



**International
Fertilizer Industry
Association**

Challenges for Plant Nutrition Management: Fertilizer Industry's Viewpoint

Luc.M. Maene and Angela B. Olegario



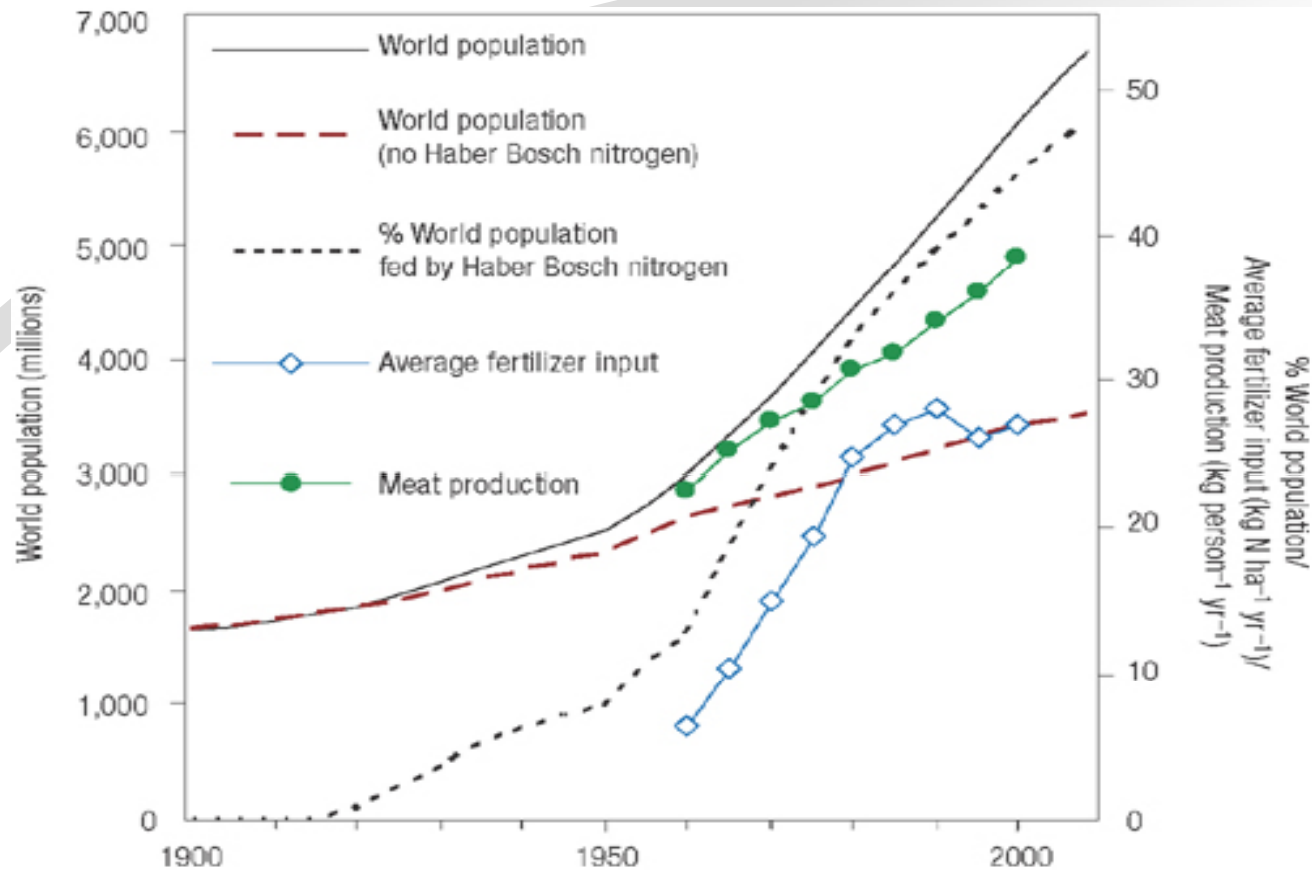
XVI – IPNC 2009 Sacramento, California

Contents

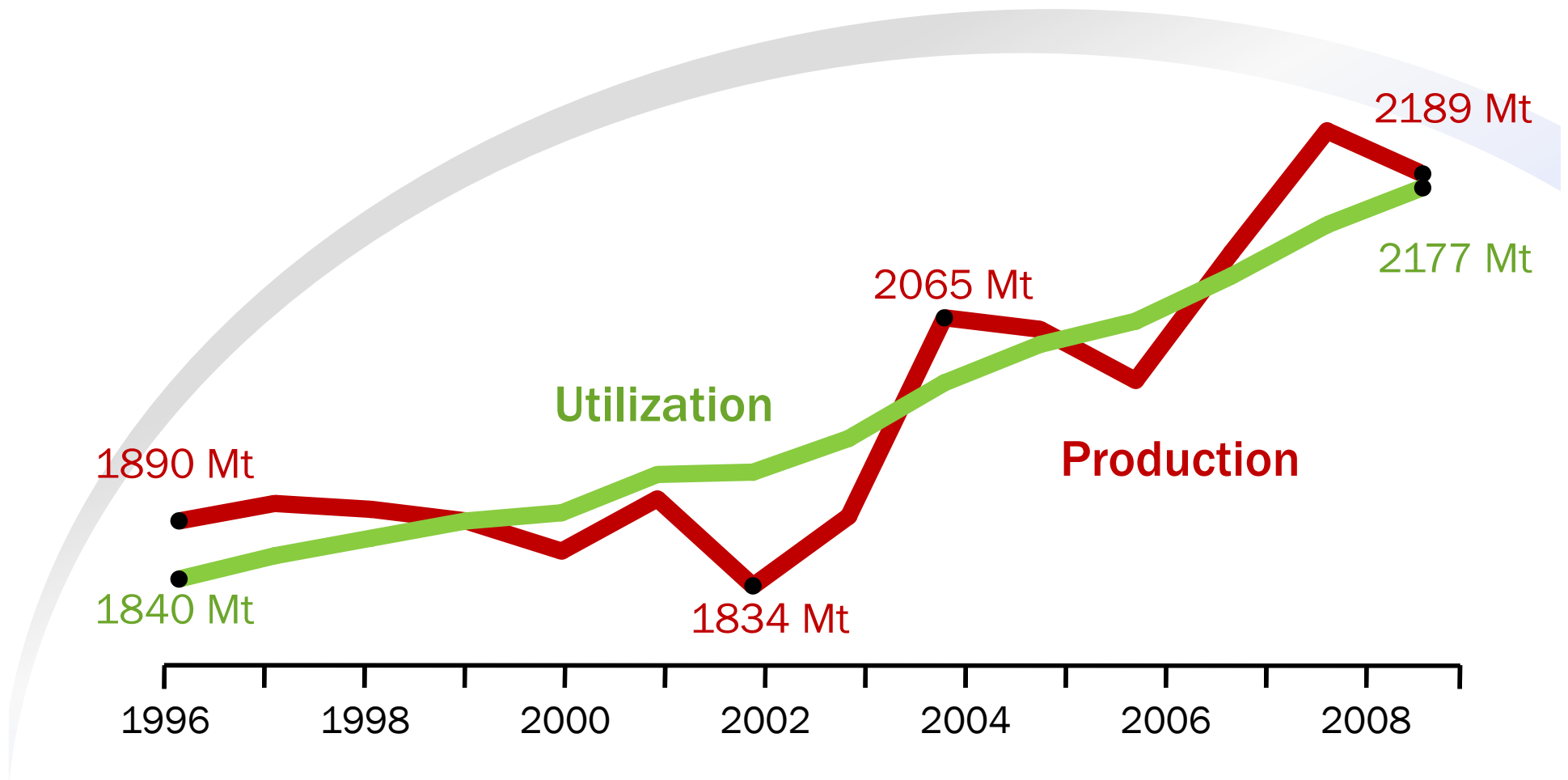
- World cereal situation
- World fertilizer situation
- Driving forces in agriculture and impact on fertilizer demand
- Industry's capacity to meet demand
- Challenges and strategies ahead



Population trends and nitrogen use during the 20th century



World cereal production and utilization



World cereal forecast

Million tonnes	2008/09 (e)				2013/14 (f)			
	Production	Utilization	Stocks	Stocks to use	Production	Utilization	Stocks	Stocks to use
WHEAT	683	654	148	23%	687	687	165	24%
MAIZE	791	784	136	17%	851	852	133	16%
RICE	439	432	85	19%	452	456	91	20%



