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The Development of the Fertilizer Industry in the last 50 Years

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ANDA 50 ANOS

7°Congresso Brasileiro de Fertilizantes, São Paulo

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- Evolution of Capacity and Trade
- Evolution of Fertilizer Demand
- Evolution of Production Technology, trends in energy efficiency, emissions and safety
- Focus on Food Security / Sustainability
- ifa2030

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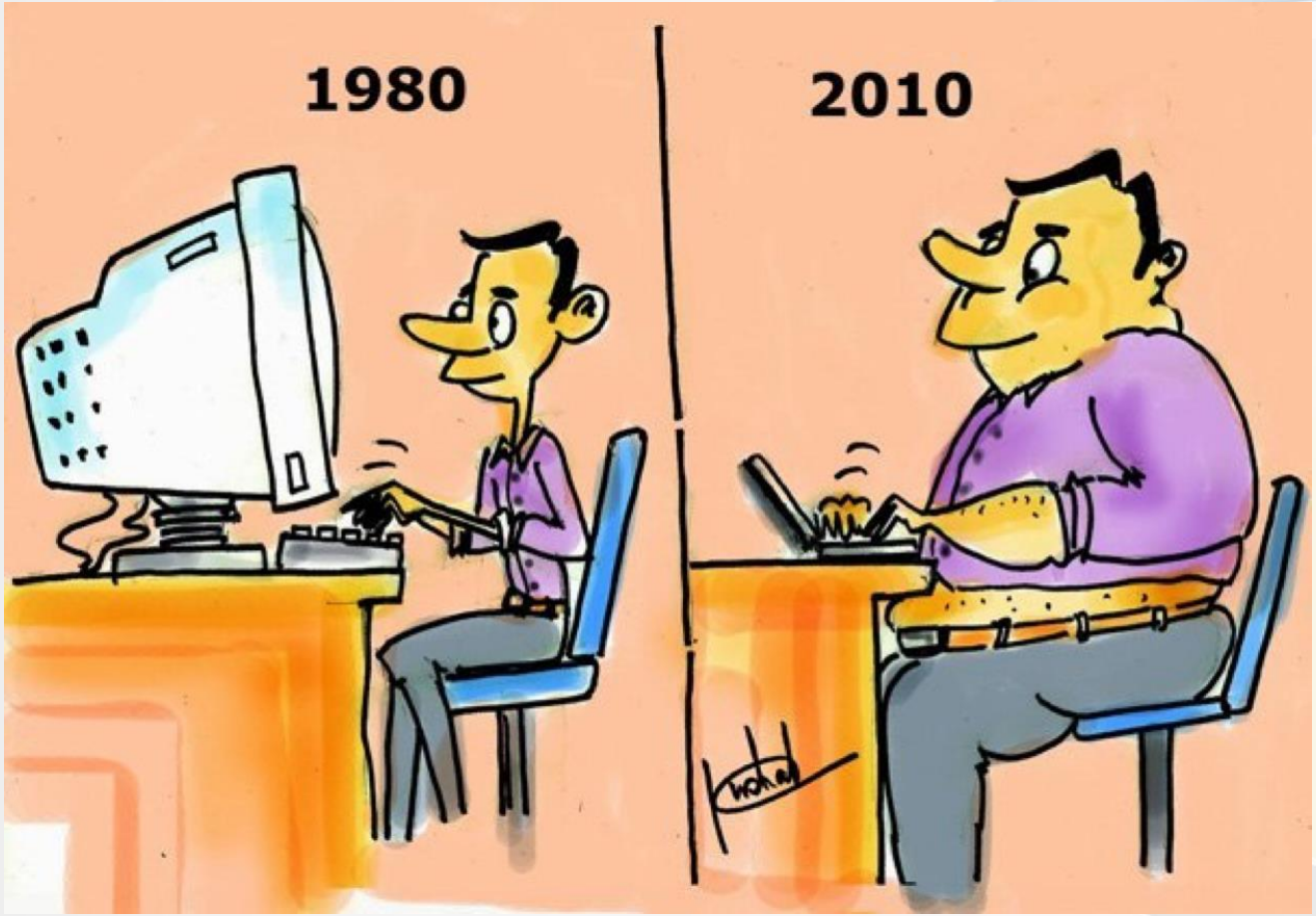
On a funny note…



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… and more seriously

ANDA has been a member of IFA since 1972. ANDA provides important input to IFA on market intelligence, agricultural issues and communications & public affairs.

- 1981 — Joint regional meeting in Bahia in Brazil
- 1992 — Preparation of the Rio Summit- ANDA attends on behalf of IFA
- 1993 — Collaboration on adapting IFA's "Guidelines on best agricultural practices" for Latin America
- 2001-2003 — IFA President is W. Puggina from Brazil
- 2003 — Preparation with CFI of the document "**Fertilizer Reduces Greenhouse Gases: Global Industry Taking Action**" for the COP9 in Milan
- 2012 — ANDA participates in the development of the "Roots4Growth" campaign and website

EVOLUTION OF CAPACITY AND TRADE
1980s-2020s

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The big picture on supply

- 1980-2000: Steady capacity expansion: essentially on N, little on P and none on K.
- Early 2000s significant capacity expansion in China → becomes exporter by early to mid-2000s.
- 1980-2008: Steady trade expansion until global fertilizer supply squeeze of 2007/08 → surge of capacity projects → current glut of N and K supply.
- Since the late 2000s, downstream added-value production expanding → steady/lower raw material trade. Raw material trade now accounts for 20% of global sales (23% in 1987).
- Industry consolidation has occurred in virtually every producing region.
- Fertilizer production has been gradually shifting from commodities to more specialized fertilizers.
- Global fertilizer sales are seen growing at 1.5% per annum till 2021 (vs 2% p.a. in 1994-2014).

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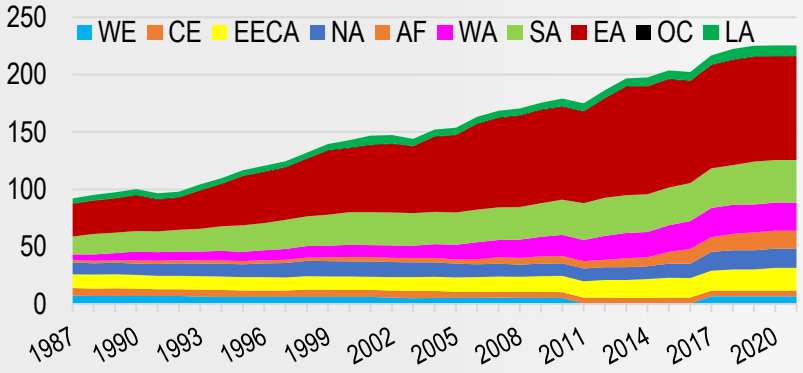
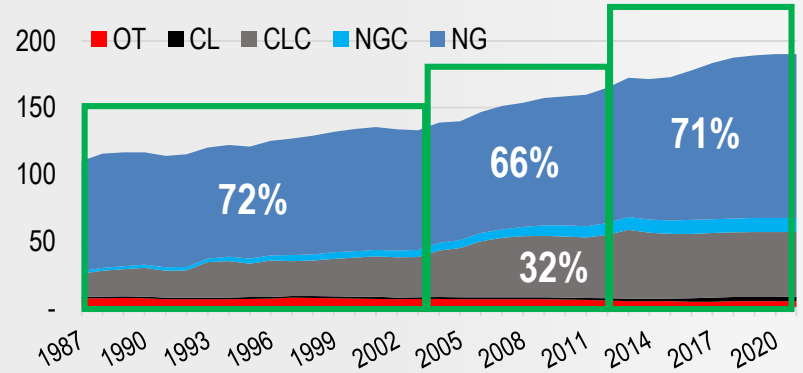
Ammonia capacity evolution 1987-2021





- Sustained capacity expansion in China since the early 2000s
- West Asia emerged as major producing region in the 2000s
- In the near term, Africa to show the fastest capacity growth, China's capacity to flatten

- 1987-2003: Natural gas prevalent feedstock
- By 2014, coal reaches 32% thanks to capacity growth in China (94% of total coal based cap).
- After 2014, coal-based capacity stalls
  → natural gas feedstock expansion (notably in US, Africa and EECA).

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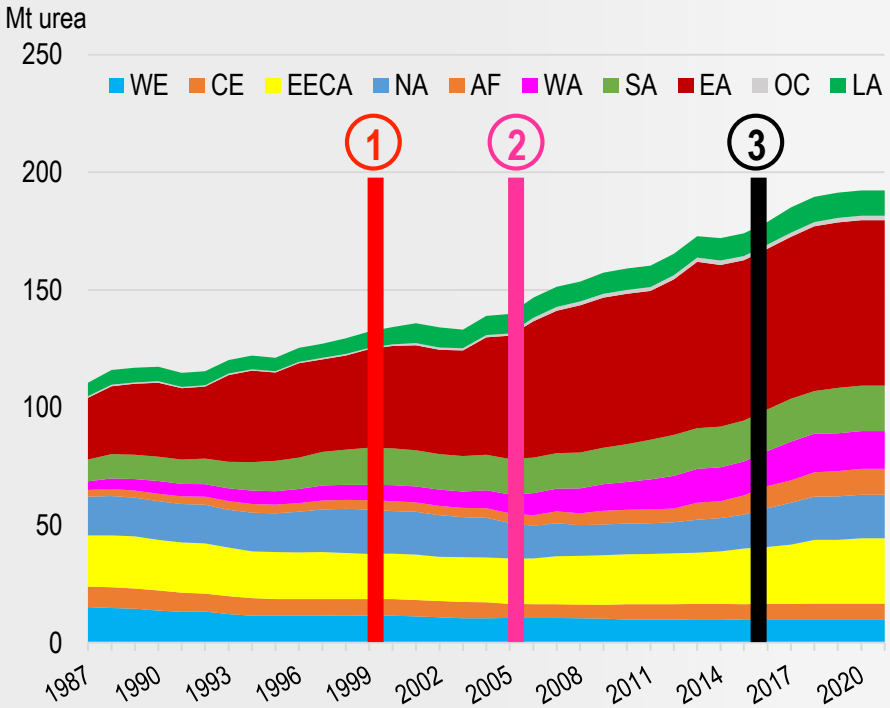
Source: IFA Production & International Trade, 2017

Urea capacity evolution 1987-2021



1987-2021: urea capacity to double

1. 2000-2016: East Asian capacity increase to 45% of global capacity share
2. Mid-2000s, West Asian capacity expansion → as capacity in NA and WE receded
3. 2016
   - Reemergence of capacity in the US and EECA
   - Resurgence of AF
   - Deceleration in China

Urea capacity in LA has remained static (4% global share)

