The Development of the Fertilizer Industry in the last 50 Years

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- Evolution of Production Technology, trends in energy efficiency, emissions and safety
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ifa2030
On a funny note...
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
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.


- 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).
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).

Source: IFA Production & International Trade, 2017
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)

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

Source: IFA Production & International Trade, 2017
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

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 P₂O₅

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

POTASSIUM
Mt K₂O

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

Source: IFA Production & International Trade, 2017
Global urea trade

**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

Source: IFA Production & International Trade, 2017
- 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)

Source: IFA Production & International Trade, 2017
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%).

Source: IFA Production & International Trade, 2017
Brazil: rising imports toward 2021

- 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

- 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

- 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
EVOLUTION OF FERTILIZER DEMAND
Global Fertilizer Consumption
multiplied by 6 since 1960

Mt nutrients


N P2O5 K2O

FSU collapse

1961 109.8
2014 109.8

N 11.8 11.0 41.8 8.8
P2O5 32.6
K2O 32.6

Source: IFA Agriculture
The mature markets

Source: IFA Agriculture

Total Fertilizer Consumption
(N + P₂O₅ + K₂O)

Mt nutrients


West Europe  Central Europe  North America  Oceania

Total Aggregate Fertilizer Consumption
(N + P₂O₅ + K₂O)

Mt nutrients


West Europe  Central Europe  North America  Oceania

Source: IFA Agriculture
The large demand drivers

Total Fertilizer Consumption (N + P2O5 + K2O)

Mt nutrients


- China
- India
- Rest of Asia

Source: IFA Agriculture

Total Aggregate Fertilizer Consumption (N + P2O5 + K2O)

Mt nutrients


- West Europe
- Central Europe
- North America
- Oceania
- China
- Rest of Asia

Source: IFA Agriculture
Tomorrow’s markets

Total Fertilizer Consumption (N + P2O5 + K2O)

- EECA
- Brazil
- Rest of Latin AM
- Africa

Total Aggregate Fertilizer Consumption (N + P2O5 + K2O)

- West Europe
- Central Europe
- North America
- Oceania
- China
- India
- Rest of Asia
- EECA
- Brazil
- Rest of Latin AM
- Africa

Source: IFA Agriculture
Global demand close to 200 Mt by 2021/22

Evolution of global fertilizer demand

Mt nutrients

Source: IFA Agriculture
Anticipated regional volume expansion by 2021/22

-1 1 3 5
Mt nutrients

Lat. Am. & Carib.  South Asia  East Asia  Africa  E. Eur. & C. Asia  North America  West Asia  Oceania  W. & C. Europe

Anticipated relative regional growth by 2021/22

Africa  E. Eur. & C. Asia  Lat. Am. & Carib.  South Asia  West Asia  East Asia  Oceania  North America  W. & C. Europe

N  P2O5  K2O

Source: IFA Agriculture
Arable Land will continue to expand in SSA and Latin America

Source: FAO, 2012

- 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.
Largest exporter of soybeans, sugar, beef, poultry, orange juice; 2\textsuperscript{nd} 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 \textit{et al.} (2013)
Expanding area will drive fertilizer use and agricultural production

Soybeans
- Yield
- Harvested Area

Sugar cane

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

Source: OCDE-FAO (2016)
FUBC over time (World and Brazil)

Fertilizer Use by Crop in 2014/15

- World
- Brazil

Relative Evolution of Crops’ Contribution to World Fertilizer Consumption, 2014/15 vs. 1995-97

- Wheat
- Rice
- Maize
- Soybean
- Cotton
- Sugarcane
- Vegetables
- Other Cereals
- Other Oilseeds
- Other Crops
- Grassland
- Roots & Tubers
- Fruits
- Fibre Crops
- Sugar Crops

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)
...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)
The future of fertilizer development?

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

Decoupling Green Energy: “green” ammonia synthesis and energy storage system demonstrator

- Being built at Rutherford Appleton Laboratory, near Oxford, UK.
- Project 50% supported by Innovate UK (UK government funding agency).
- Evaluation of all-electric synthesis and energy storage demonstration system by Dec 2017.
...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
FOCUS ON FOOD SECURITY / SUSTAINABILITY OVER THE DECADES
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
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.
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

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
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

1990s

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
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
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
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.
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?
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
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?

Promoting Global Food Security and Safeguarding the Environment

How can IFA help us get there?
…and a last look at fashion trends