Key drivers in world agriculture and fertilizer demand



Challenges for Plant Nutrition Management:
Fertilizer Industry's Viewpoint

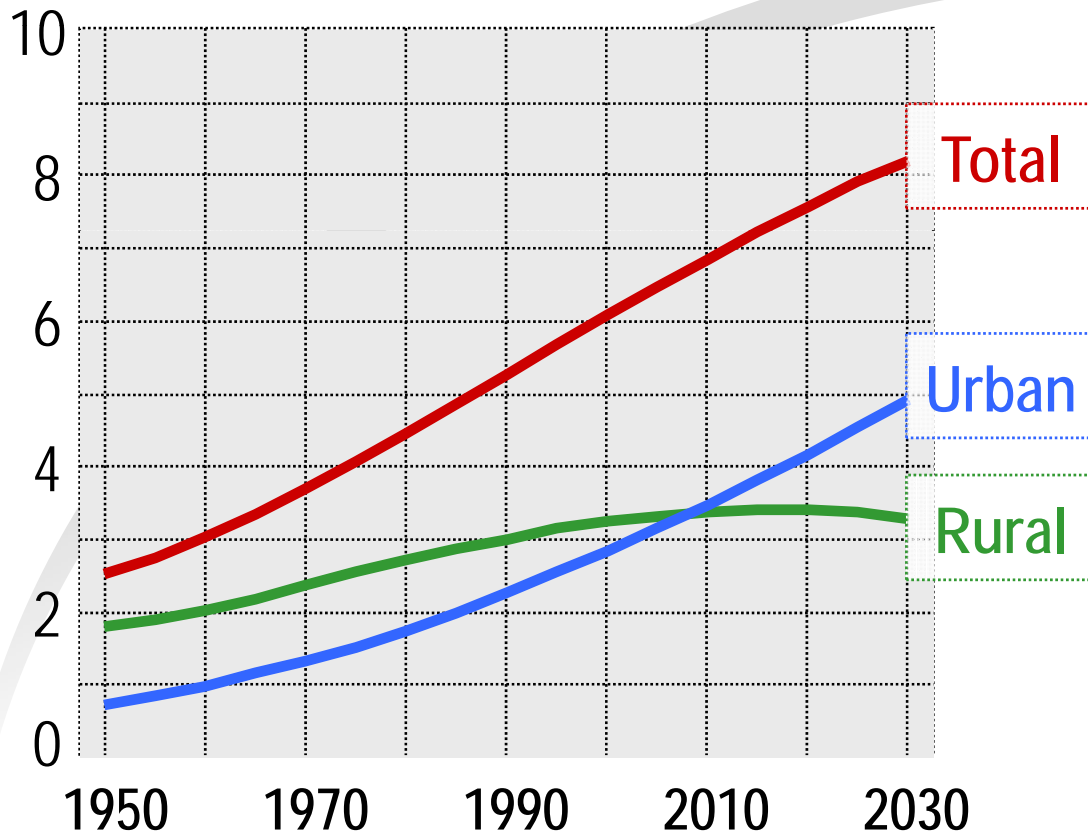
Key drivers in world agriculture and fertilizer demand

- **Continued world population growth:** more food and fiber
- **Income growth:** more meat, fish, fruits, vegetables, sugar and vegetable oils; less cereals and pulses per capita
- **High oil prices:** strong incentives for bioenergy production; ag commodity prices higher and more volatile
- **Limited immediately available additional arable land:** no alternative to increasing yields; increased cultivated area in Latin America and SE Asia
- **Growing environmental concerns:** increased recycling of organic nutrient sources; optimization of nutrient use efficiency
- **Improved technologies:** higher resource use efficiency