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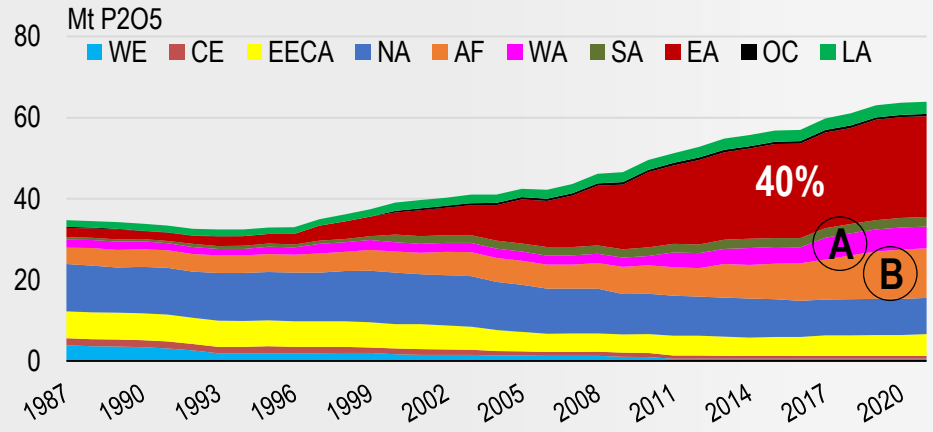
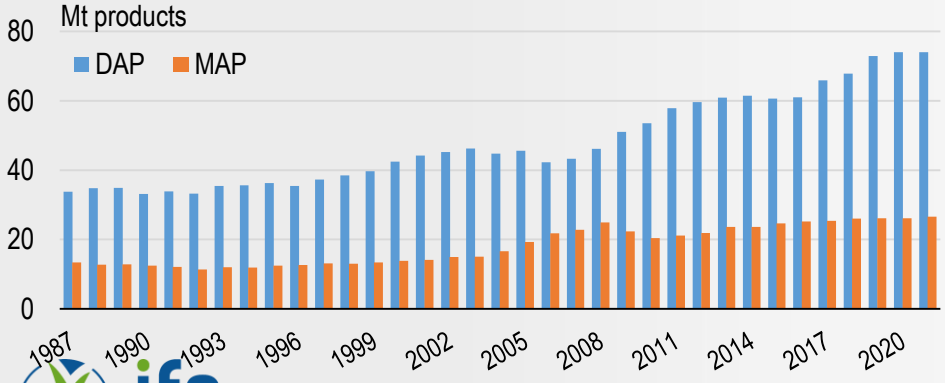
Source: IFA Production & International Trade, 2017

Phosphate capacity evolution 1987-2021





- 1987-1997: Slightly declining global capacity
- 1997 to 2014: Exponential capacity growth in China (**40% global PA capacity**)
  → displacing traditional producers in NA and EECA

A. 2011-2017: Emergence of new DAP capacity in West Asia

B. 2013-2021: Rapid expansion in Africa

2017-2021: Static capacity in China

- DAP sees greatest PP capacity growth
  - 75% share in 1987-2021
  - 5% annual growth rate: 2007-2021
- MAP capacity growth: 1% pa 2007-2021
- MAP + S expanded three-fold since 2013

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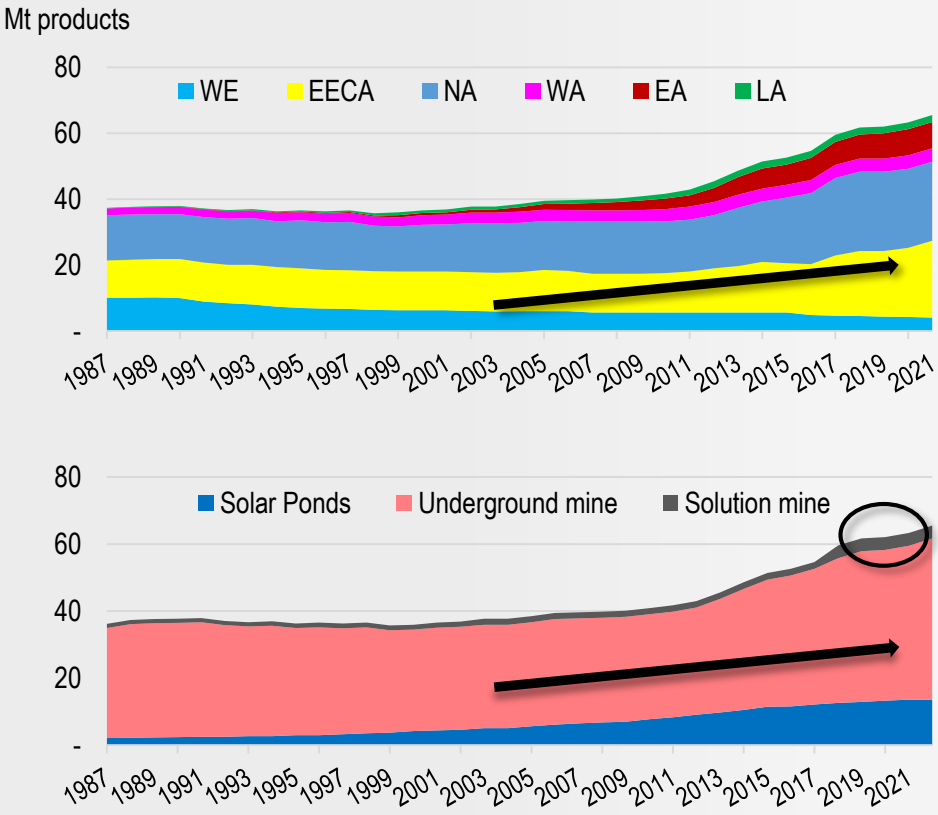
Source: IFA Production & International Trade, 2017

Potash Capacity Evolution 1987-2021



- NA and EECA continue to account for 70% of global capacity
- But since the early 2000s, East Asia (China) has emerged as a key producer, from 0 to 7 Mt of capacity
- Europe significant capacity erosion

- 1987: Underground mining = 90% of global capacity → drops to 72% in 2021 (increased capacity from Solar Ponds operations, esp in China)
- Solution mining capacity is seen increasing in future

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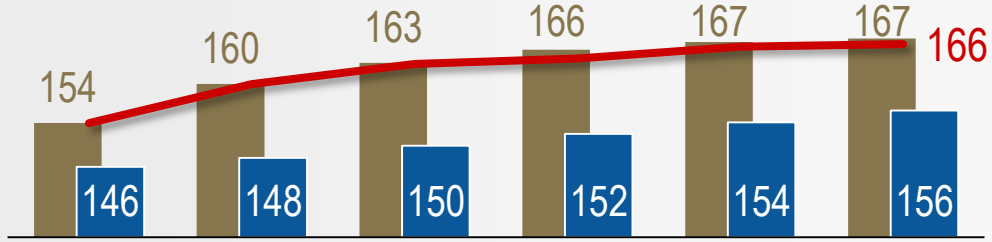
Source: IFA Production & International Trade, 2017

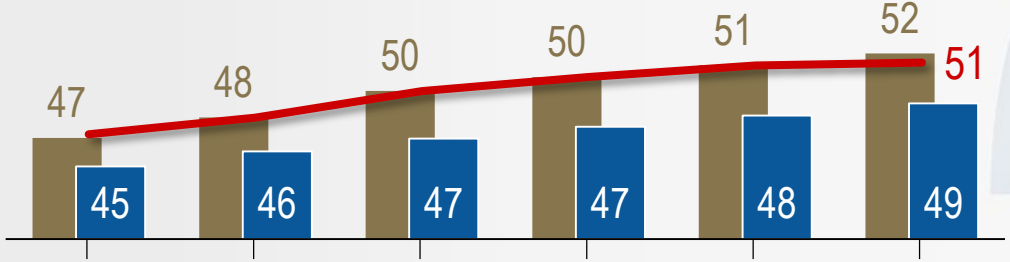
Supply/demand outlook 2016-2021

NITROGEN
Mt N



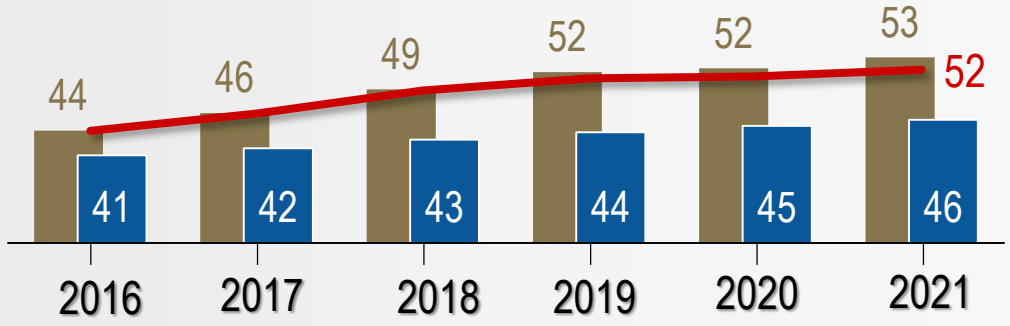
- SUPPLY +**1.8**% pa
- DEMAND +**1.2**% pa
- Potential surplus rising up to 10 Mt N

PHOSACID
Mt P_2O_5



- SUPPLY +**2.4**% pa
- DEMAND +**1.8**% pa
- Potential surplus nearly doubling

POTASSIUM
Mt K_2O



- SUPPLY +**3.8**% pa
- DEMAND +**2.2**% pa
- Potential surplus more than doubling

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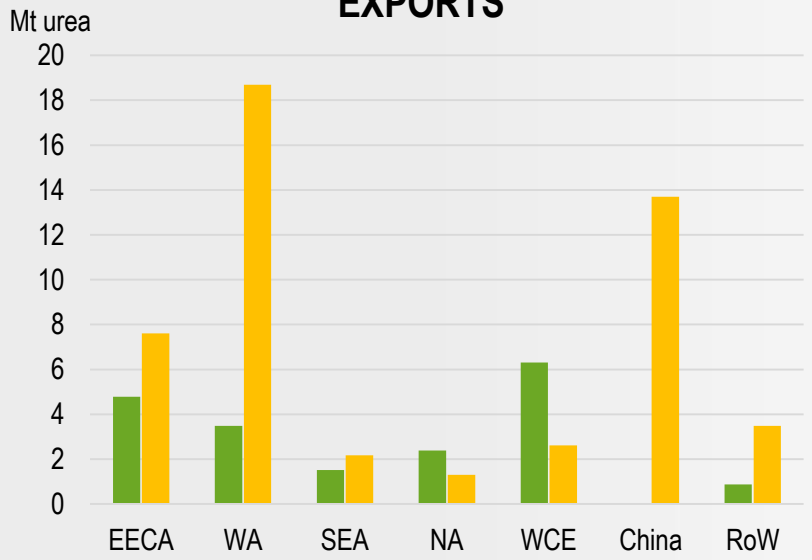
Source: IFA Production & International Trade, 2017

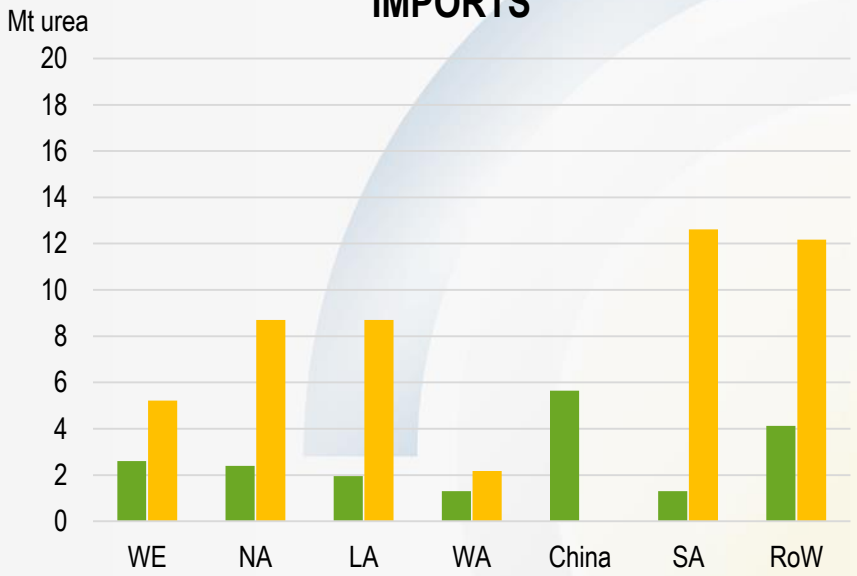
Global urea trade 1987 vs 2015

EXPORTS



- Rising dominance of WA (38% of world's urea exports in 2015)
- Emergence of China in 2006 to become world's largest exporter in 2015 (28% share)
- Growth in EECA, SEA and ROW; but declining exports from WCE

