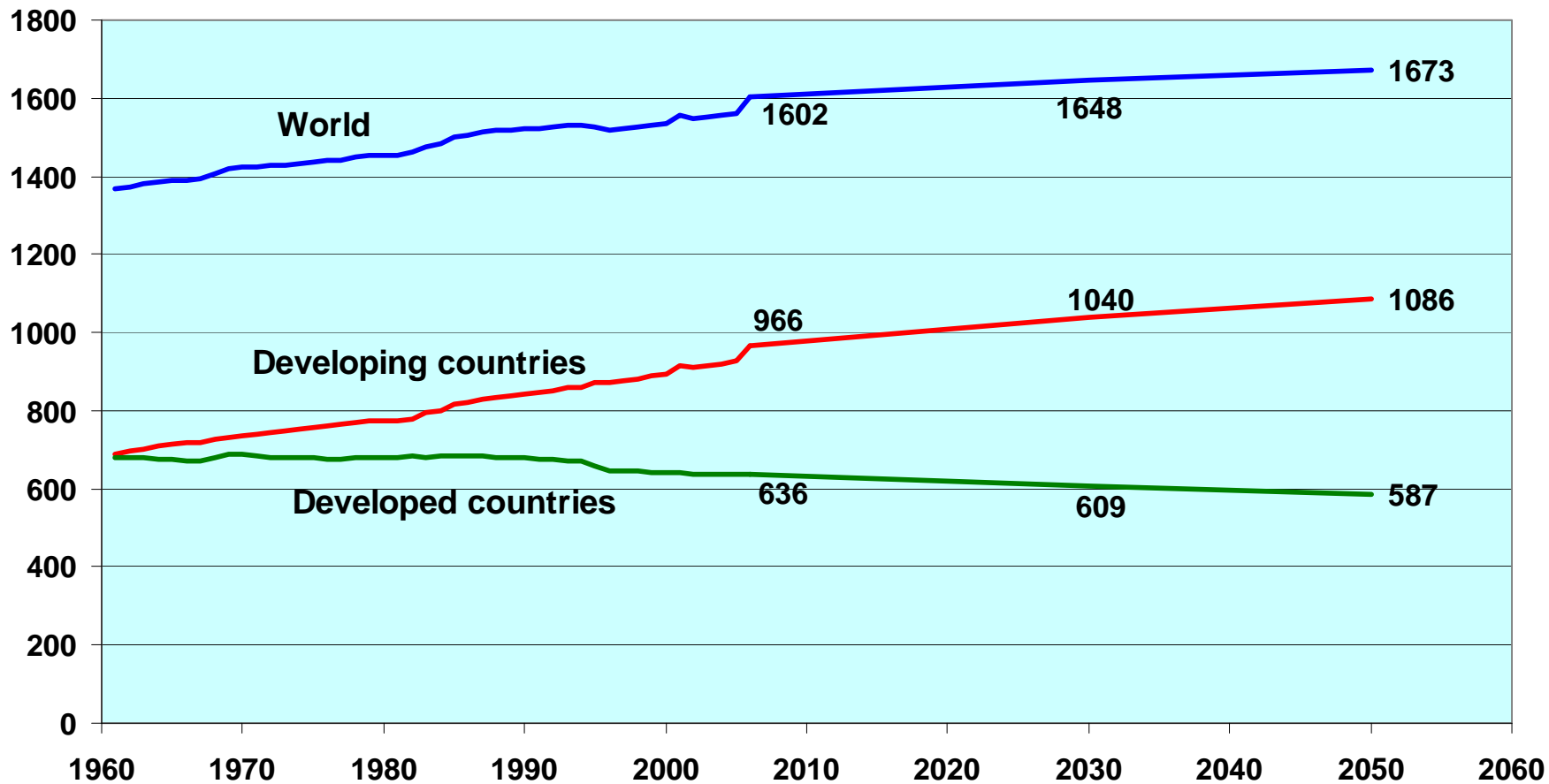
The resource outlook to 2050

Arable land and land under permanent crops (million ha)



Arable land expansion

Arable land and land under permanent crops (million ha)