Divergent expectations of farming and urban populations

Population in billion people



→ Sufficient, affordable, safe, nutritious food

→ Clean water and air

→ Conservation of wildlife and biodiversity

→ Affordable and reliable energy supplies

→ Higher and more stable produce prices

→ Greater yields with lower input costs

→ Greater respect for the farming profession



Challenges for Plant Nutrition Management:
Fertilizer Industry's Viewpoint

World fertilizer situation



Challenges for Plant Nutrition Management:
Fertilizer Industry's Viewpoint

Global fertilizer consumption

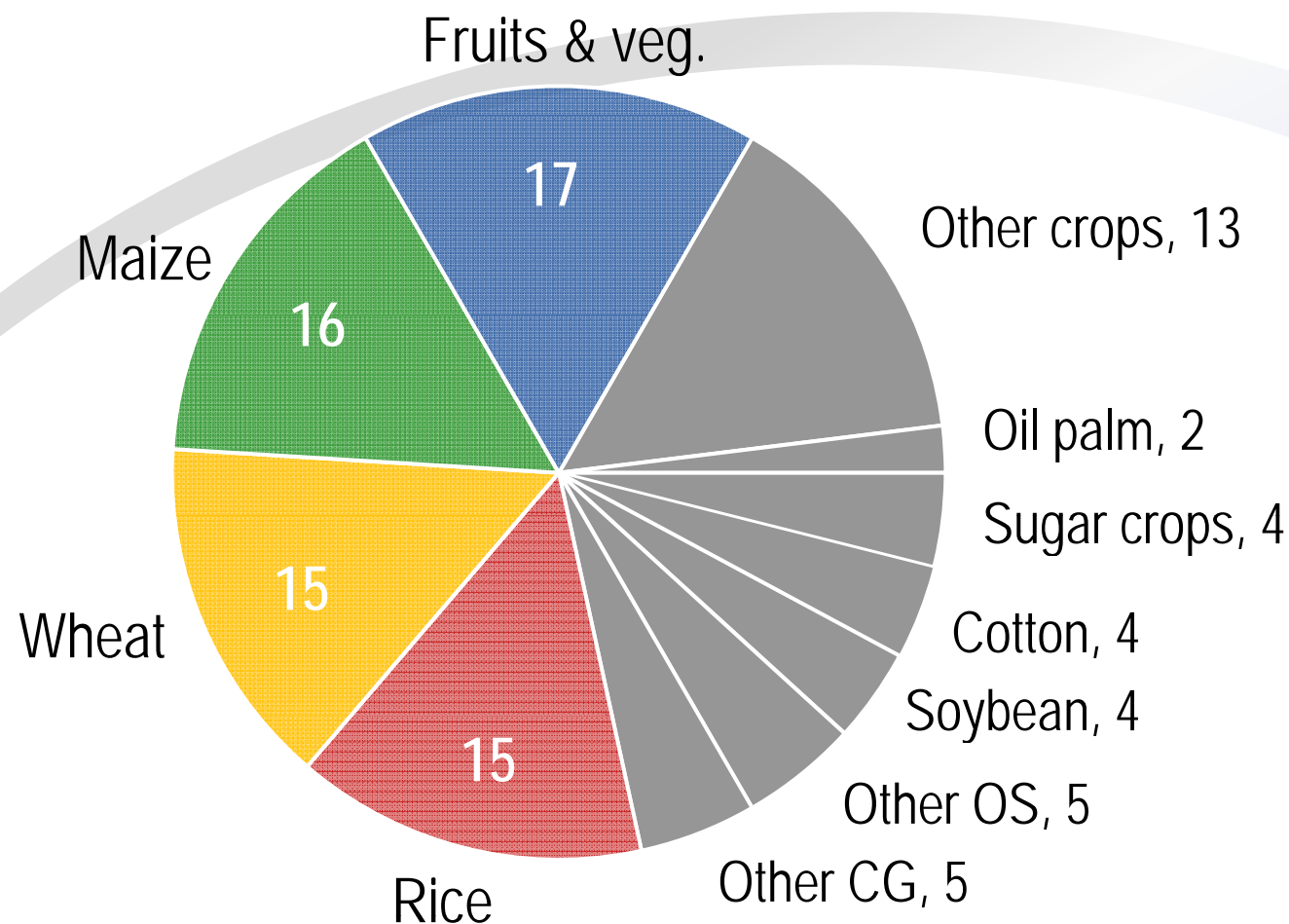
Short-term forecasts

Million tonnes nutrients

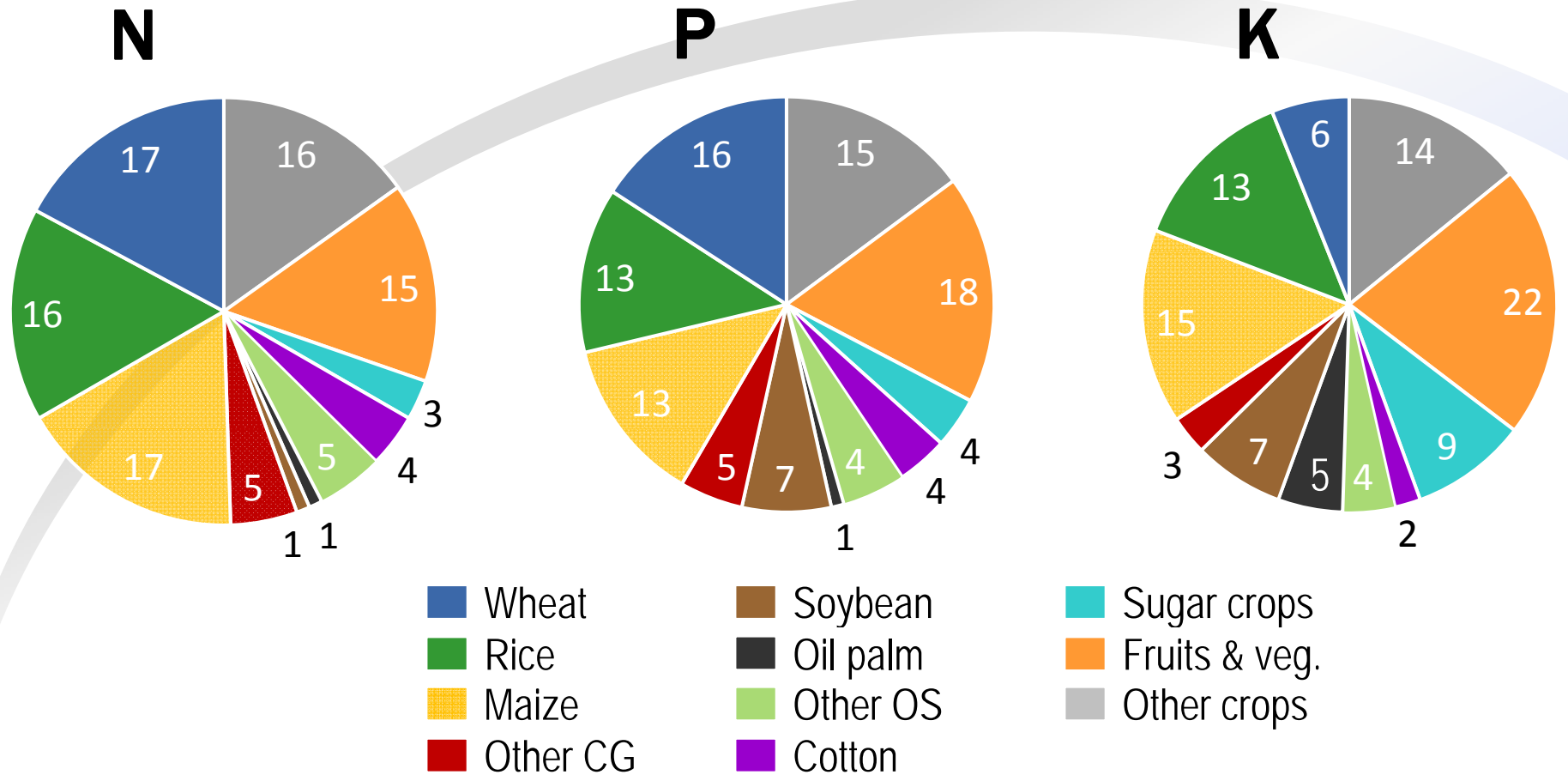
	2007/08 (e)	2008/09 (f)	Change	2009/10 (f)	Change
N	101.0	99.4	-1.6%	102.1	+2.6%
P ₂ O ₅	38.8	36.0	-7.3%	38.1	+6.1%
K ₂ O	28.3	24.3	-14.4%	25.3	+4.1%
Total	168.1	159.6	-5.1%	165.4	+3.6%



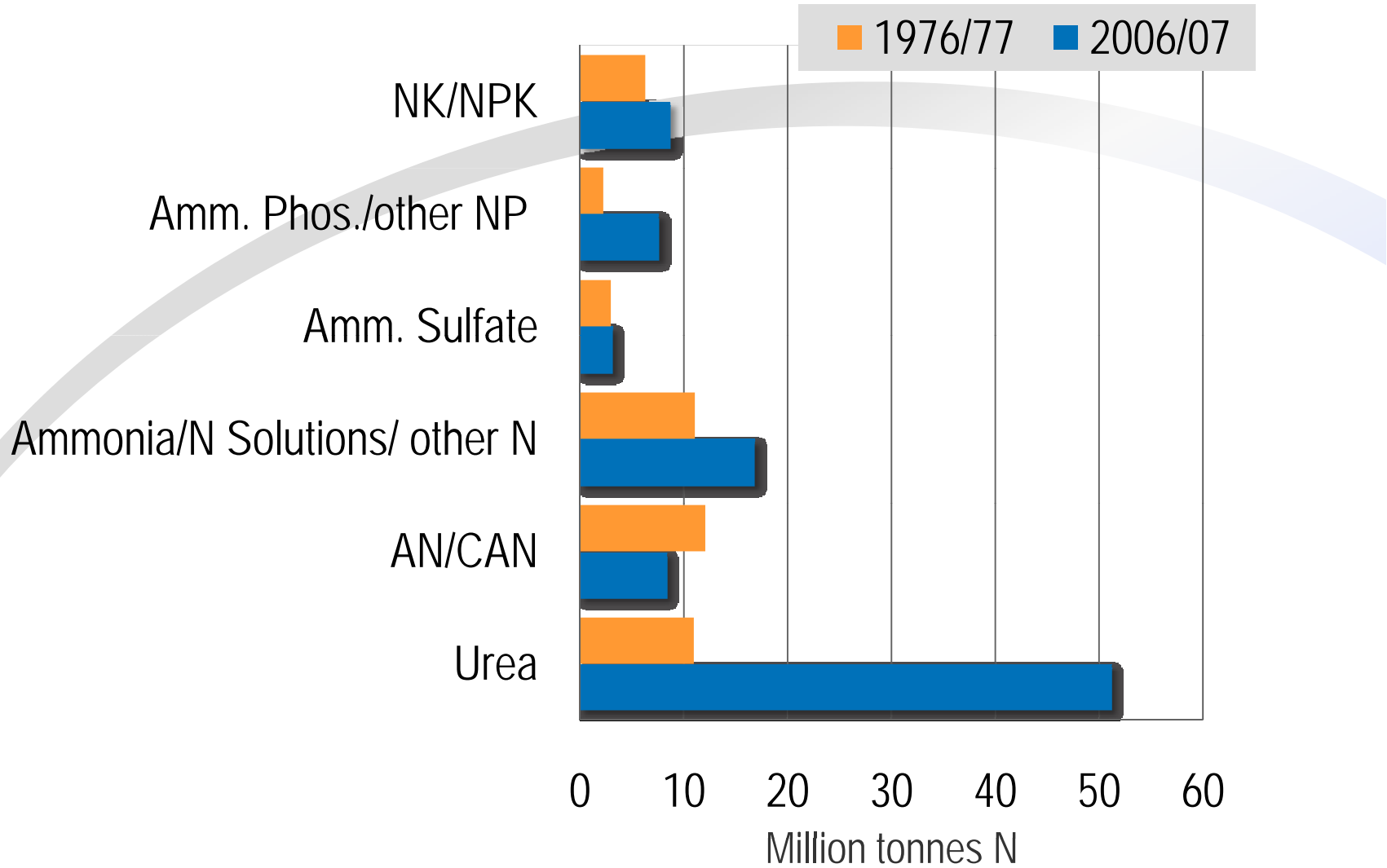
Total fertilizer use by crop at the global level in 2006/07 (%)



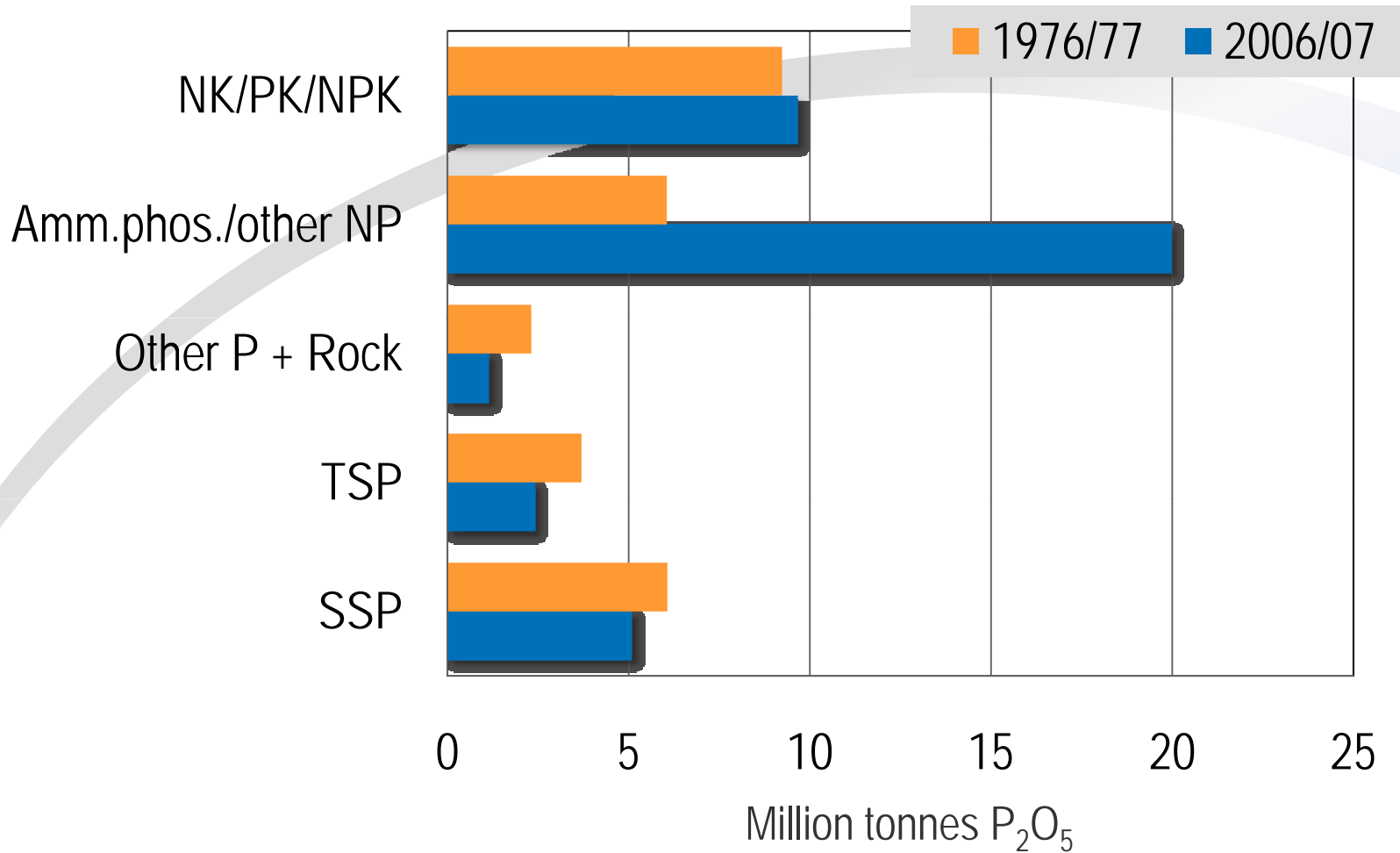
Nutrient use by crop (%)