IMPORTS



- China was world's largest importer in 1987 (29% of global import): phased out in 2003.
- India now world's largest urea importer (20% share in 2015)
- Growing imports in WCE and LA, but will recede in USA

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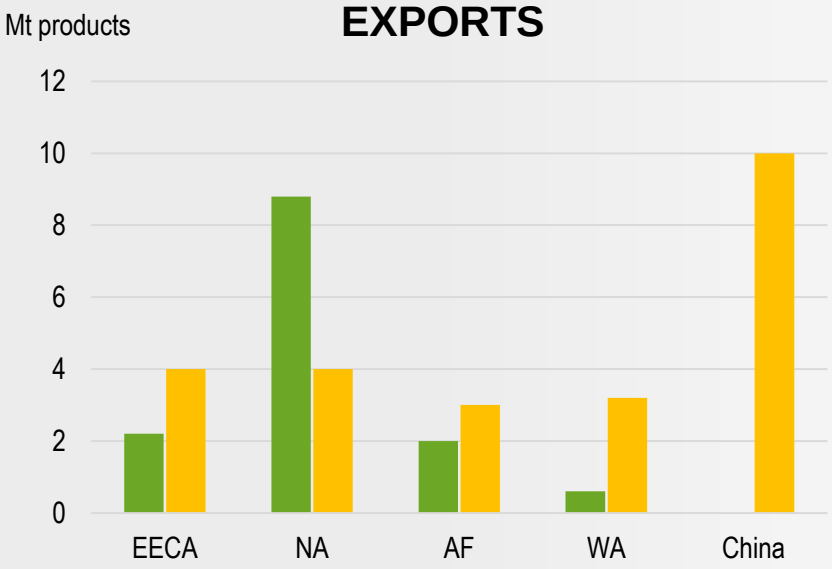
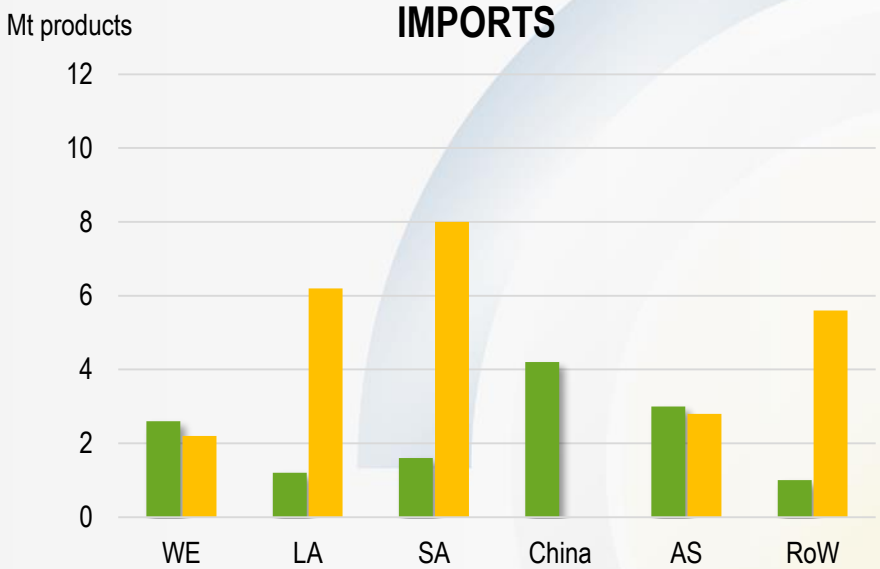
Source: IFA Production & International Trade, 2017

Global MAP-DAP trade 1987 vs 2015



- Declining exports from USA
- Massive dominance of China: **40% of global trade in 2016**
- Newcomer: Saudi Arabia
- Steady growth in EECA and AF



- Rising importance of India and Brazil as world's largest importers
- China's shift from importer **(30% of global imports in 1987)** to a net exporter in 2007
- Growing demand in Rest of World (incl. AF)

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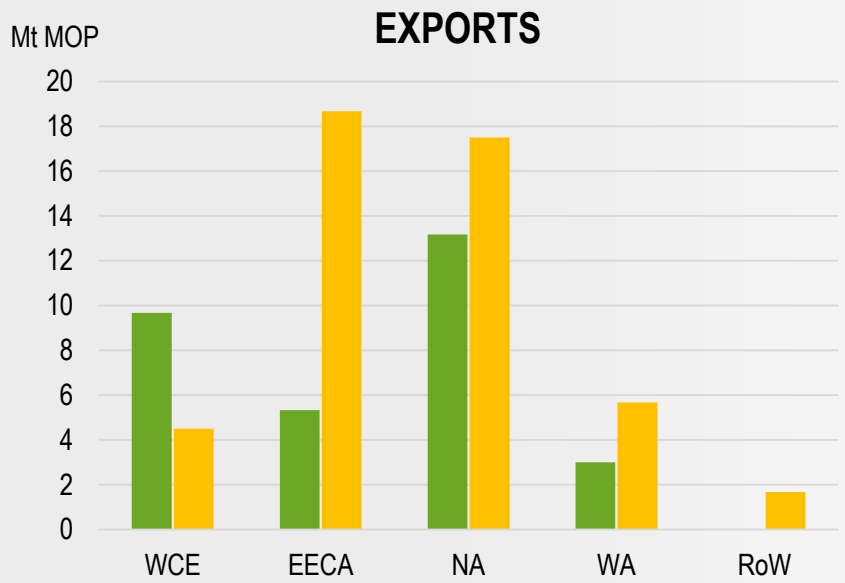
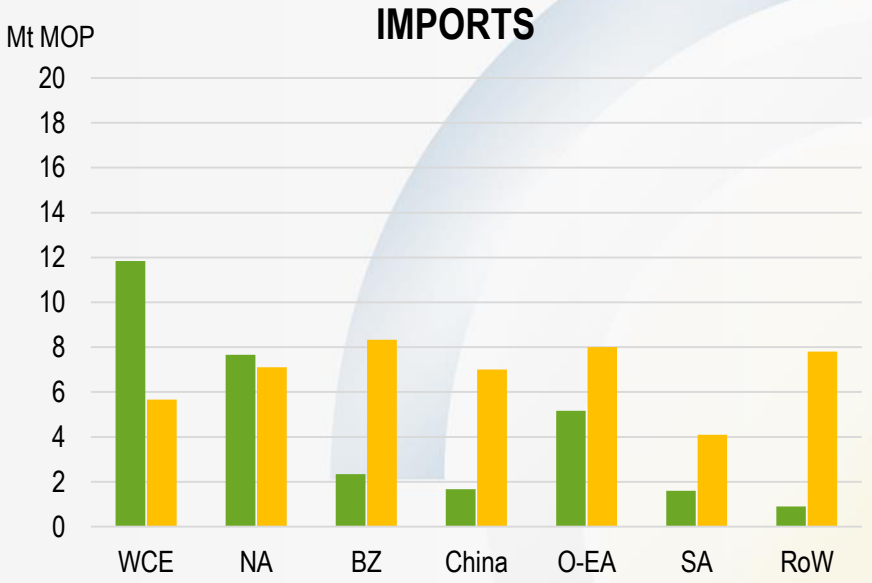
Source: IFA Production & International Trade, 2017

Global MOP trade 1987 vs 2015





- EECA three-fold export expansion (39% of global exports in 2015)
- NA (Canada) : 2nd largest exporting region (37% global exports in 2015)
- WCE in steady decline, but WA and RoW growing!

- Fast growing demand: S and E Asia, Africa, West Asia
- WCE was world's largest importer in 1987 (mostly for NPK re-export), followed by US.
- Import demand has since shifted to Brazil (19% of global imports); China (15%); India (9%).

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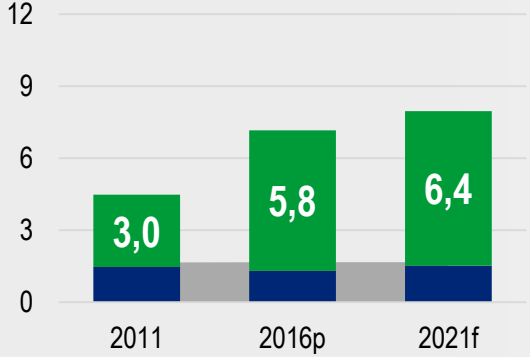
Source: IFA Production & International Trade, 2017

Brazil: rising imports toward 2021

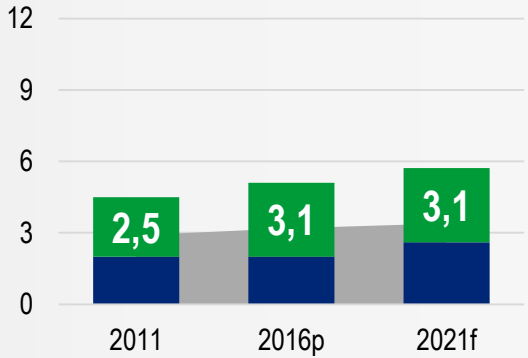
CAPACITY PRODUCTION IMPORTS

Mt UREA



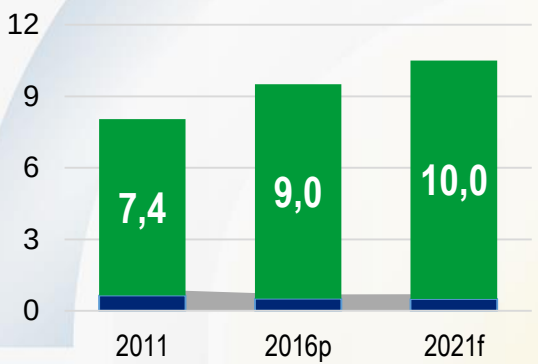
- No major changes in urea capacity and production
- Brazil is World's third largest urea importer. Import reliance: 80%
- Urea imports may reach 6.4 Mt in 2021

Mt P2O5 P Fertilizers



- 10% increase in capacity and production between 2016 and 2021
- World's largest MAP importer. Import reliance: 55%
- MAP/DAP imports to exceed 6 Mt products in 2021

Mt MOP



- Small level of capacity and production, with no changes ahead
- 2nd largest MOP importer. Import reliance: 95%
- MOP imports projected to grow by 10% over 2016 to 10Mt MOP in 2021