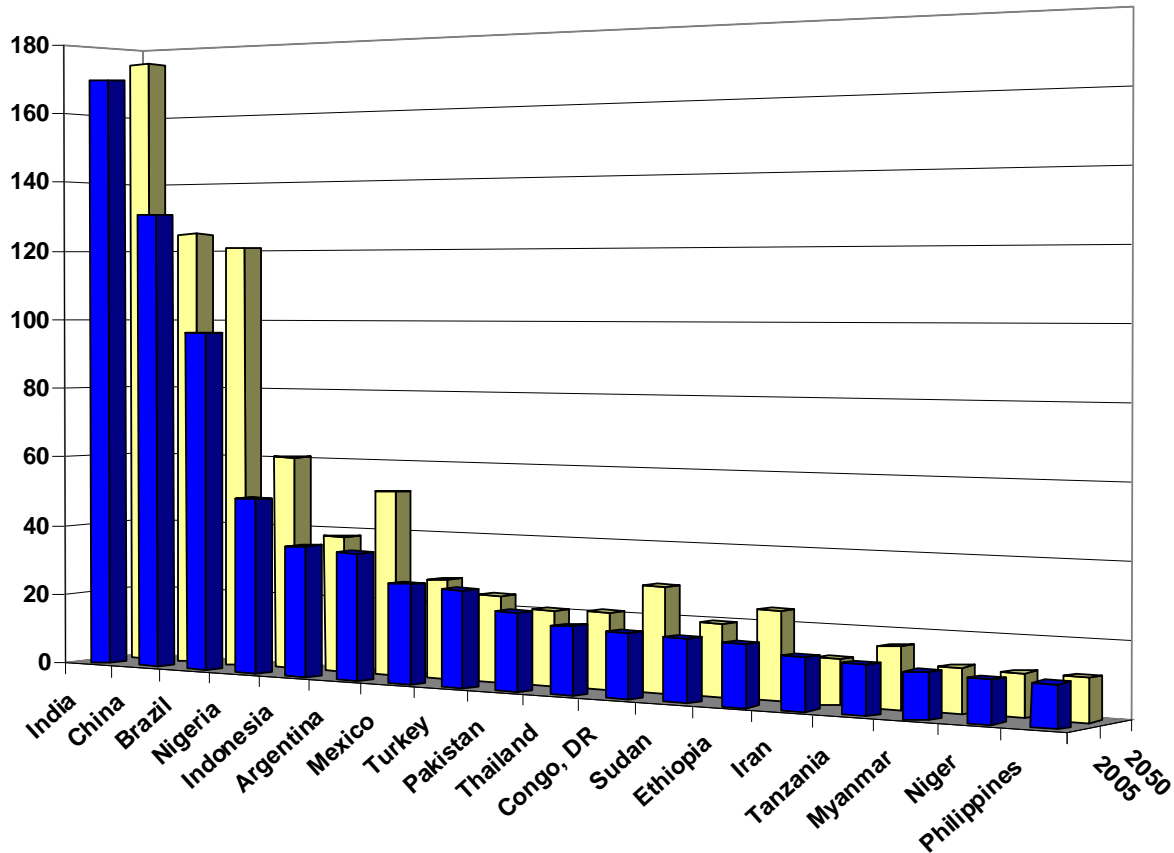
Arable land expansion

Total arable land: data and projections

	arable land in use (mln. ha)			annual growth (% p.a.)	
	1961/63	2005 adj.	2050	1961-2005	2005-2050
World	1375	1602	1673	0.30	0.10
Developing countries	693	966	1086	0.67	0.27
Developed countries	679	635	587	-0.14	-0.18
sub-Saharan Africa	133	236	300	0.80	0.55
Latin America	105	203	255	1.01	0.52
Near East/ North Africa	86	86	82	0.34	-0.11
South Asia	191	206	212	0.15	0.07
East Asia	178	235	237	0.99	0.02

Arable land expansion

18 developing countries with over 10 mln. ha of arable land in use
(accounting for 75% of total)



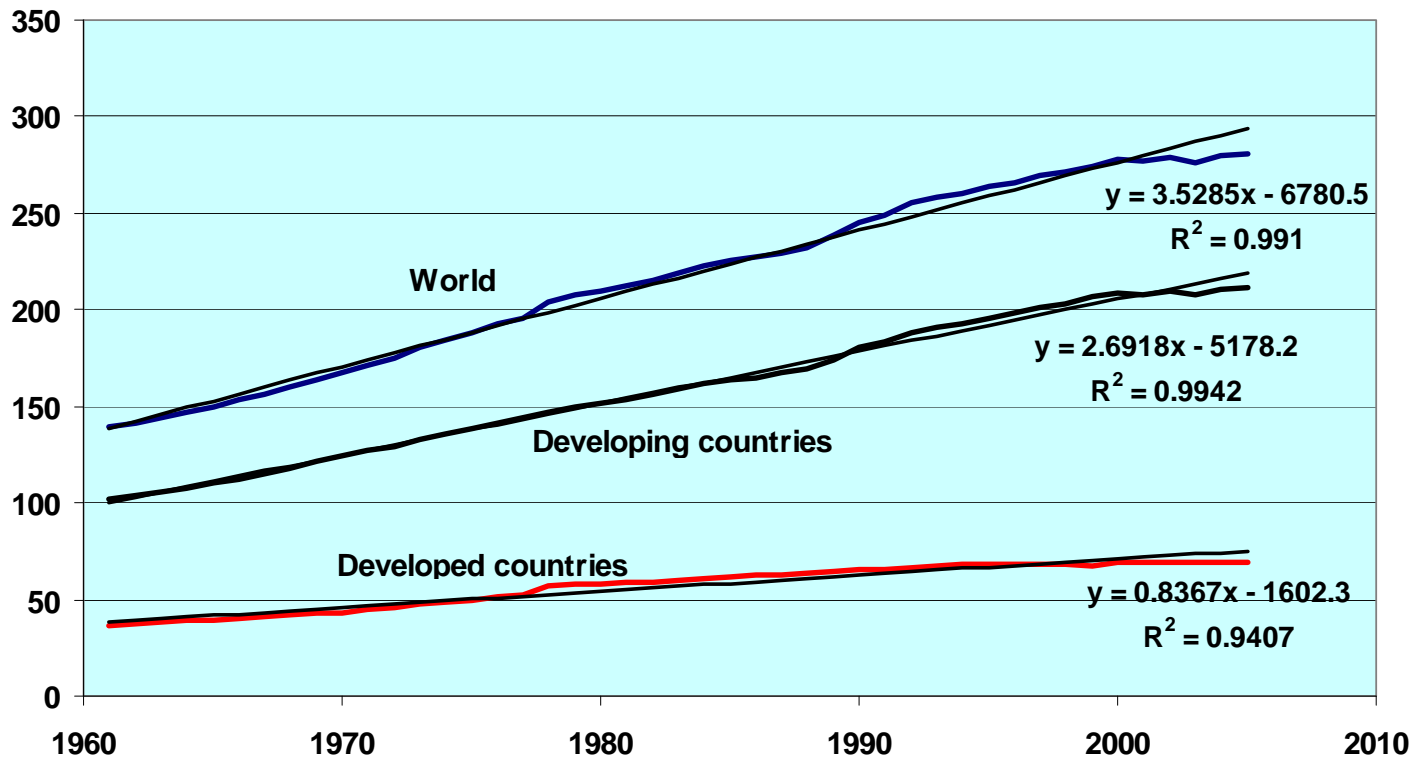
Arable land expansion

Harvested land

		arable land	cropping intensity	harvested land
		mln. ha	percent	mln. ha
World	2005/07	1602	87	1392
	2050	1673	93	1556
Developing countries	2005/07	966	95	919
	2050	1086	99	1078
excl. China and India	2005/07	666	82	547
	2050	785	89	697
Developed countries	2005/07	635	74	473
	2050	587	81	478

Irrigated land expansion and water use

Area equipped for irrigation (million ha)