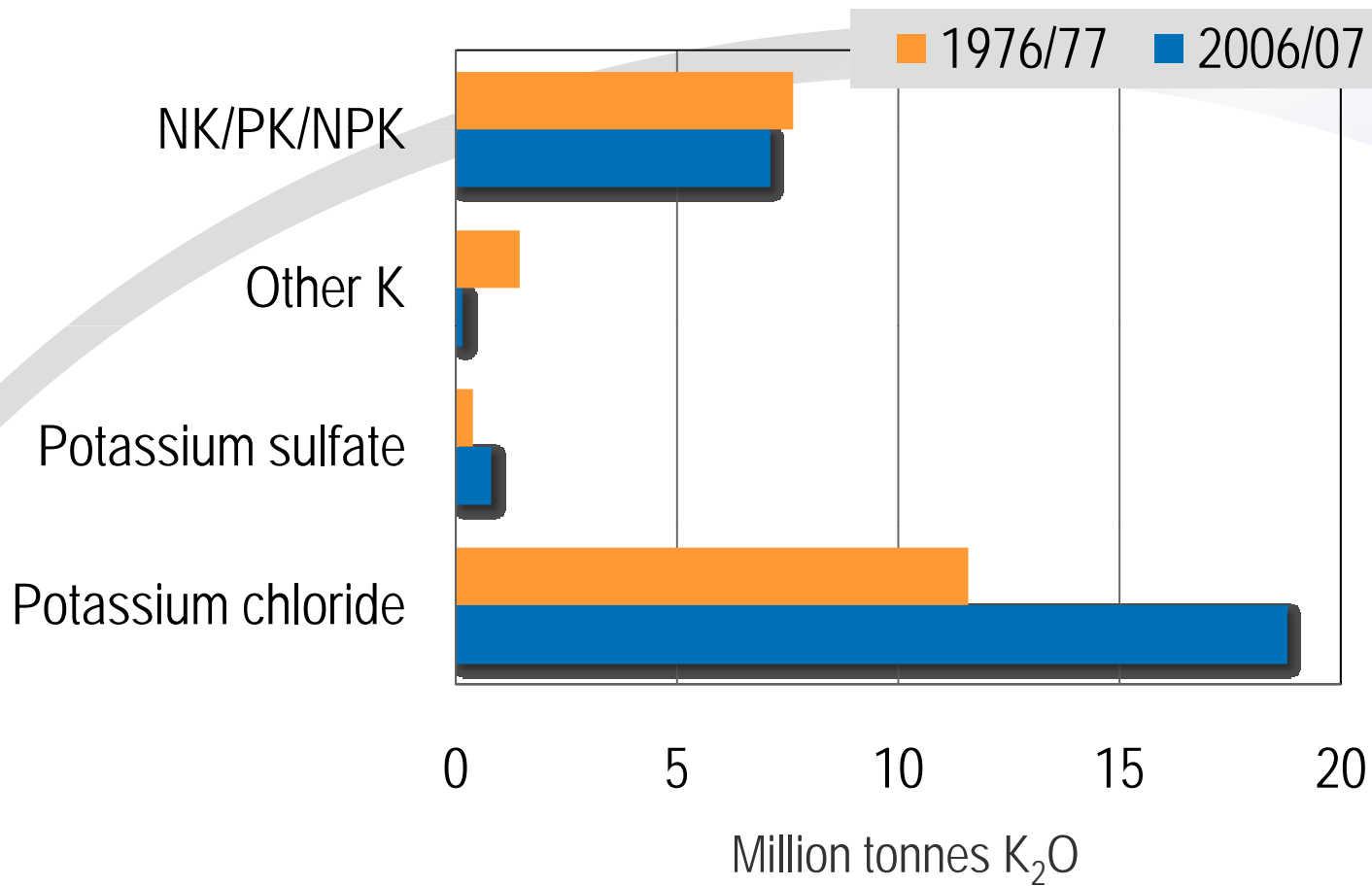
World nitrogen consumption by product



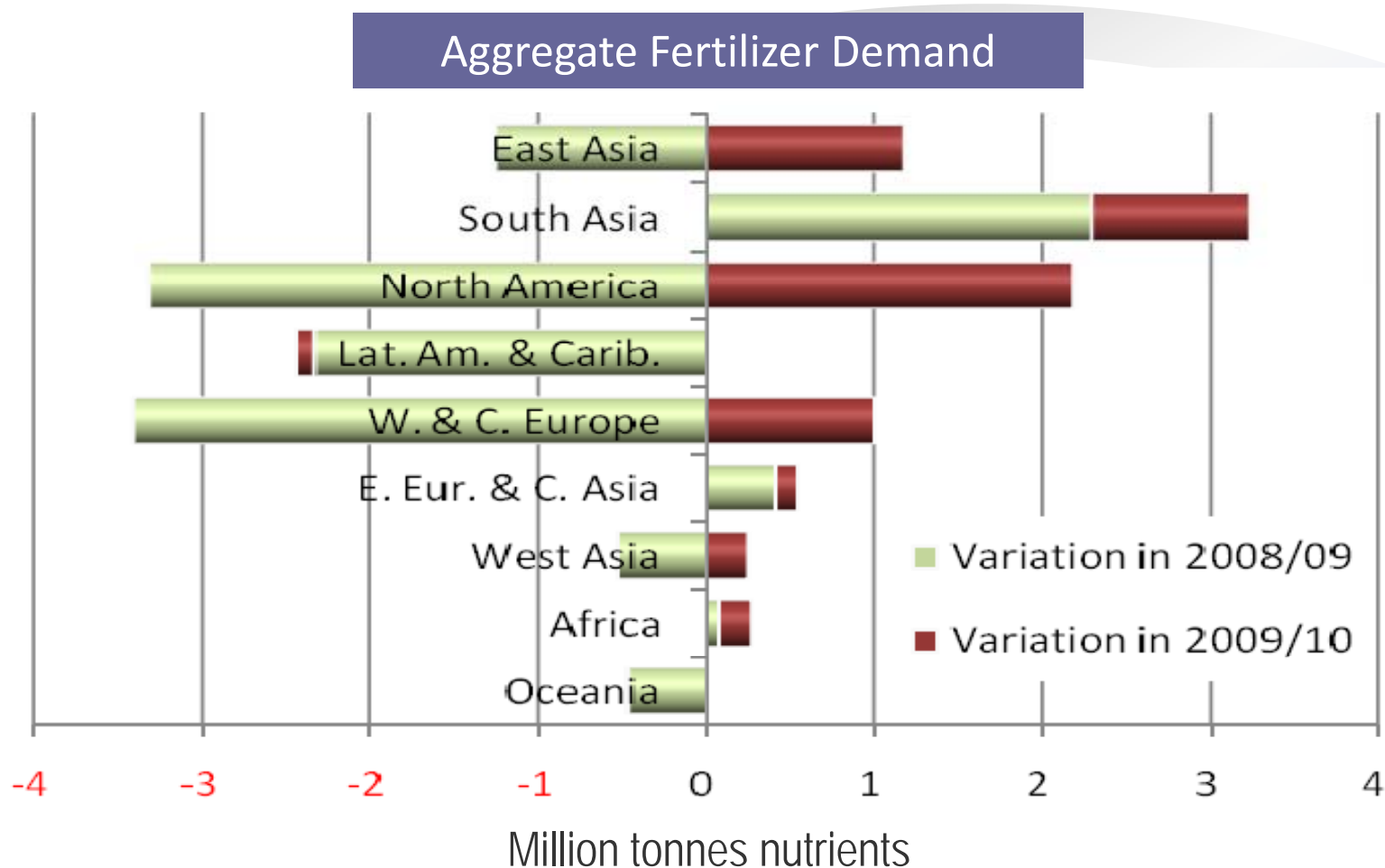
World phosphate consumption by product



World potash consumption by product



Anticipated variation of regional fertilizer demand in 2008/09 and 2009/10



Global fertilizer consumption Medium-term forecasts

Million tonnes nutrients

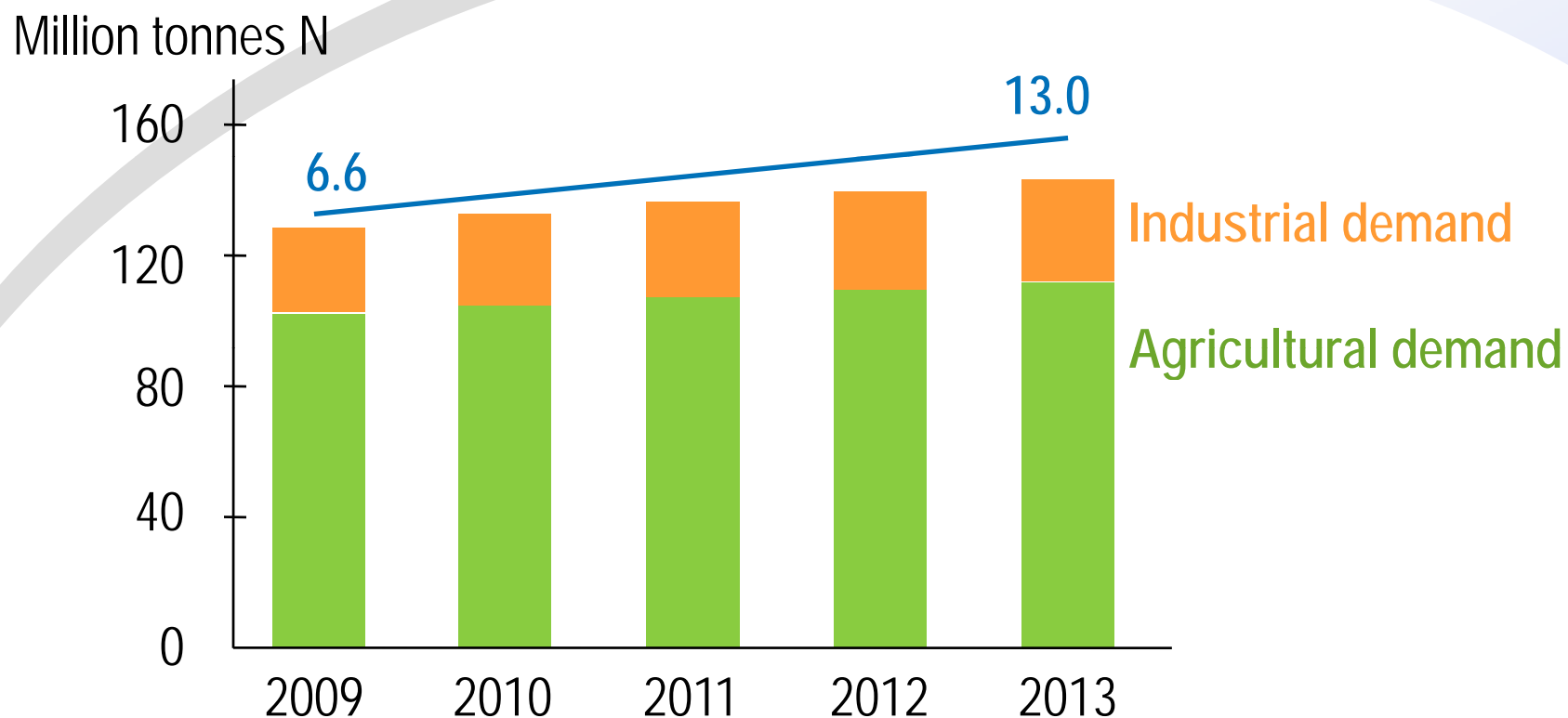
	Av. 2006/07 to 2008/09 (f)	2013/14 (f)	Change p.a.
N	99.3	111.2	+1.9%
P ₂ O ₅	37.6	44.5	+2.8%
K ₂ O	26.5	31.3	+2.8%
Total	159.6	187.0	+2.3%