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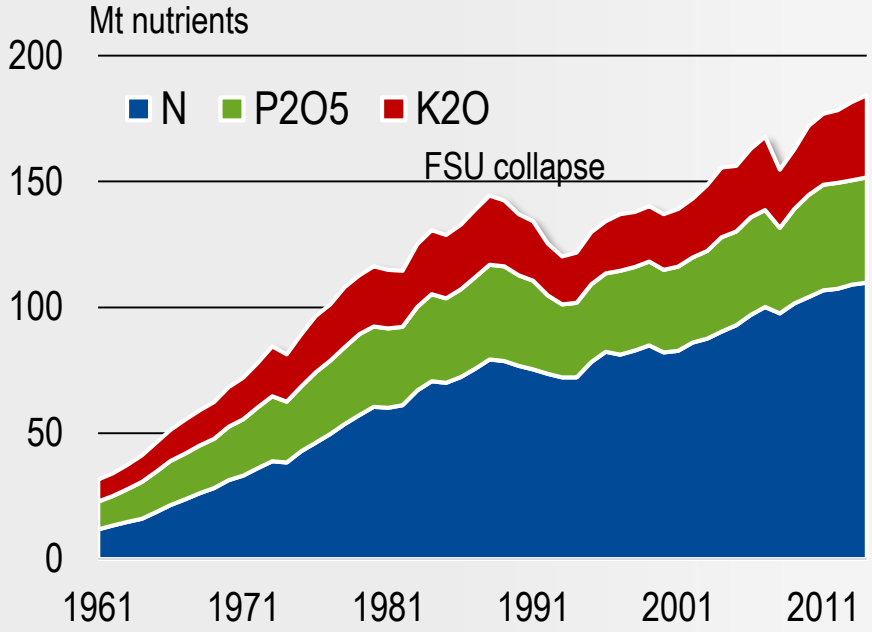
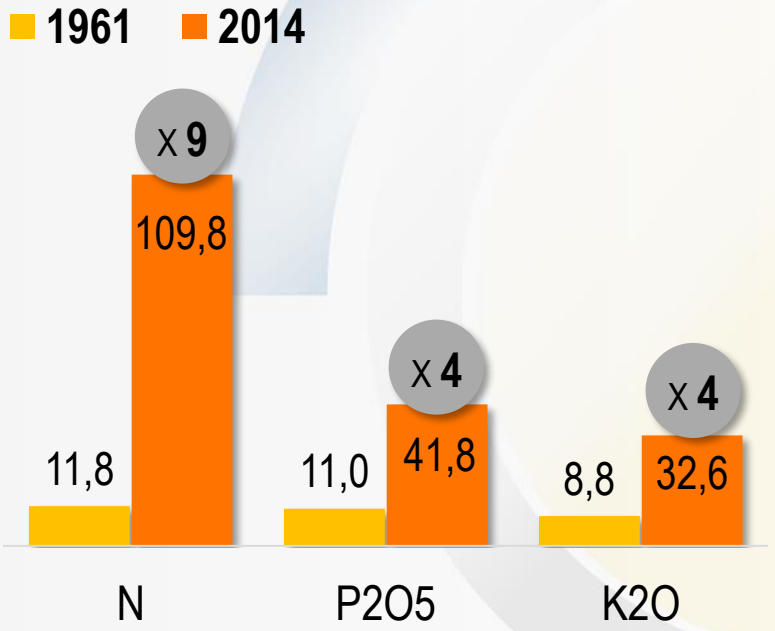
EVOLUTION OF FERTILIZER DEMAND

Global Fertilizer Consumption

multiplied by 6 since 1960





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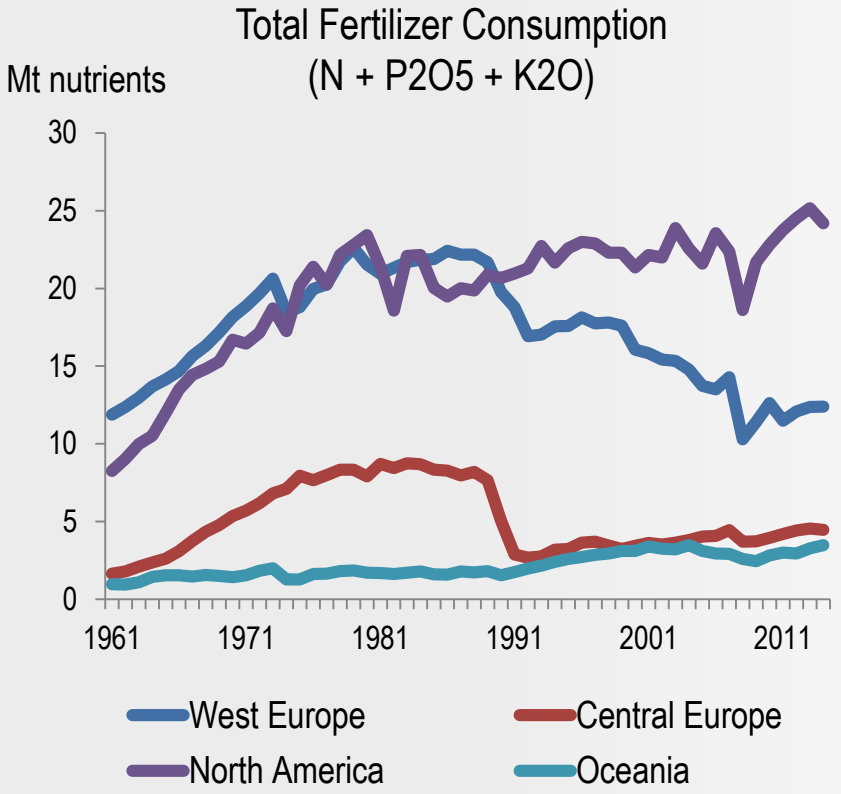
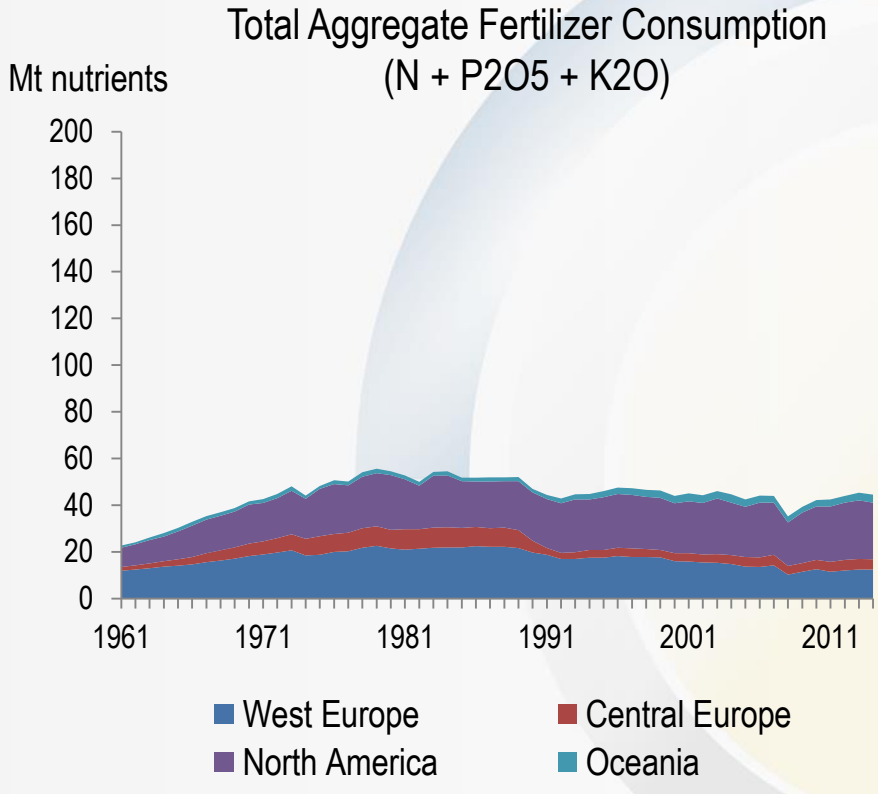
Source: IFA Agriculture

The mature markets





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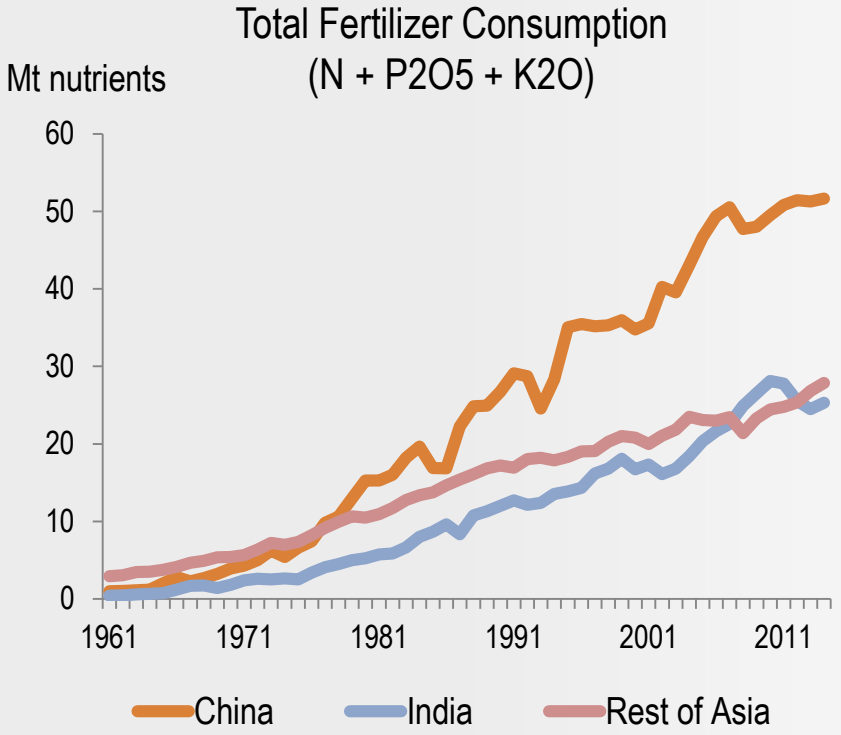
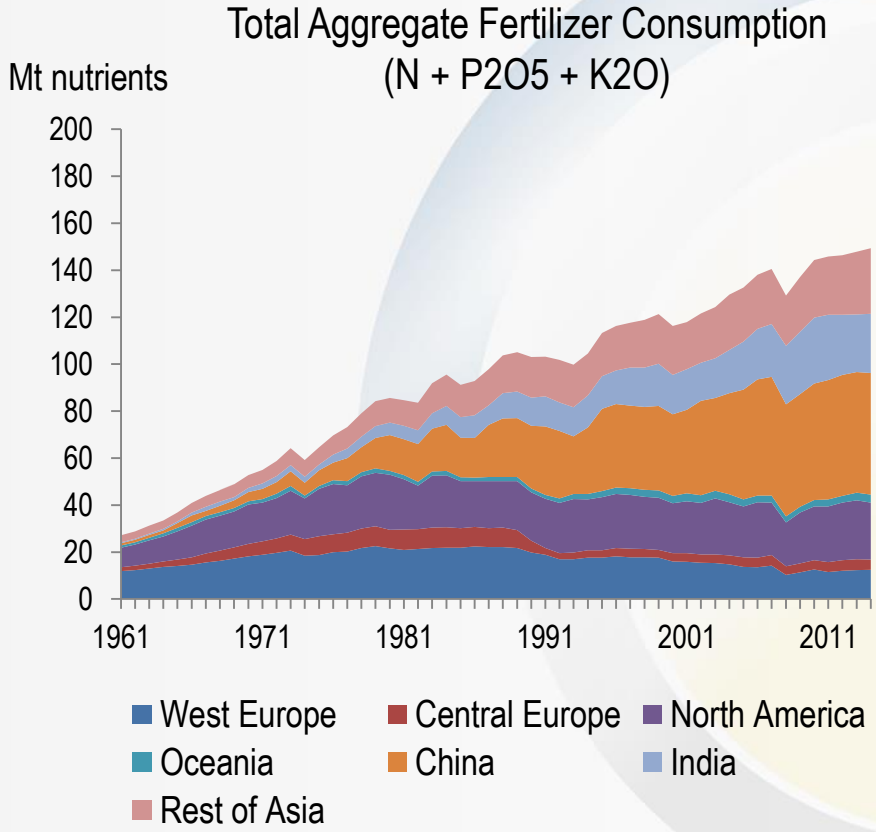
Source: IFA Agriculture