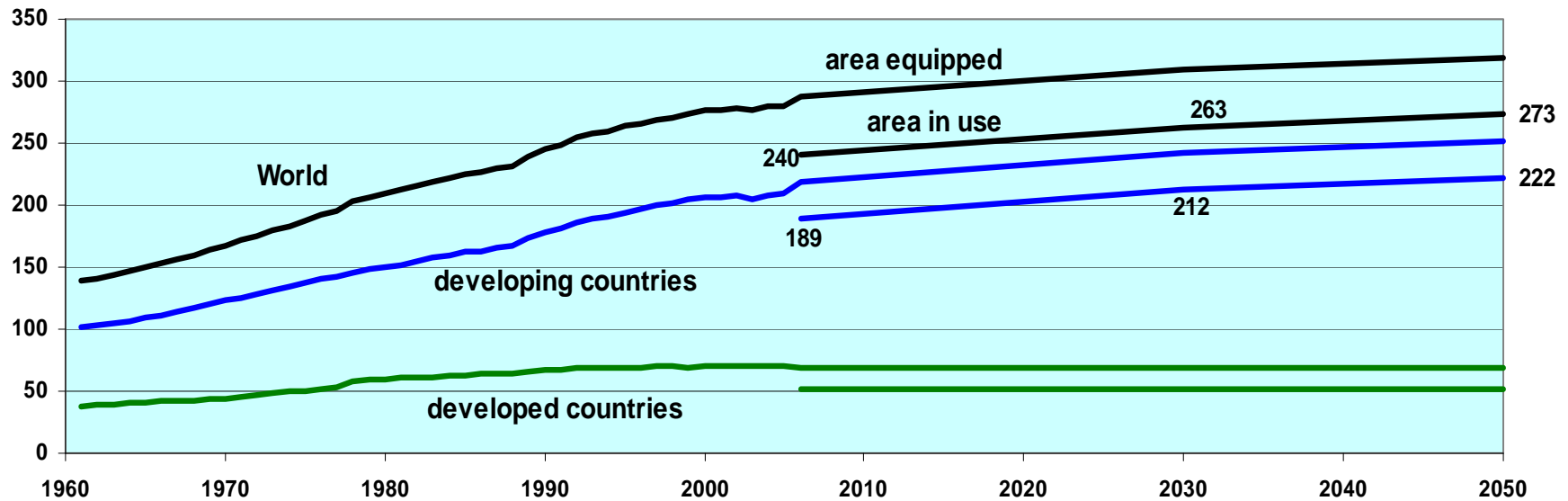
Irrigated land expansion and water use

Area equipped for irrigation

	1961/63	2005/07	2050	1961-05	2005-50
	million ha			% p.a.	
World	141	287	318	1.71	0.24
Developed countries	38	68	68	1.57	0.00
Developing countries	103	219	251	1.76	0.31
excl. China and India	47	97	117	1.91	0.42
sub-Saharan Africa	3	6	8	2.07	0.67
Latin America	8	18	24	2.05	0.72
Near East/North Africa	15	29	36	1.86	0.47
South Asia	37	81	86	1.98	0.14
East Asia	40	85	97	1.42	0.30

Irrigated land expansion and water use

Area equipped for irrigation and area in use (million ha)



Irrigated land expansion and water use

Water withdrawal for irrigation (cubic km)

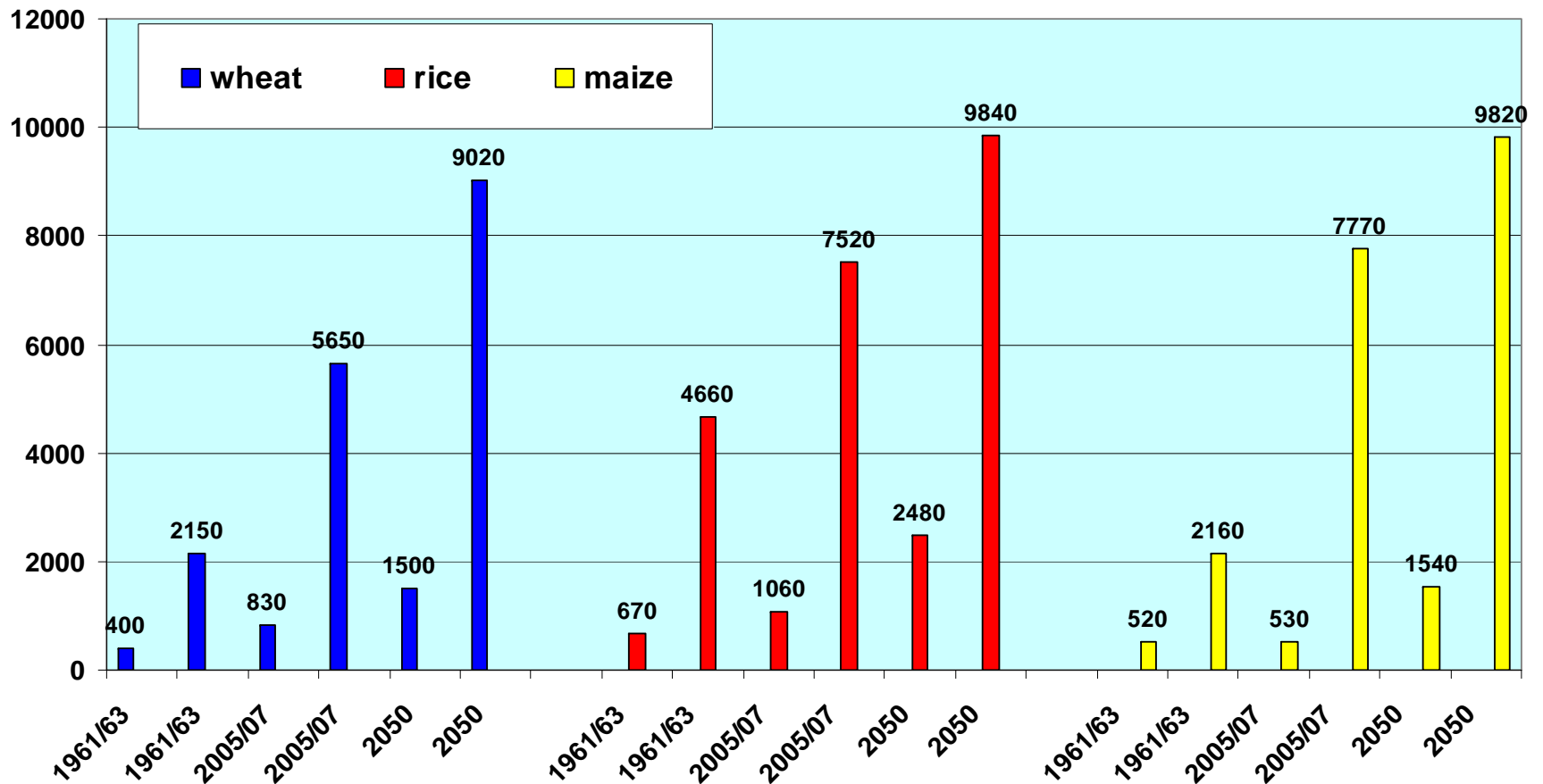
	Water use efficiency ratio (%)		Irrigation water withdrawal (km ³)		Pressure on water resources (%)	
	2005/07	2050	2005/07	2050	2005/07	2050
World	44	46	2620	2906	6	7
Developed countries	42	43	505	493	4	4
Developing countries	44	47	2115	2413	8	9
sub-Saharan Africa	22	25	55	87	2	2
Latin America	35	35	181	253	1	2
Near East/North Africa	51	61	347	374	58	62
South Asia	54	57	819	906	36	39
East Asia	33	35	714	793	8	9