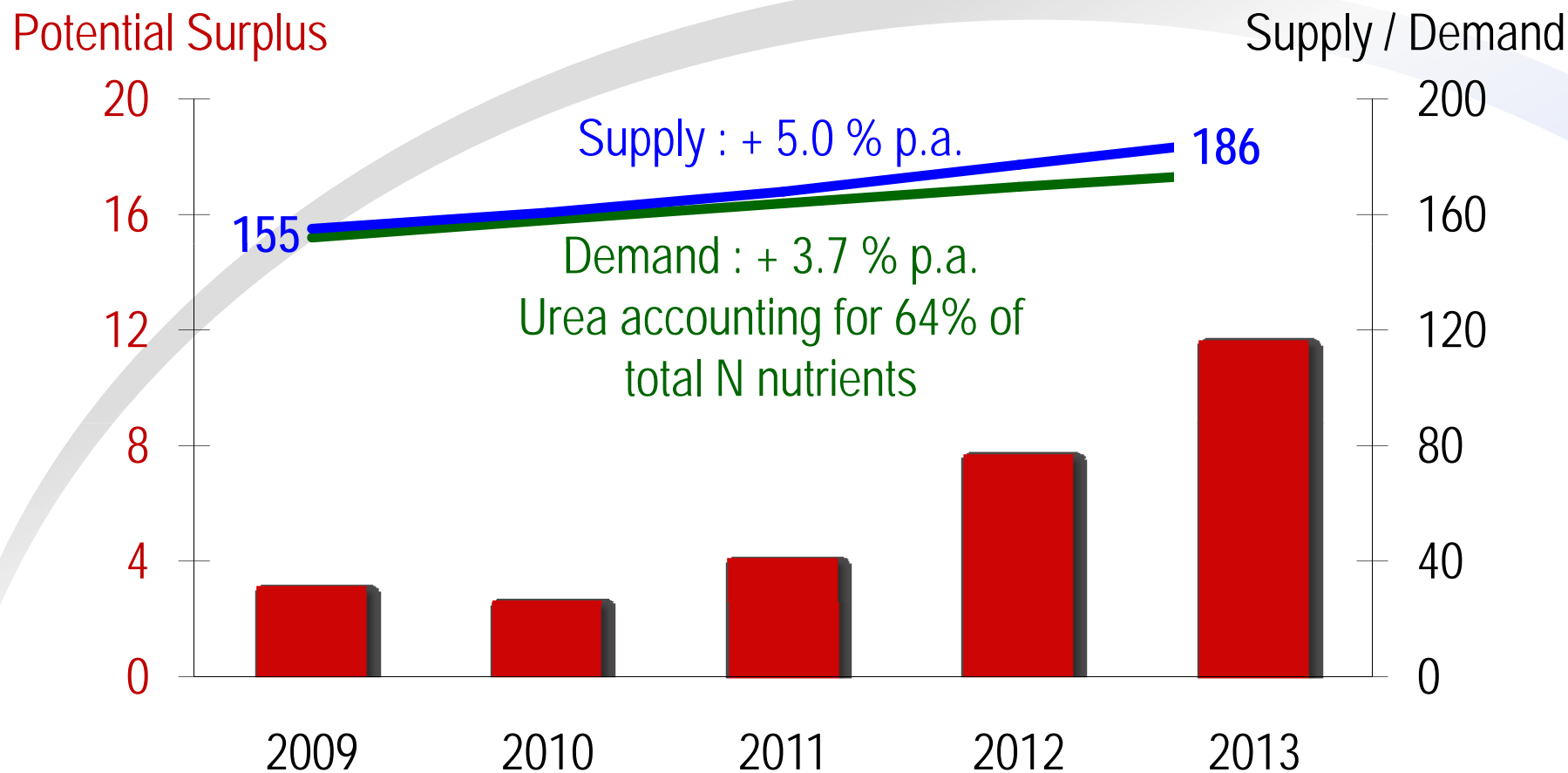
World nitrogen supply/demand balance

Supply: 133.5 Mt (2009) to 154.7 Mt (2013): +16%

Demand: 126.9 Mt (2009) to 141.7 Mt (2013): +12%

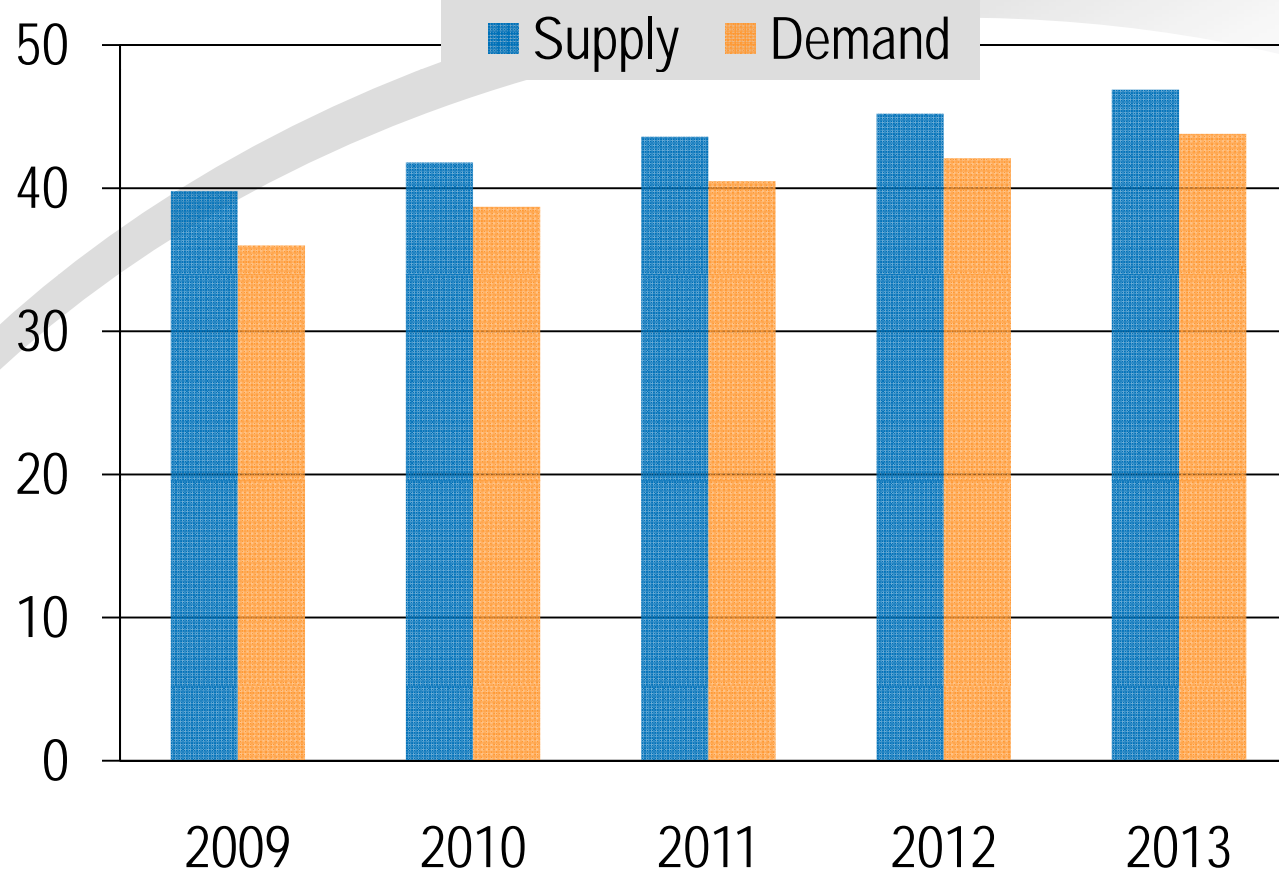


World urea supply/demand balance (Million tonnes urea)



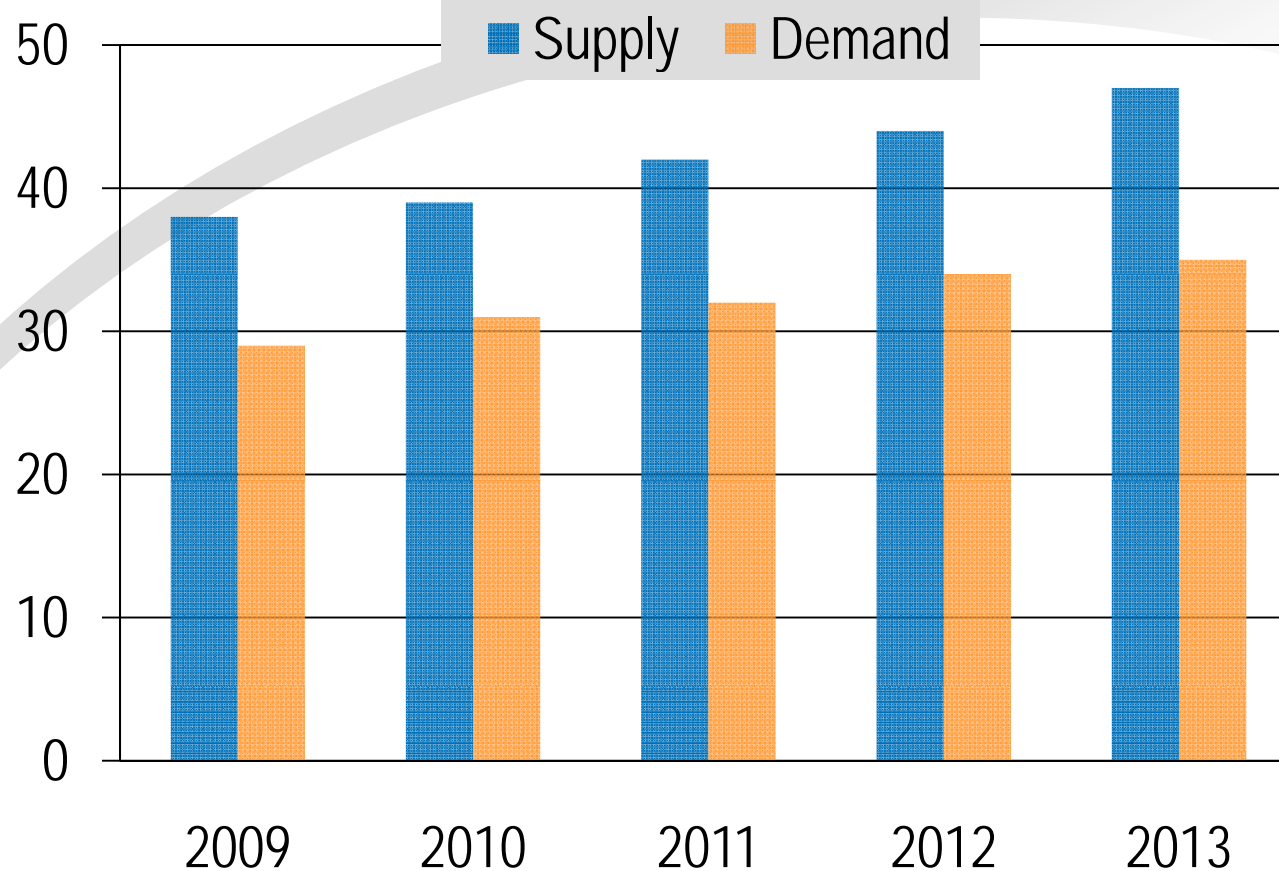
World phosphoric acid supply/demand balance