The large demand drivers





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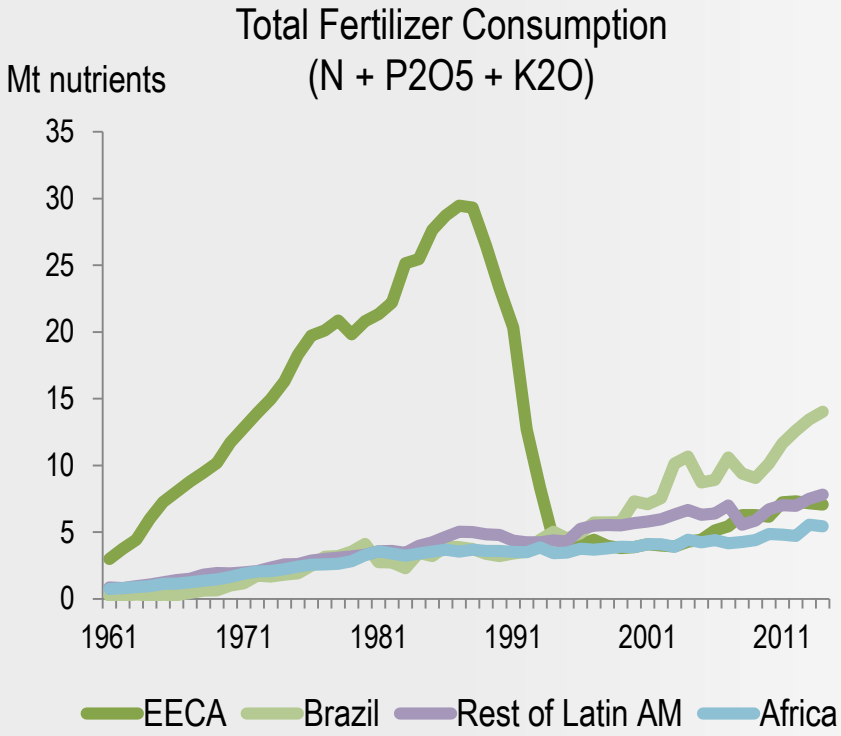
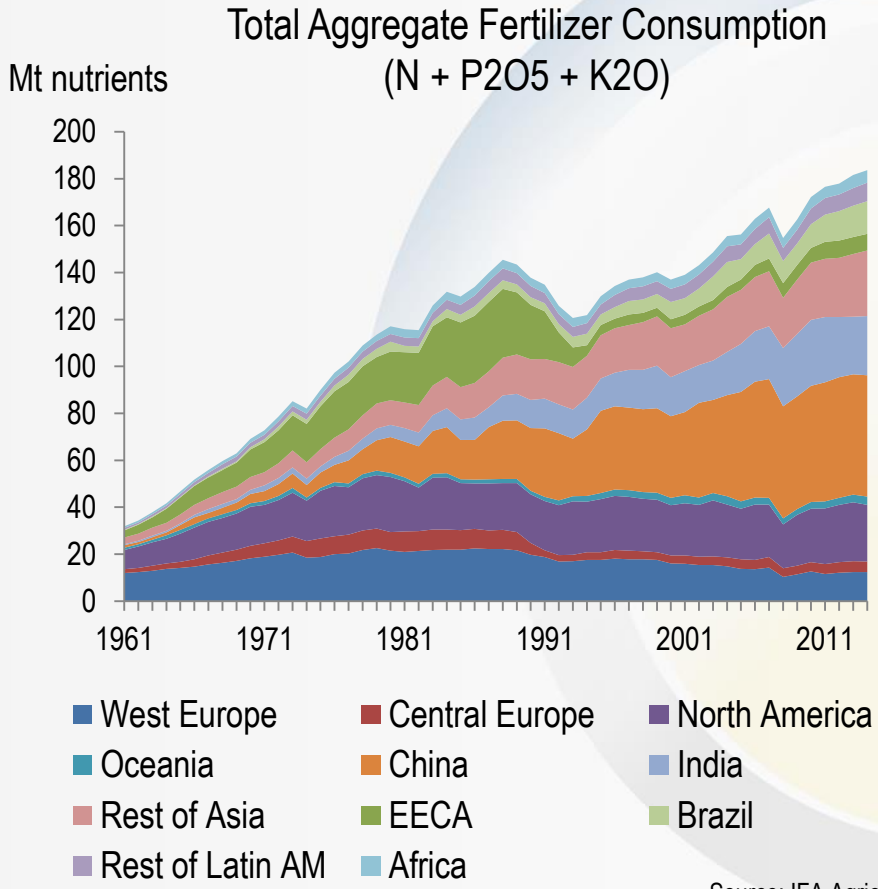
Source: IFA Agriculture

Tomorrow's markets

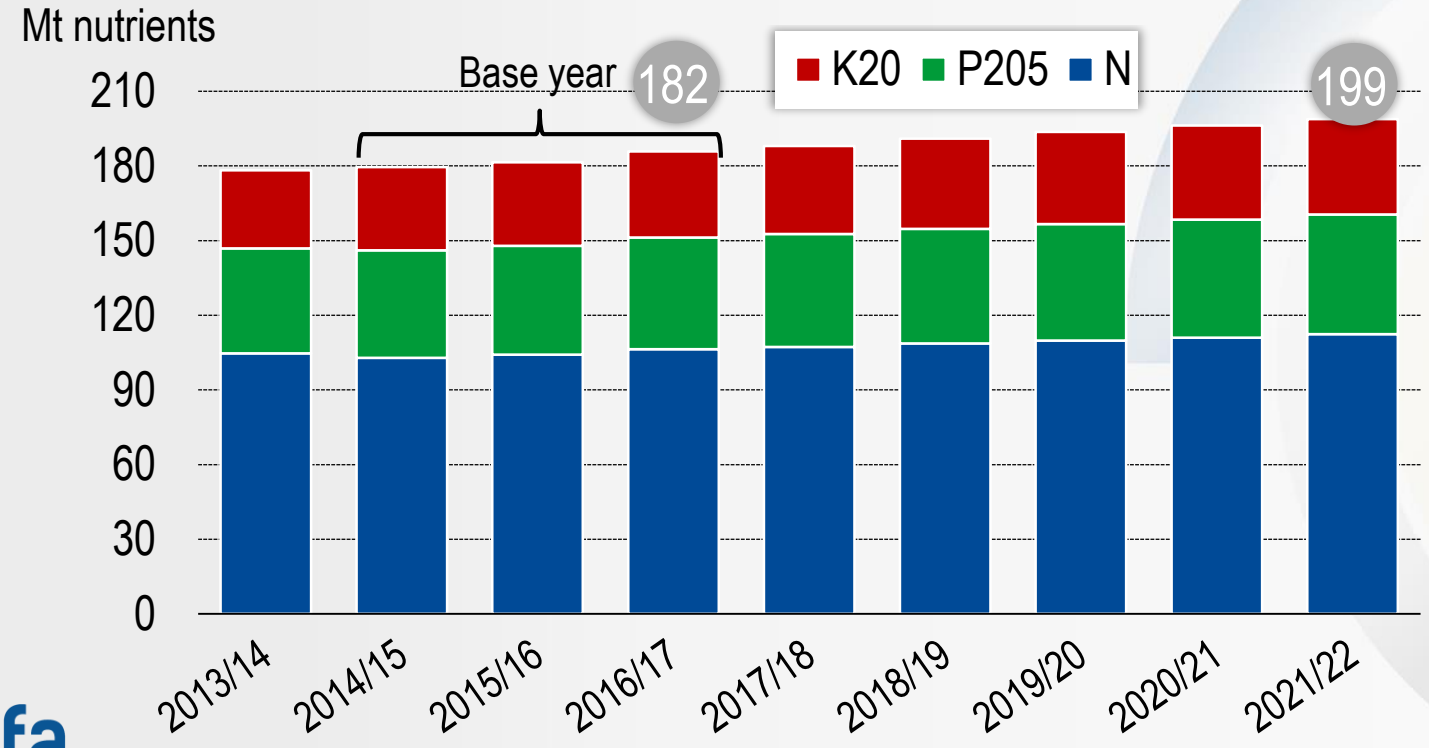




Source: IFA Agriculture

Global demand close to 200 Mt by 2021/22

Evolution of global fertilizer demand



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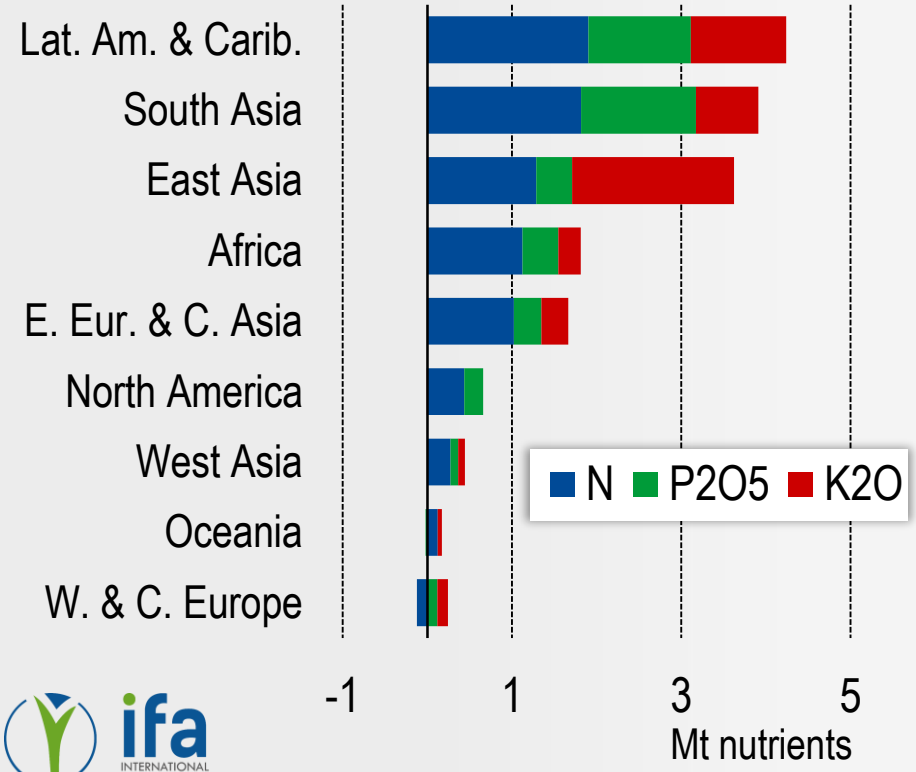
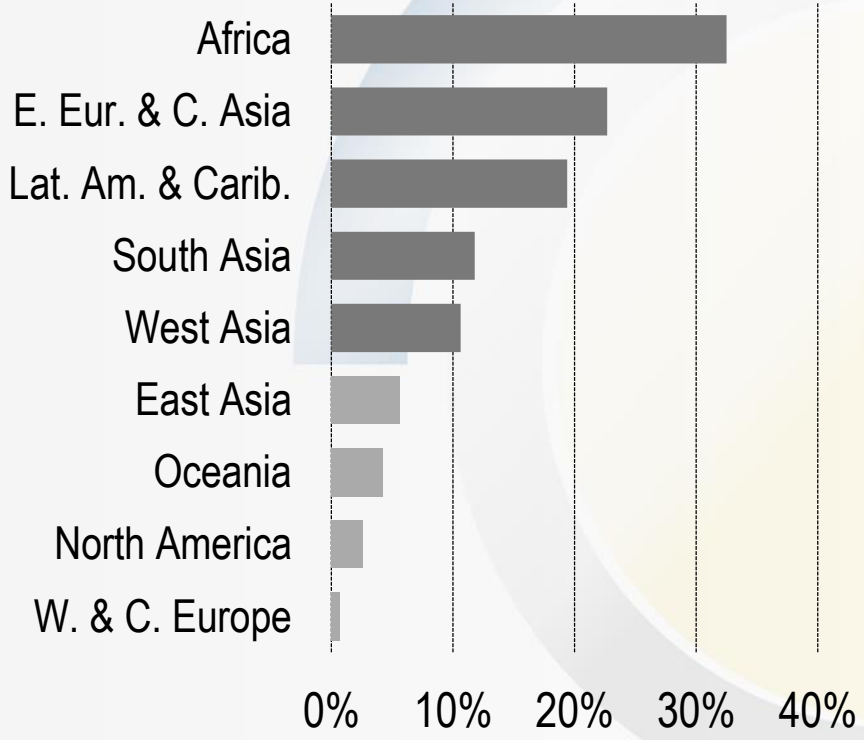
Source: IFA Agriculture