Yield increases and yield gaps

world	2005/07	2050	1961/63	2005/07	2050	1961-2007	2005/07 - 2050
	land (mln. ha)		yield (t/ha)			yield (% p.a.)	
All crops (\$/ha)	1392	1556				1.7	0.8
All cereals	705	753	1.40	3.22	4.34	1.9	0.7
Wheat	224	242	1.14	2.72	3.75	2.1	0.7
Rice (paddy)	158	150	1.93	4.05	5.23	1.8	0.6
Maize	155	190	1.99	4.73	6.06	2.0	0.6
Soybeans	95	141	1.14	2.29	3.66	1.5	1.1
Groundnuts	24	39	0.86	1.49	1.91	1.6	0.6

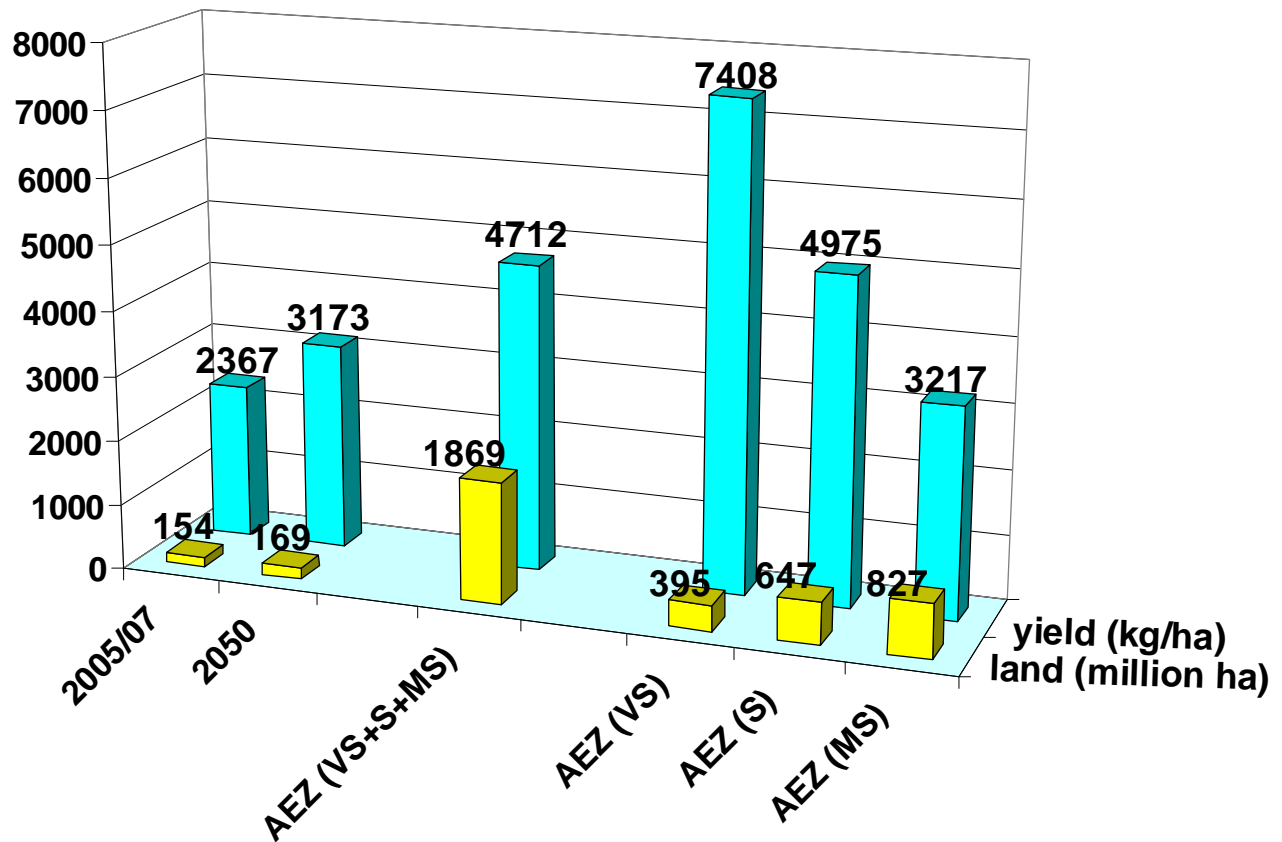
Yield increases and yield gaps

Cereal yields: bottom and top 10% of developing countries with over 50 thousand ha under crop