Million tonnes P_2O_5

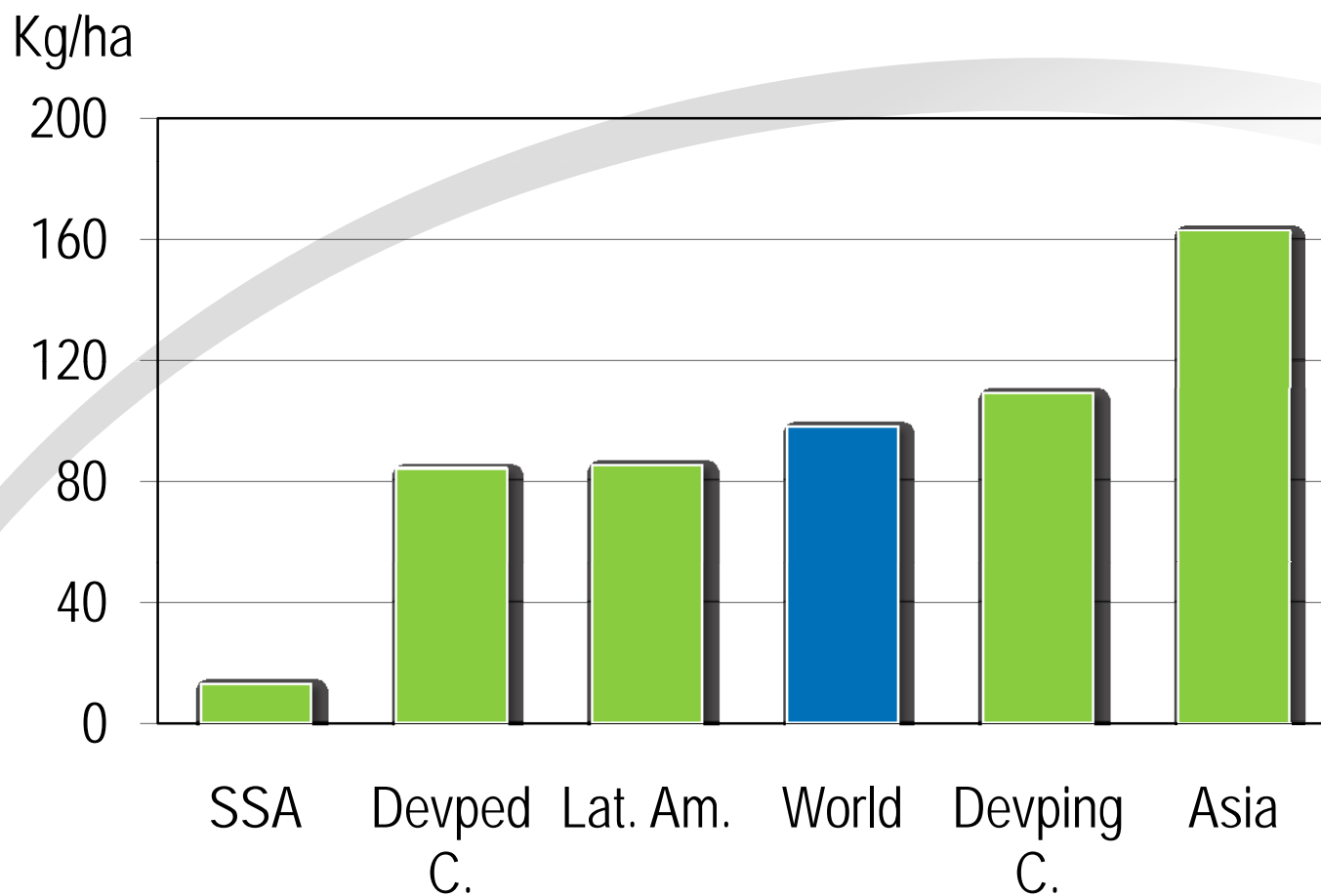


World potash supply/demand balance

Million tonnes K_2O



Fertilizer use



Nitrogen use efficiency – Low PFP_N

		N fertilizer use (kg N/ha)	Yield (t/ha)	PFP _N
RICE	Japan	78	6	27
	South Korea	110	7	26
	China	193	6	20
WHEAT	Japan	117	4	13
	France	80	7	31
	China	190	4	12
MAIZE	U.S.A.	150	8	27
	Argentina	150	5	30
	China	188	5	17



Average recovery efficiencies of N, P and K from manufactured fertilizers in Asia

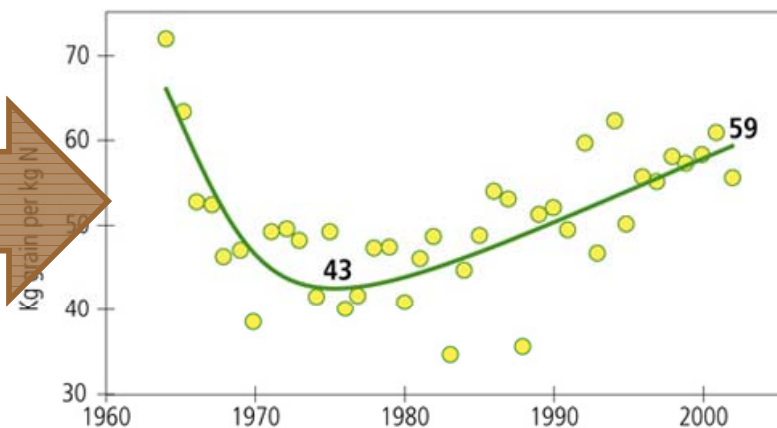
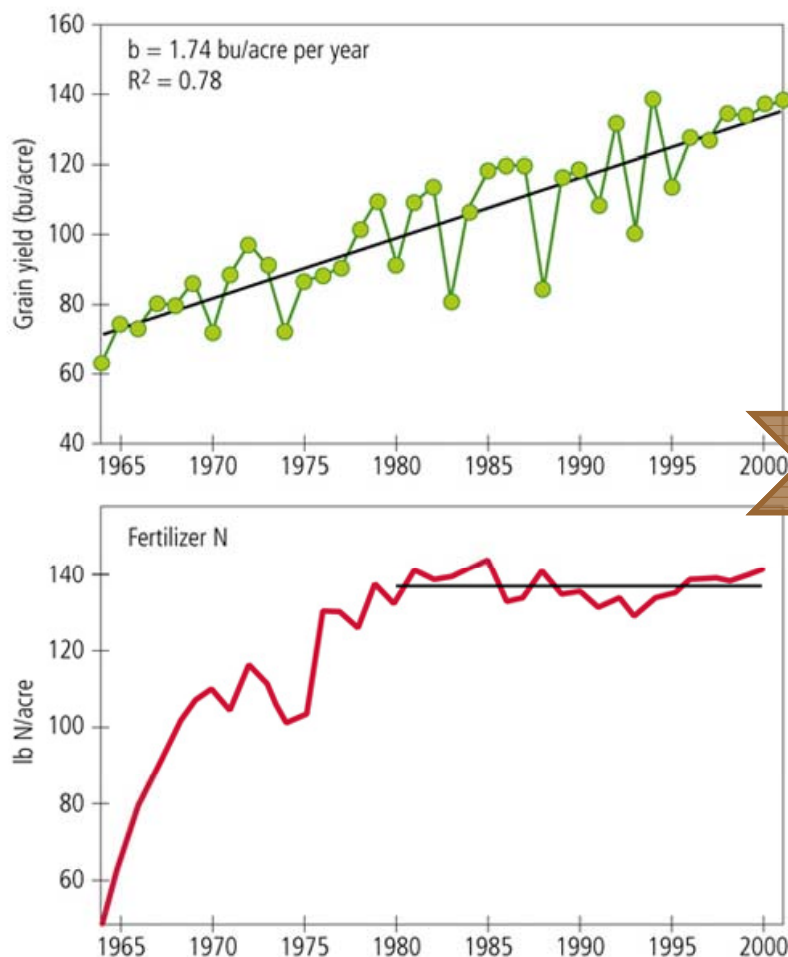
	Nitrogen (kg increase in uptake / kg nutrient applied)	Phosphorus	Potassium
Rice in S, E and SE Asia, farmers' practice ¹	0.33	0.24	0.38
Rice in S, E and SE Asia, site-specific management ¹	0.43	0.25	0.44
Wheat in India ²	0.58	0.27	0.51
Wheat in China ²	0.45	0.22	0.47
Maize in China ²	0.50	0.24	0.44

¹ Recommended rates - ² Rates currently applied by farmers

Source: Dobermann A. (2007)



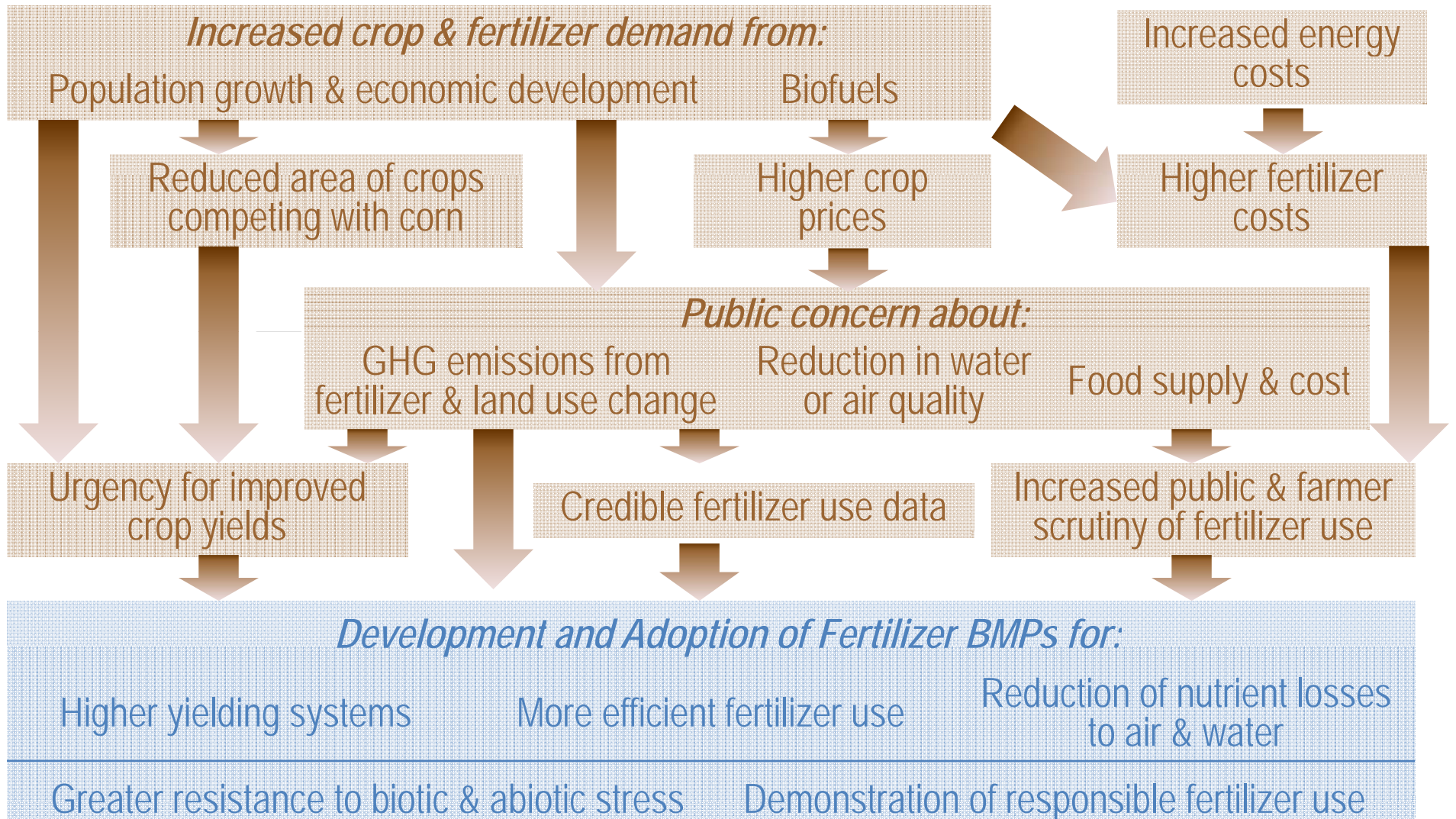
Higher N use efficiency is possible



| Source: Cassman *et al*, 2002
and Fixen and West, 2002



Contemporary nutrient use issues



“BEST” for doing what?