Lat Am, Africa and EECA increasingly influential

Anticipated regional volume expansion by 2021/22



Anticipated relative regional growth by 2021/22



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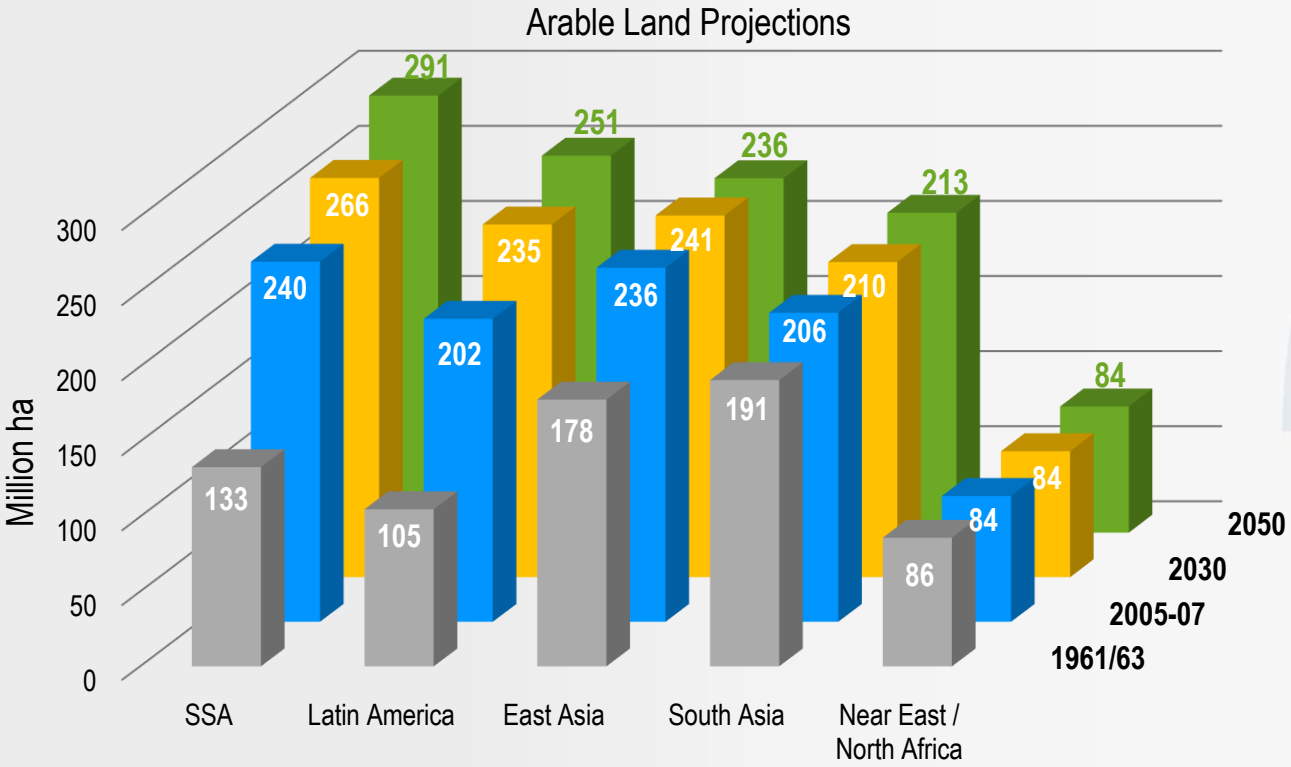
Source: IFA Agriculture

Arable Land will continue to expand in SSA and Latin America



- future increase in global agricultural production largely from increased productivity (FAO).
- "Arable land expansion will remain however an important factor in the growth of crop production in many countries of **Latin America and sub-Saharan Africa** although less so than in the past." (FAO, 2012)
- Latin America: mostly **Brazil and Argentina.**

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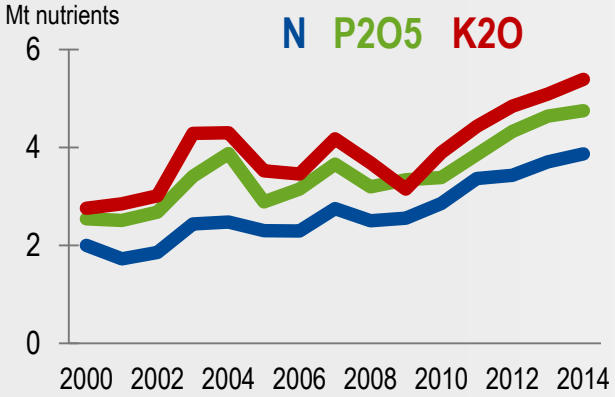
Source: FAO, 2012

Brazil: rising fertilizer use

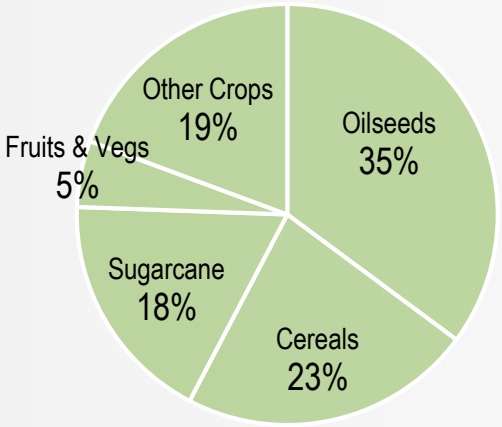
- Largest exporter of soybeans, sugar, beef, poultry, orange juice; 2nd largest exporter of maize
- Soybean, maize and sugarcane account for over 70% of total cropland
- Strong growth in fertilizer consumption (average +3.4%/year during 2004-14)
- Soybean and sugarcane drive P2O5 and K2O use
- Significant yield gaps for maize and wheat

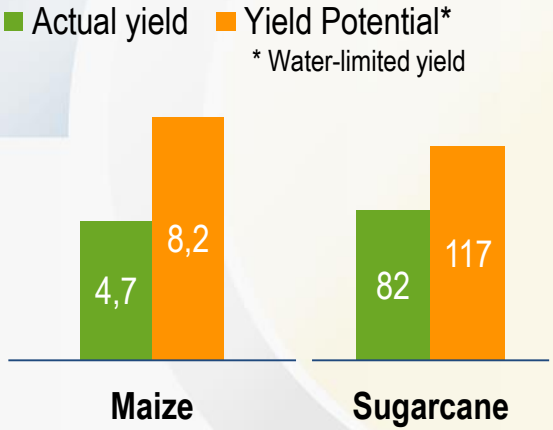
Fertilizer Consumption



Source: IFA Agriculture

Fertilizer Use By Crop (2014)





Source: Marin *et al.* (2013)

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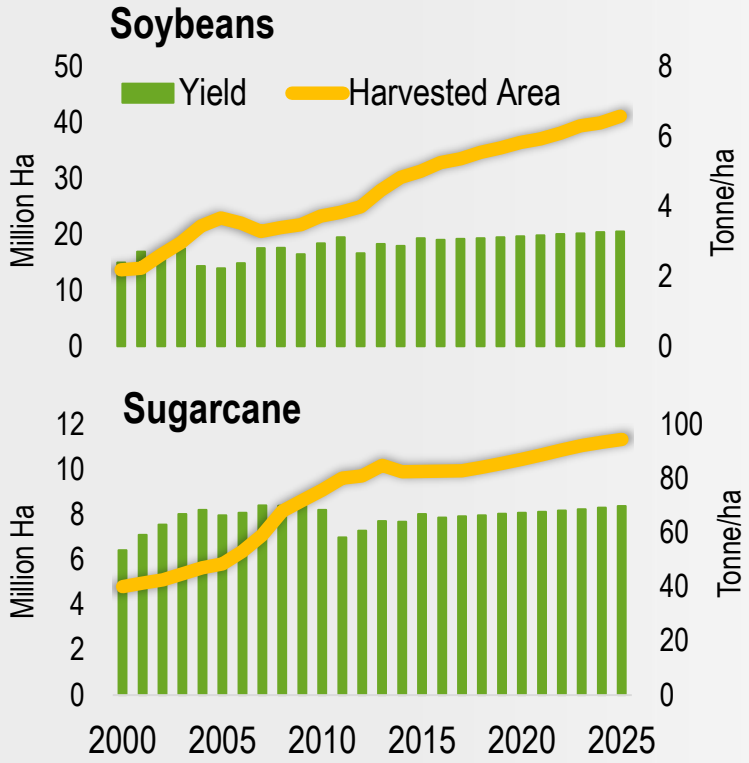
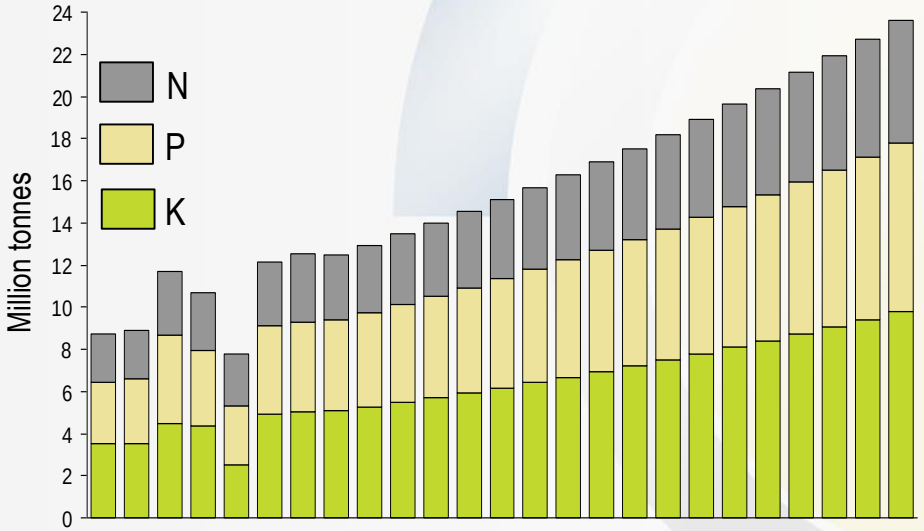
Expanding area will drive fertilizer use and agricultural production



Integer forecasts a significant ramp up in nitrogen, phosphate and potash demand in Brazil between 2011 and 2030