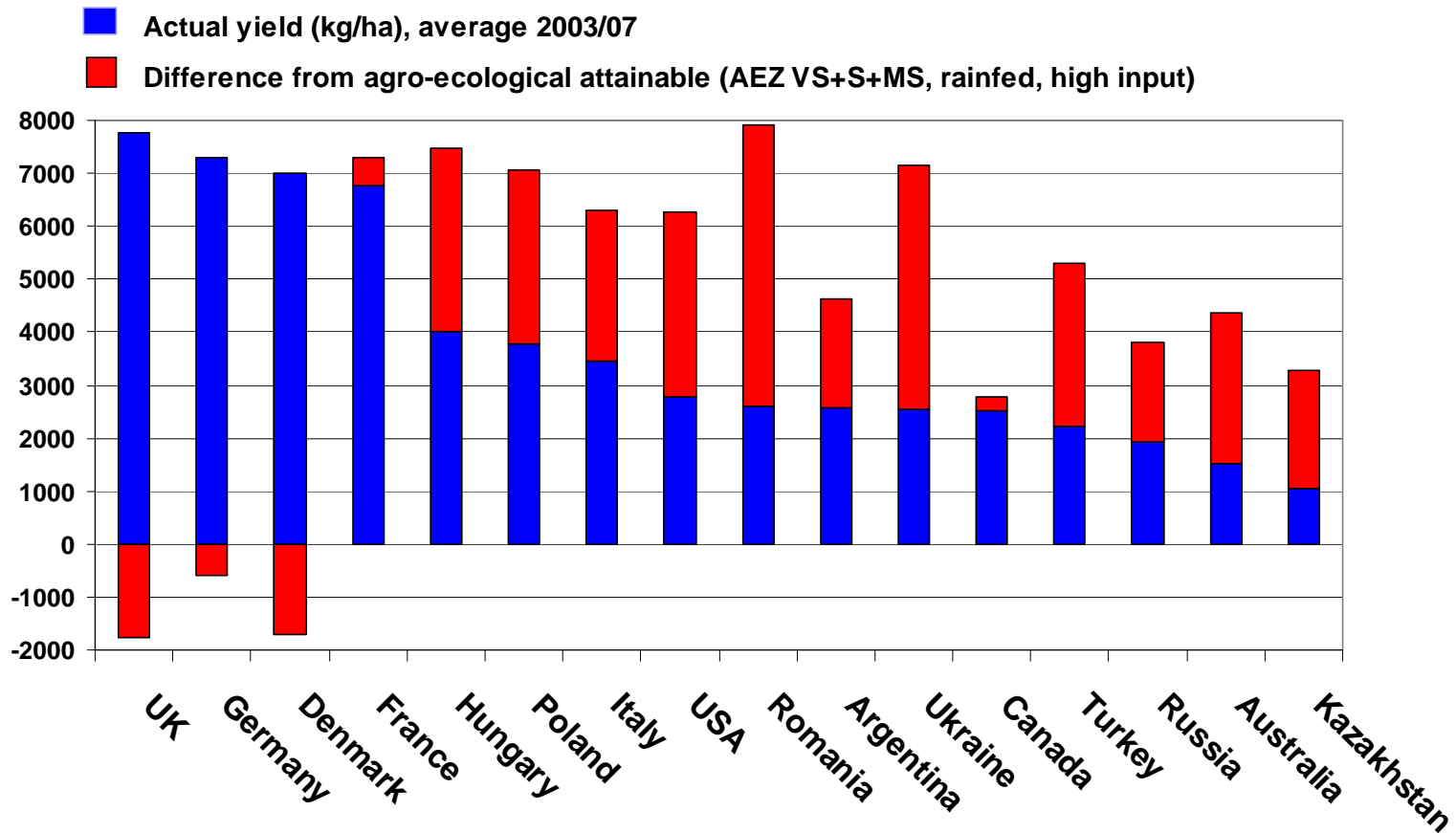
Yield increases and yield gaps

Rainfed wheat in the world



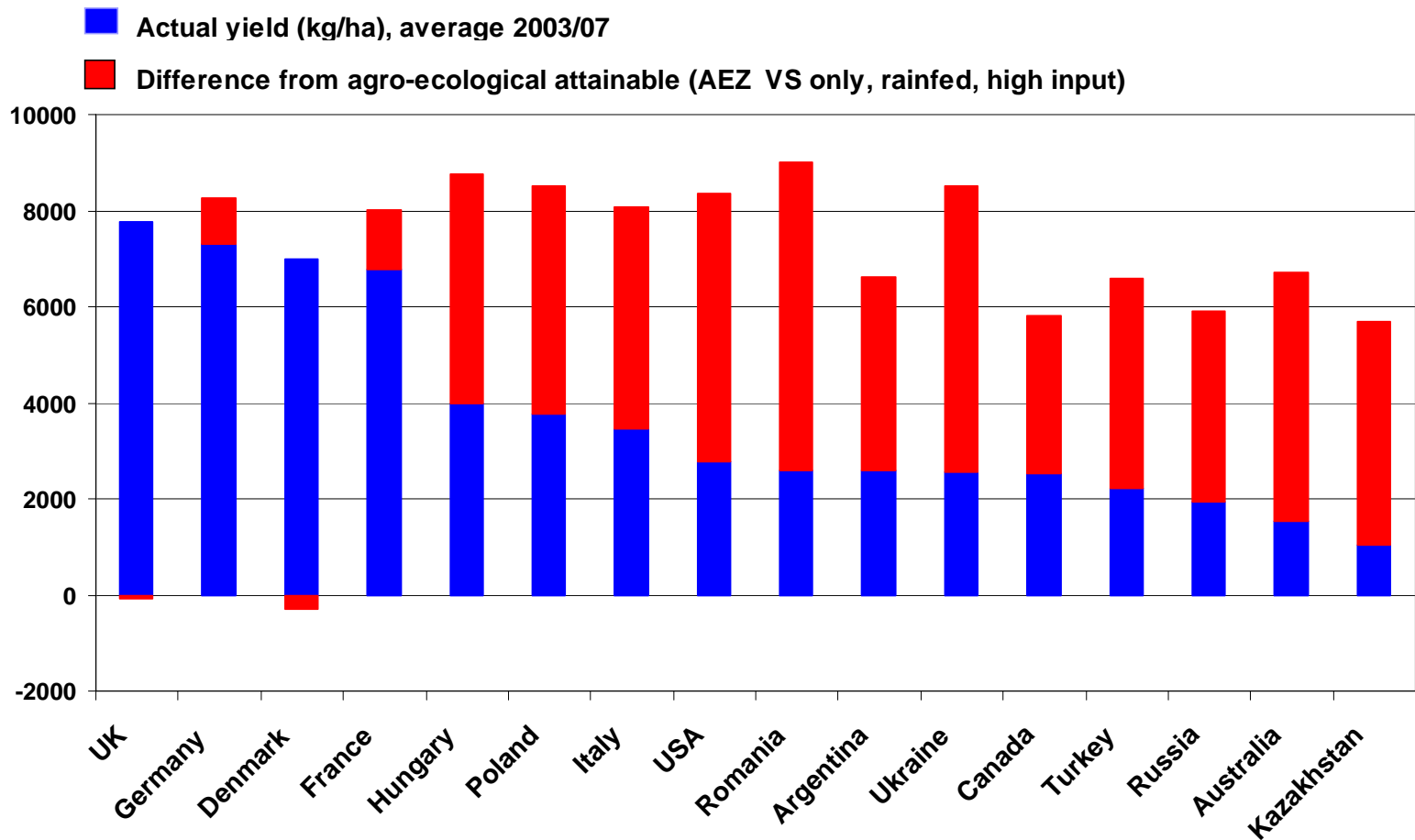
Yield increases and yield gaps

Wheat yields: 16 countries with over 4 million tonnes of mainly rainfed wheat production