- Maximize crop uptake per unit of nutrient applied
- Maximize yield increase per unit of nutrient taken up
- Maximize yield increase per unit of nutrient applied
- Maximize farmer profit
- Reduce greenhouse gas emissions
- Limit nutrient run-off
- Replenish degraded soils
- Biofortify crops for human nutrition
- Adapt to climate change



Some key questions for crop nutrition

- How to better integrate fertilizers with manures, biofuel co-products and urban wastes given the high costs of transporting the latter?
- What role do all the micronutrients play? How do they interact with each other, the major nutrients, anti-nutrients and other molecules? How do we manage nutrients where toxicity thresholds are low?
- How can we raise global nutrient use efficiency? How do we reconvert nutrients escaping the agricultural system to inert forms?
- How can economic incentives for enhanced-efficiency products and other “improved” crop nutrition services become more positive?

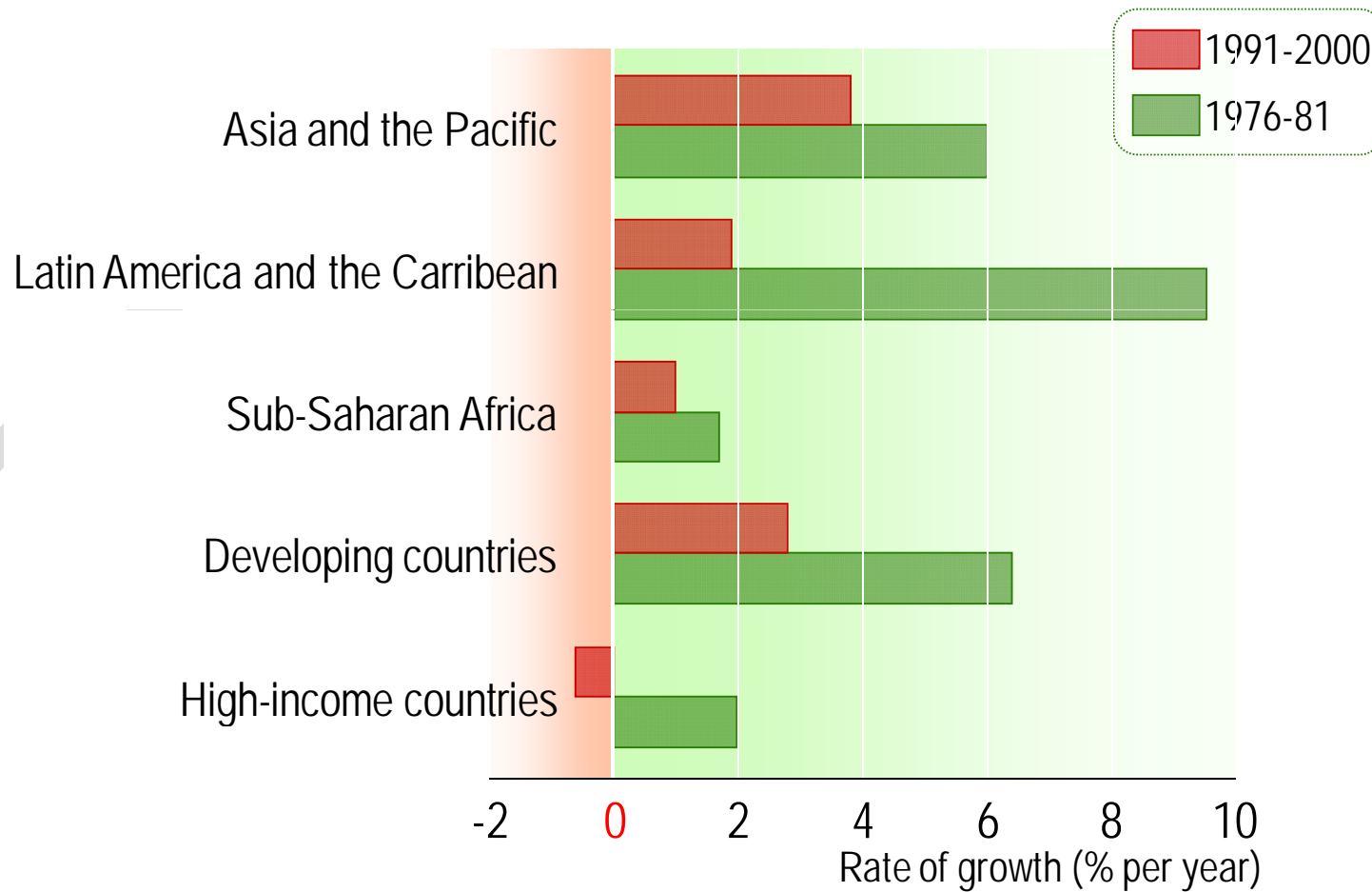


Some key questions for crop nutrition

- What will be the impact of modern biotechnology?
The spread of bioenergy crop varieties?
- How do crop nutrients interact with soil biology?
- How does crop nutrition interact with other facets of integrated crop management (water, waste and pest management, among others)?
- How do we develop and disseminate best management practices for all crop/agro-climatic combinations?



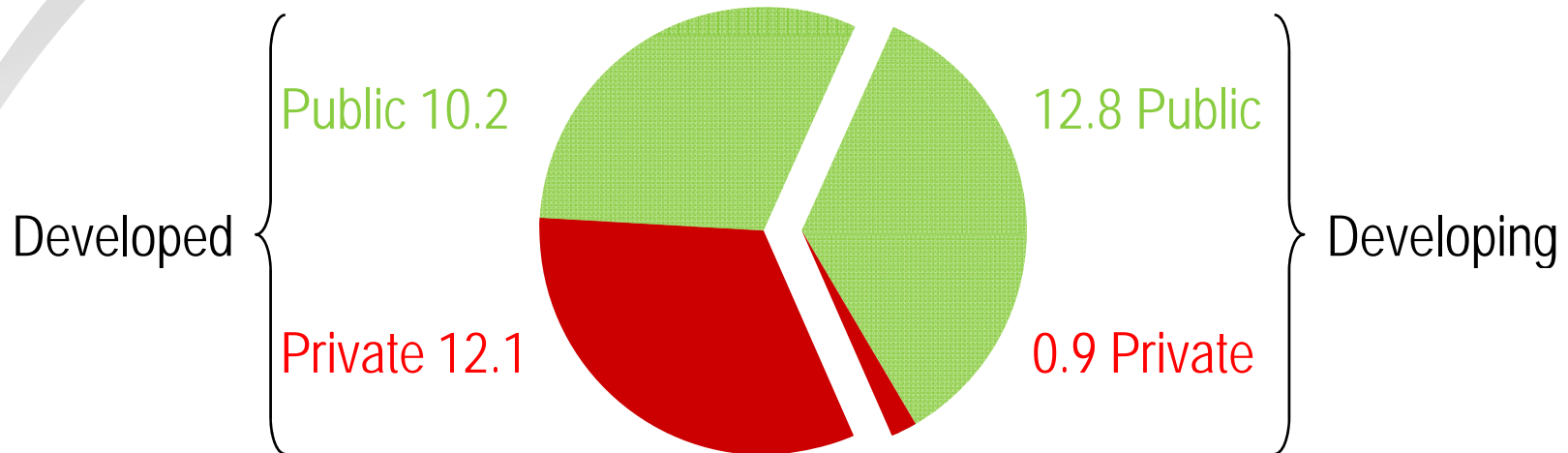
Public sector investments in ag research have slowed



How agricultural R&D is funded (2000)

	Total	Public	Private
Developed	62%	44%	93%
Developing	38%	56%	7%
Total	100%	100%	100%

Total - \$36 billion
(2000 international dollars)



The challenges ahead

- The scientific challenge of achieving global food security AND protection of natural resources has been grossly underestimated
- Average farm yields must reach 85-90% of genetic yield potential in the major cereal cropping systems-especially on irrigated land
- Innovative, efficient and profitable nutrient management should be a high priority!



Beyond the factory gate...



- Our business impacts throughout the global community
- We have to manage that relationship
- Develop partnerships



Challenges for Plant Nutrition Management:
Fertilizer Industry's Viewpoint