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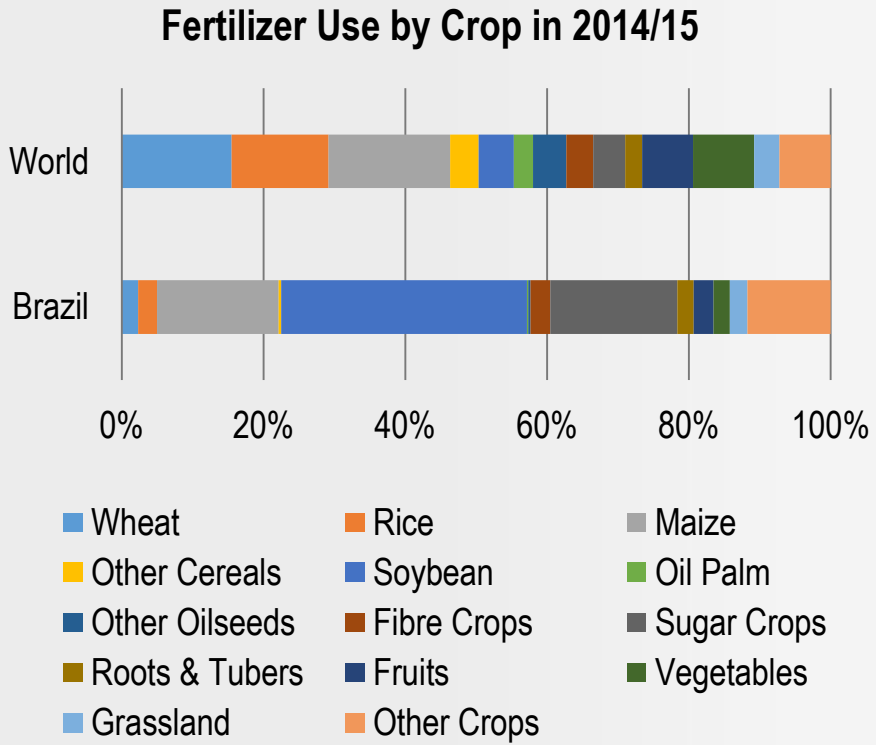
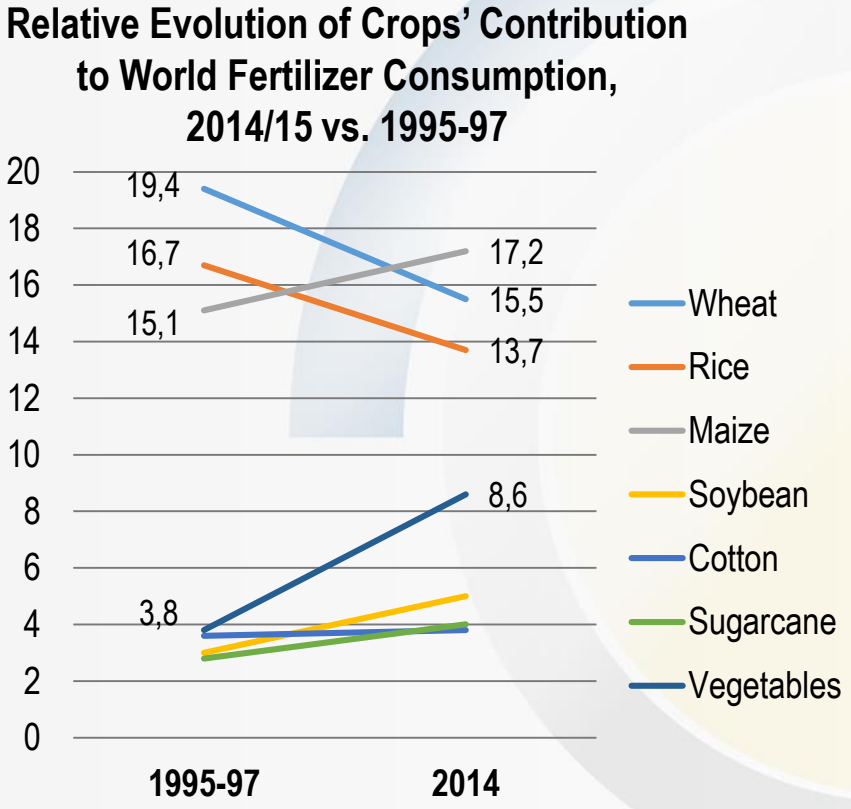
Source: OCDE-FAO (2016)

FUBC over time (World and Brazil)

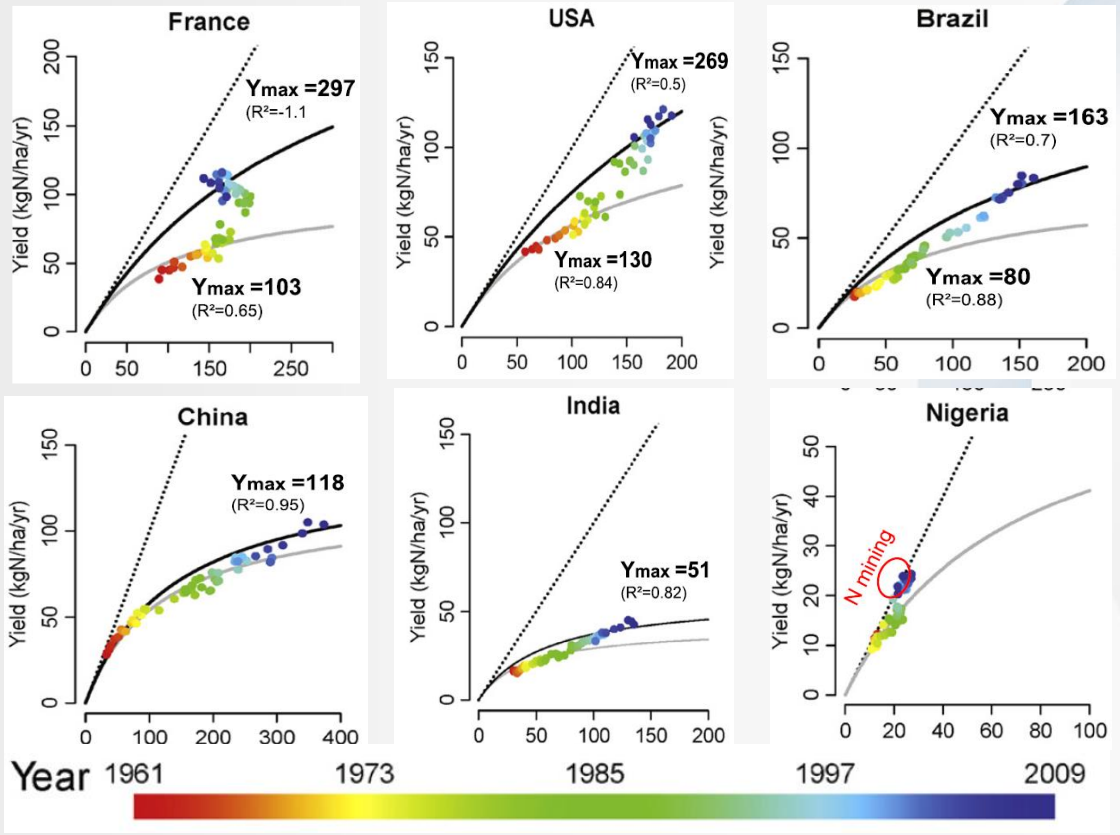




Sources: FAO, 2000 (for 1995-97 data); IFA, May 2017 (for 2014 data)

NUE trends differ among regions

Evolution of N output vs N input (kg N/ha/year) over 1961-2009 in various countries



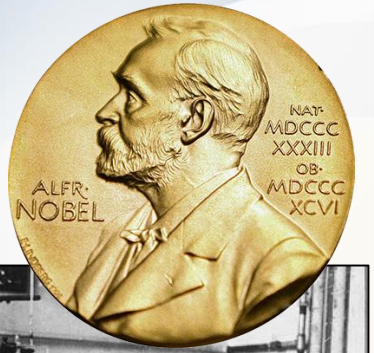
Sources: Lasseletta *et al.*, 2014

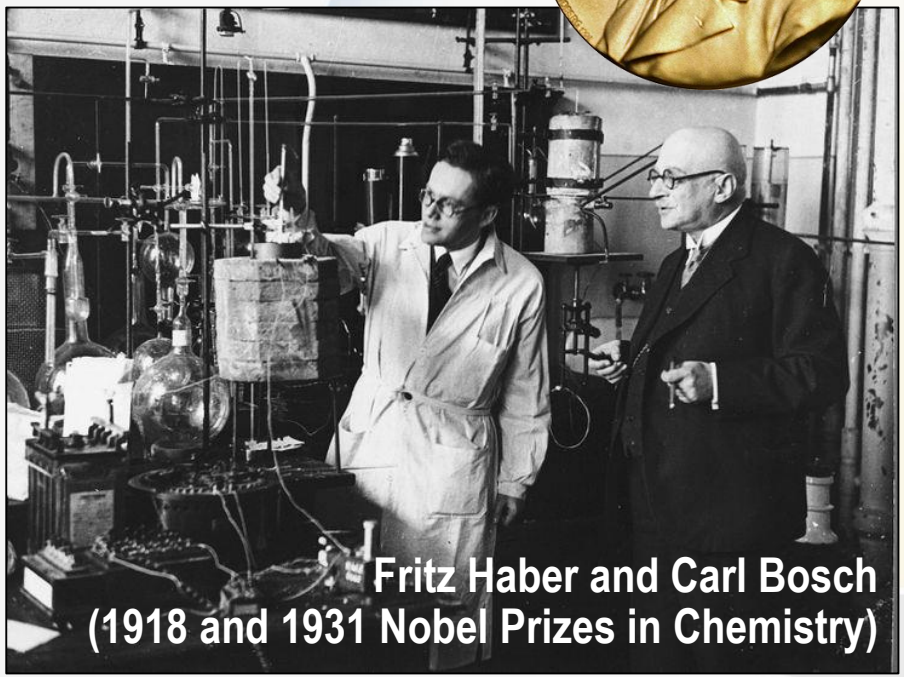
EVOLUTION OF PRODUCTION TECHNOLOGY

Break-through technologies…

Long history of fertilizer development:
the most significant break-throughs
happened in the first half of the last century

- Ammonia (BASF) in 1909
- Urea (BASF) in 1922
- MOP (Carlsbad) in 1932
- DAP (TVA) in 1959





Fritz Haber and Carl Bosch
(1918 and 1931 Nobel Prizes in Chemistry)

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…and further innovations

- Large capacity manufacturing plants
- Improvements in Energy Efficiency
- Improvements in Water Efficiency
- Reduction of GHG from production
- Safety/Product Stewardship
- Fluid bed granulation technology

- NPK Compounds
- Specialty fertilizer products
- Development of fertilizers specifically for sulphur (ammonium sulphate, SOP)

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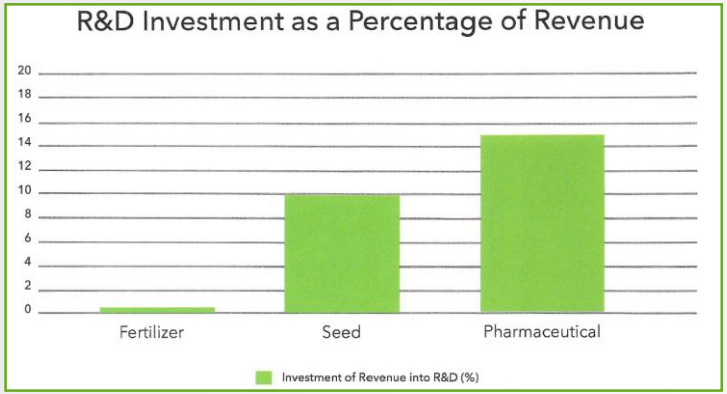
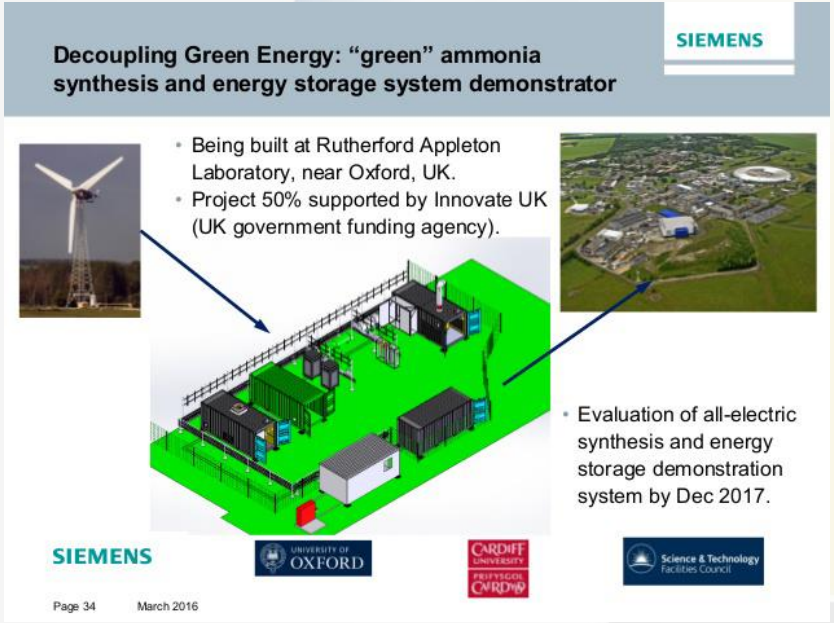
The future of fertilizer development?