Yield increases and yield gaps

Wheat yields: 16 countries with over 4 million tonnes of mainly rainfed wheat production



Summary and conclusions -1

- **Increment agr. production 2006 to 2050: World +70%; Developing + 97%; Developed +23%.**
- **Continuing slowdown growth crop production (World 2.2 to 1.1%; Developing 3.0 to 1.2%)**
- **Most to come from more intensive agr.: World 90%; Developing 80%; Developed > 100%.**
- **Arable land to expand by 70 mln. ha (<5%).
Developing + 120 mln. (12%), Developed – 50 mln. (- 8%).**
- **Harvested land + 160 mln. (17%)**

Summary and conclusions - 2

- Land equipped for irrigation + 32 mln. ha (11%) all of it in Developing.
- Irrigated harvested land + 17%.
- Water withdrawal for irrigation + 11%.
- Crop yield growth on average to halve (World 1.7 to 0.8%; Developing 2.1 to 0.9%)
- GAEZ: suitable land left, butqualifications
- Water: fairly similar as for land
- Bridgeable yield gaps

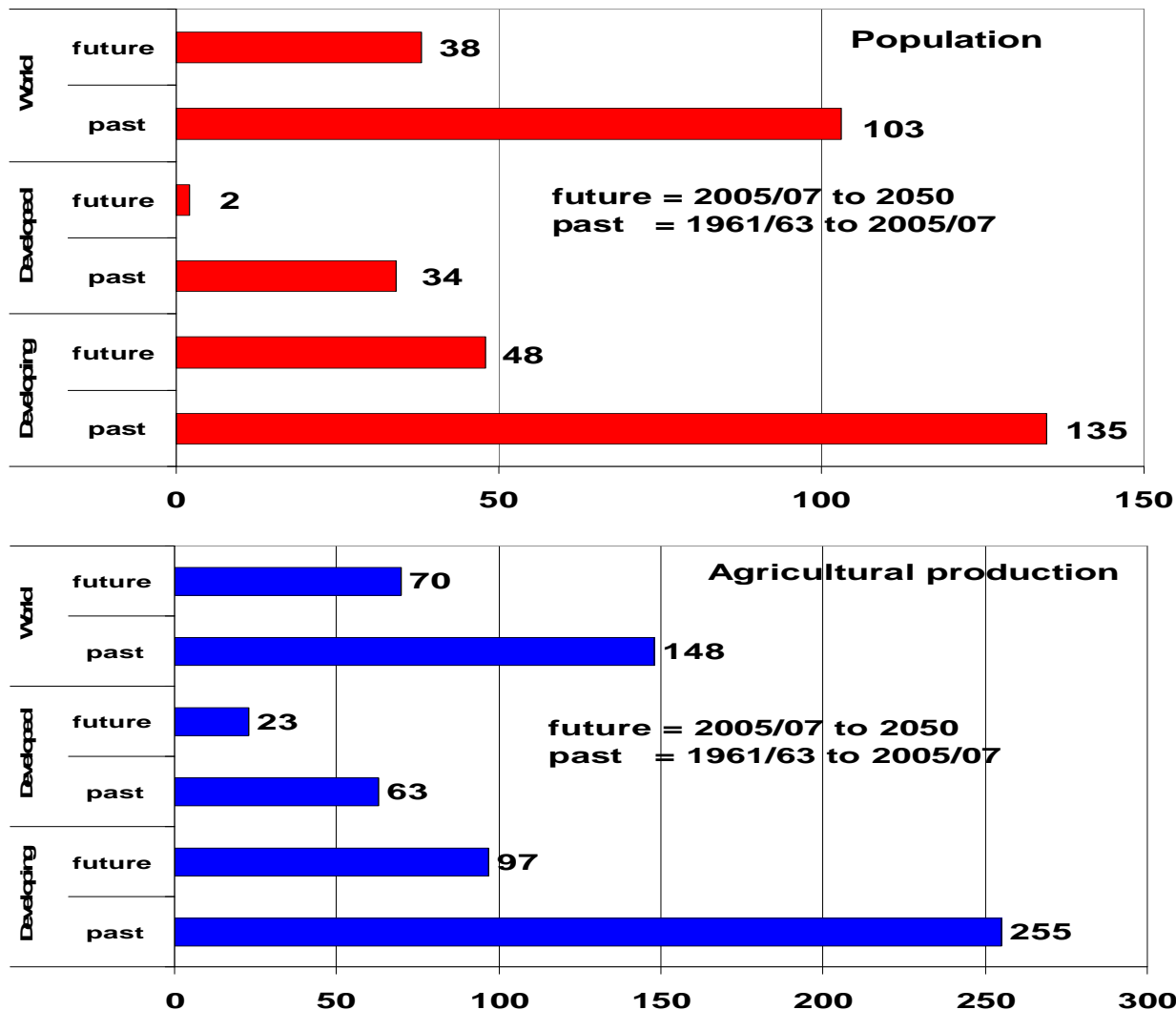
Summary and conclusions - 3

- **Presented only highly aggregated picture...of course enormous variation among countries and commodities**
- **On the one hand, some developing countries set on path similar as for developed countries**
- **On the other hand, some developing countries facing severe land / water constraints**
- **Public intervention needed...e.g. in investment in agr. research**
- **All this for food and feed. Bio-fuels and Climate Change might change this.**

Thank you !

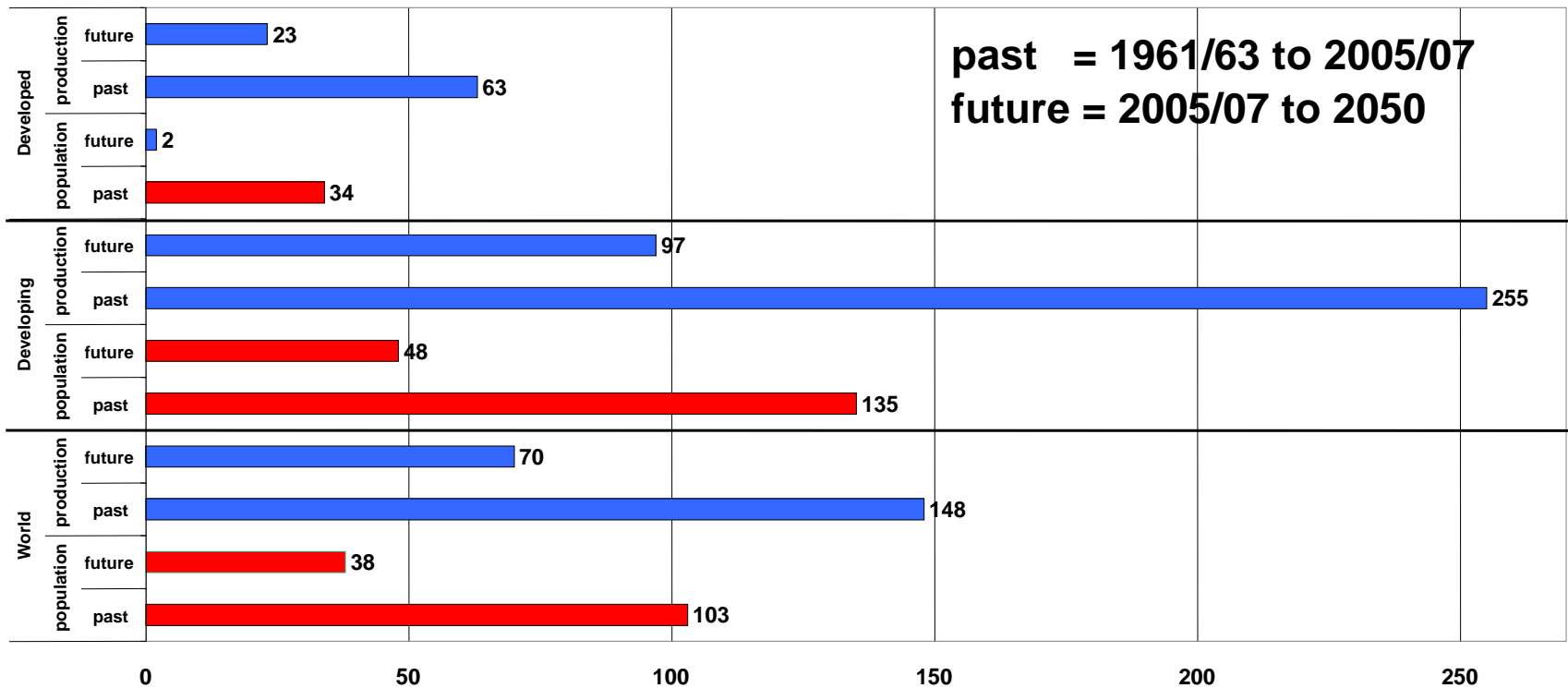
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Absolute increments in percent



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Absolute increments in percent