- Optimizing BATs & Safety Practices
- Shifting from linear to circular economy?
- “Zero Emissions”
- Searching for “Haber-Bosch Process 2.0”





Green Ammonia (Siemens) in 2017

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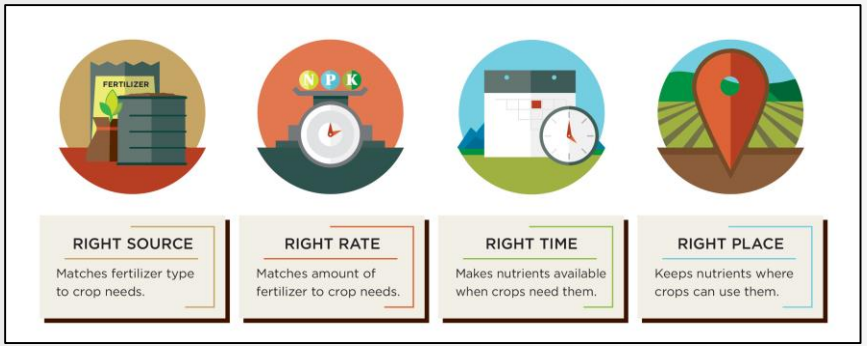
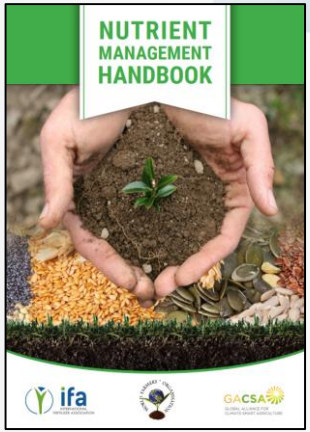
…and innovations in application

- Balanced Nutrition
- Micronutrients
- Integrated Nutrient Management
- Site and Soil Specific Fertilizer Recommendations – “4Rs”



- Soil Mapping
- Precision Agriculture
- Sophisticated Diagnostic Tools
- Big Data



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FOCUS ON FOOD SECURITY / SUSTAINABILITY OVER THE DECADES

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The 1950s-60s

- Period of unprecedented population growth coupled with agricultural intensification
- **Food security** is achieved through the Haber-Bosch process and the innovations of the Green Revolution : high-yielding cereal varieties
- Norman Borlaug “Father of the Green Revolution”- wheat research in Mexico, South East Asia saves billions from starvation

Noteworthy events

- 1960: Establishment of the International Rice Research Institute (IRRI)
- 1961: Creation of the UN World Food Programme, first intervention in Sudan 1963
- 1961: Creation of USAID

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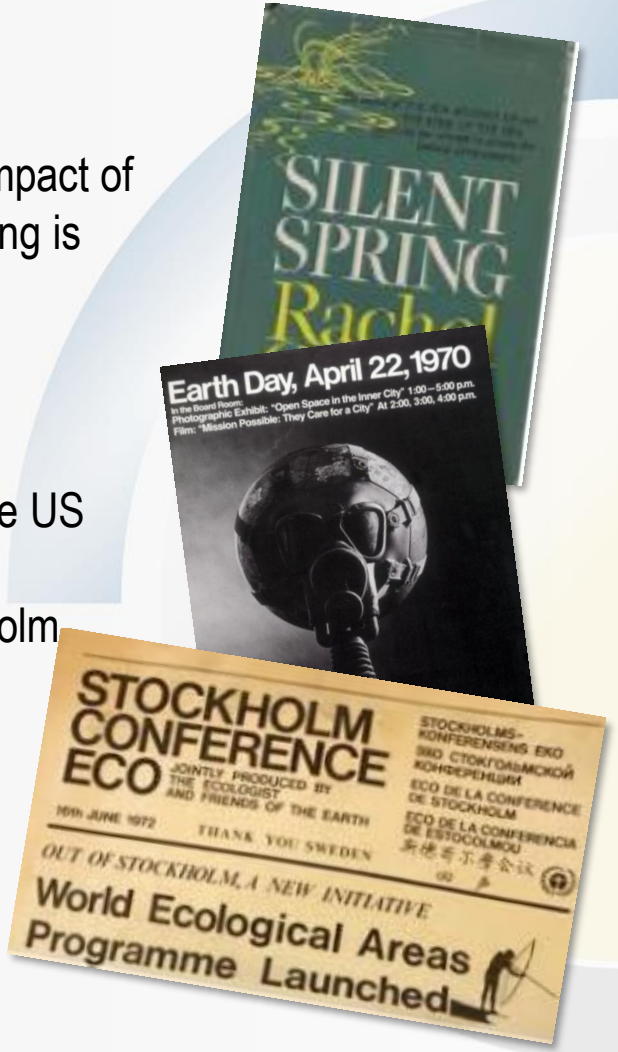
1960s-70s

- 1960s: Nascent environmental movement, concerns about the impact of intensive agriculture on the world's natural resources. Silent Spring is published in 1962.
- Big push for environmental protection in 1970s:
  - 1970: First "Earth Day" in the US
  - 1970: Creation of the Environmental Protection Agency in the US
  - 1972: Creation of the UN Environment Agency
  - 1972: UN Conference on the Human Environment in Stockholm

→ But food security doesn't disappear from the UN Agenda: the UN Committee on Food Security is created in 1974.



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1980s

Food security and climate change dominate the global agenda

CLIMATE CHANGE

- Discovery of holes in the ozone layer
- 1987: Montreal Protocol on Substances that Deplete the Ozone Layer
- 1988: Creation of the IPCC

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

FOOD SECURITY

- "Food comes First" FAO campaigns 1981-83
- Famines: Ethiopia 1984, Sudan 1983-5. USAID, UN agencies provide food and humanitarian relief
- Developed countries' public mobilized on food security through media & music- Band Aid 1984

BAND AID

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1990s

Landmark global agreements on environment and climate change

- **1992** Rio Summit: results in Agenda 21 & the Rio Declaration on Environment and Development
- **1997** Kyoto Protocol, 1st international agreement on reducing GHGs
- **1999** Creation of The Global Programme for Action (GPA) on Marine Pollution

Food Security still prominent on the global agenda

- **1993** UNEP recognizes the benefits of fertilizers
- **1994** FAO launches Special Programme for Food Security (SPFS)
- **1996** FAO organises a World Summit for Food Security

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RIO+20 United Nations Conference on Sustainable Development

2000s-2010s

SUSTAINABLE DEVELOPMENT GOALS

In 2000, adoption of the Millennium Development Goals: Global issues get linked together.

2015: Sustainable Development Goals – Agenda 2030 is adopted.

Food security

→ Food crisis 2007 (rise of food prices)

- 2006 Africa Fertilizer Summit
- 2011 1st meeting of the G20 Agriculture Ministers
- 2012 "Zero Hunger Challenge"
- 2014 UN International Year of Family Farming
- 2015 International Year of Soils
- 2016 UN Year of Pulses

Climate change

- Paris Agreement 2015: 195 countries ratify

Safety

High-profile fertilizer incidents

- 2001: Toulouse
- 2013: West Texas

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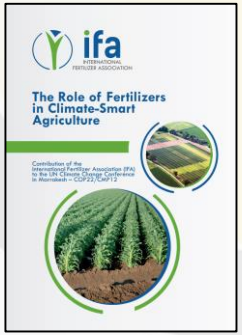
Fertilizer Industry response

- The fertilizer industry wasn't caught in the middle of food security vs. environmental protection debate, **but tackled both proactively**
- Active Engagement with UN Bodies and Initiatives
- Emphasis on Nutrient Stewardship…
- …and Product Stewardship "Protect&Sustain"
- SHE **Benchmarking**

protect&sustain
IFA'S PRODUCT STEWARDSHIP INITIATIVE



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Scenario planning - What and Why?

- Try to make sense of a fast changing world by examining the most significant factors likely to influence our environment and their implications for the fertilizer industry.
- Scenarios can help IFA members to prepare for, shape and thrive in the reality that eventually unfolds…
- …and help ensure IFA's value proposition to its members.

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IFA 2030 Roadmap

- Broad engagement with members and external stakeholders / influencers to compile set of factors likely to influence our environment.
- Classifying factors in terms of likelihood & impact and develop multiple scenarios.
- Discuss and examine implications of scenarios for the fertilizer industry: how to stay profitable and maintain a license to operate?
- Useful Tool Kit for honing IFA members' strategies.
- Final Step: How can IFA most effectively help?

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IFA 2030 Roadmap

- 1.5 year long process to engage in dialogue, examine factors, develop scenarios and arrive at recommendations – with guidance from an experienced consultant
- IFA2030 Strategy Council (IFA Executive Board, Committee Chairs +1), IFA2030 Strategy Task Force (representatives of Strategy Council members) and IFA2030 Advisory Board
- IFA2030 SC + TF meeting:
  13 November, 2017 Zuerich
- IFA Ag/CPA – January 29-31, 2018
  PIT – March 6-9
  Tech Symposium – April 9-12
- IFA2018: Report on Scenarios and Considerations for Industry
- Strategic Forum 2018: Considerations for IFA

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Seeking answers

- How does the industry need to adapt in order to remain profitable and maintain its licence to operate?
- Who do we want to be, what do we want to do, how do we want to get there?
- What's the role of other stakeholders?

- **How can IFA help us get there?**

Promoting Global Food Security and Safeguarding the Environment

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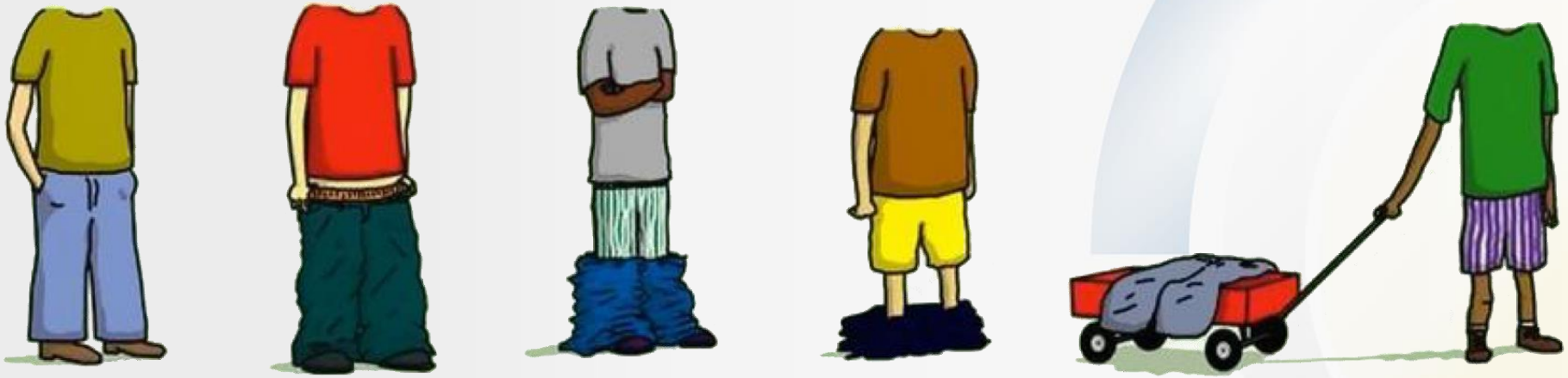
…and a last look at fashion trends



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