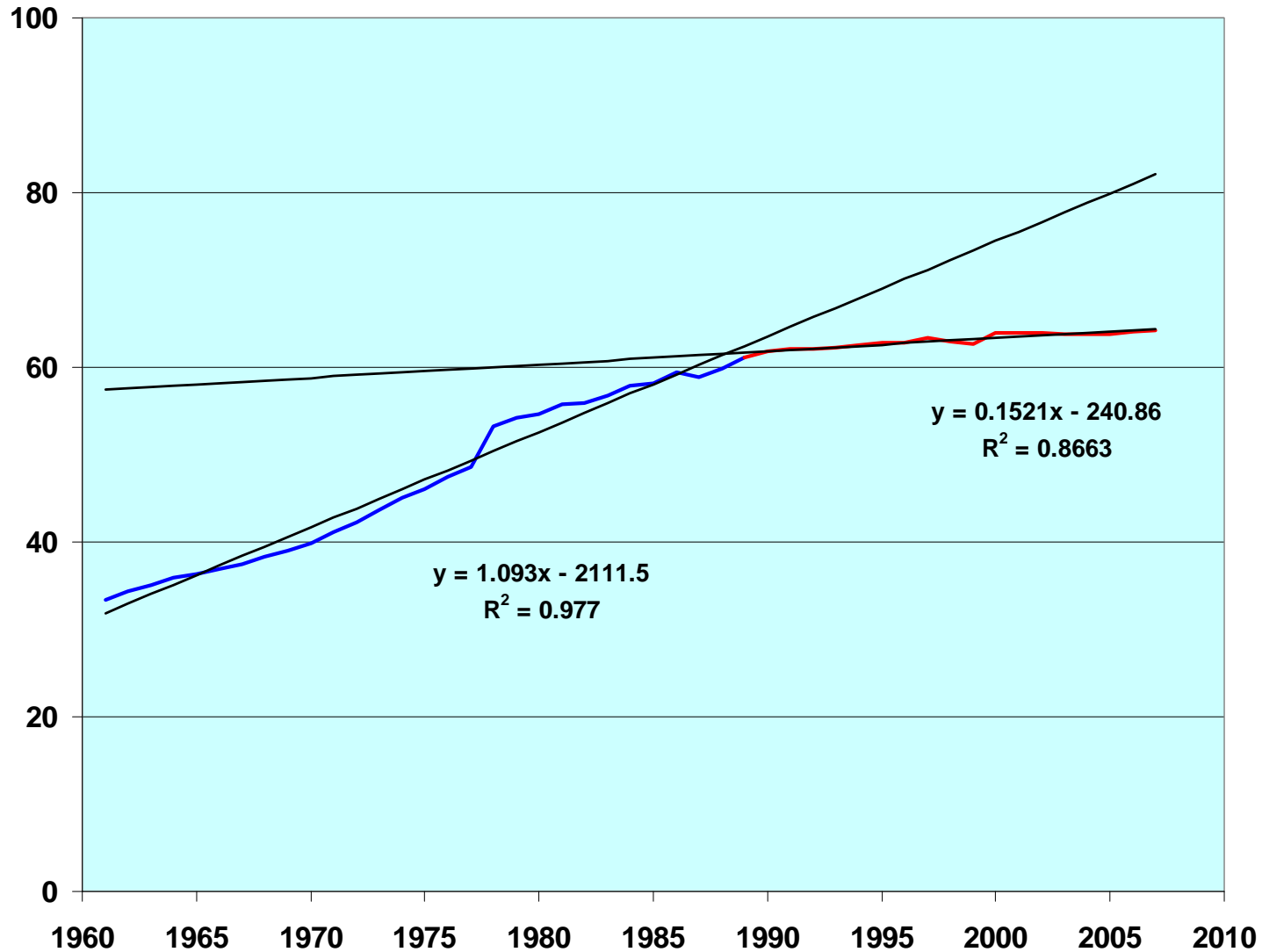


How much more needs to be produced by 2050?

Annual crop production growth (percent p.a.)

	1961-07	2005/07-30	2030-50
World	2.2	1.3	0.8
Developing countries	3.0	1.5	0.9
Developed countries	0.9	0.9	0.4
sub-Saharan Africa	2.5	2.5	1.7
Near East / North Africa	2.6	1.7	1.0
Latin America and Caribbean	2.6	2.1	1.3
South Asia	2.6	1.6	0.9
East Asia	3.5	1.0	0.5

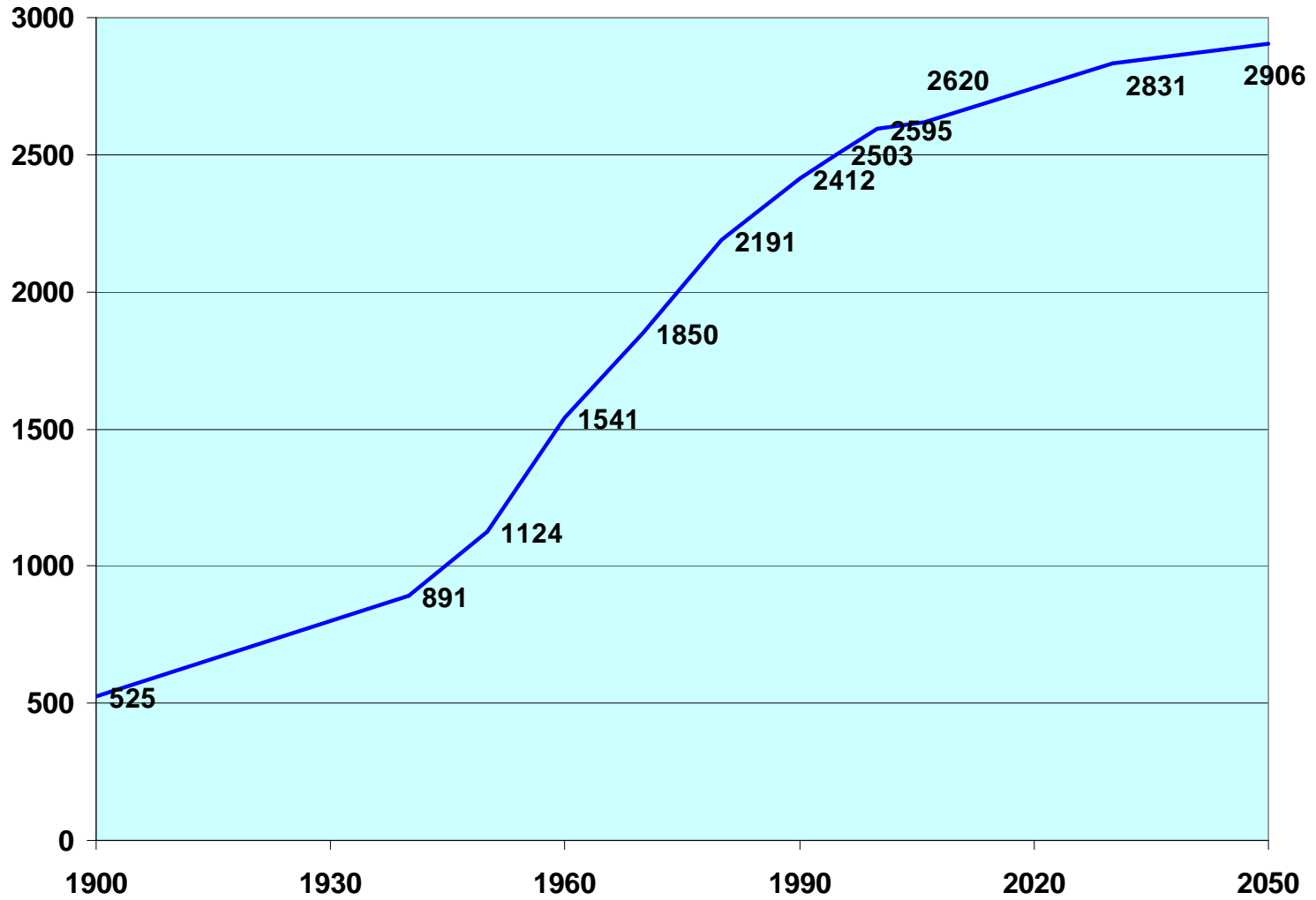
Area equipped for irrigation in North America, Europe and Australia (million ha)



Irrigated land expansion and water use

The resource outlook to 2050

Water withdrawal for irrigation (world; cubic km)



Yield increases and yield gaps

Cereal yields, rainfed and irrigated

		t/ha			% p.a.	
		1961/63	2005/07	2050	1961 -07	2005/07 -2050
Wheat	total	1.14	2.72	3.75	2.1	0.7
	rainfed		2.37	3.17		0.7
	irrigated		3.50	5.08		0.8
Rice (paddy)	total	1.93	4.05	5.23	1.8	0.6
	rainfed		2.54	3.26		0.6
	irrigated		5.10	6.40		0.5
Maize	total	1.99	4.72	6.06	2.0	0.6
	rainfed		4.26	5.58		0.6
	irrigated		6.74	7.43		0.2
All cereals	total	1.40	3.23	4.34	1.9	0.7
	rainfed		2.64	3.58		0.7
	irrigated		4.67	6.10		0.6