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ifa INTERNATIONAL FERTILIZER ASSOCIATION

Assessment of the global market for special products

Prepared for IFA by RAMS & Co

IFA Annual Conference June 11th, 2019

☐ *Final document*
☐ *Draft document*
☐ *Internal use only*
☐ *Highly confidential*

Agenda

Introduction to RAMS & Co

Approach

Outcome overview

Key findings

Introduction to RAMS & Co

Strategy boutique focused on mining, metals, and materials

Strategy consulting boutique

Based in Paris

Incorporated in 2012

Strategy focus

Corporate strategy
- Business portfolio allocations
- Growth strategies
- Corporate resilience enhancement
- Value creation and extraction
- M&A / partnerships support

Business strategies
- Competitive differentiation
- Growth strategies
- Market oriented capex flexibility
- Value chain integration
- Innovation and R&D portfolio

Commercial excellence
- Strategic marketing
- Route to market optimization
- Value-in-use and pricing
- Go-to-market organization

Help building differentiated and resilient growth stories

Resources / heavy industries focus

Energy resources
- Oil & gas
- Uranium

Mining and metals
- Iron ore / Manganese
- Carbon and stainless steels
- Non-ferrous metals (copper, zinc, nickel)
- Bauxite and aluminum

Chemicals
- Chlor-alkalis / soda ash
- Petchems
- Coatings (TiO_2, adhesives, pigments, …)
- Specialty chemicals

Materials
- Cement
- Industrial minerals (kaolin, talc, clays, …)
- Refractories / advanced ceramics

Cross-fertilize business and technical knowledge

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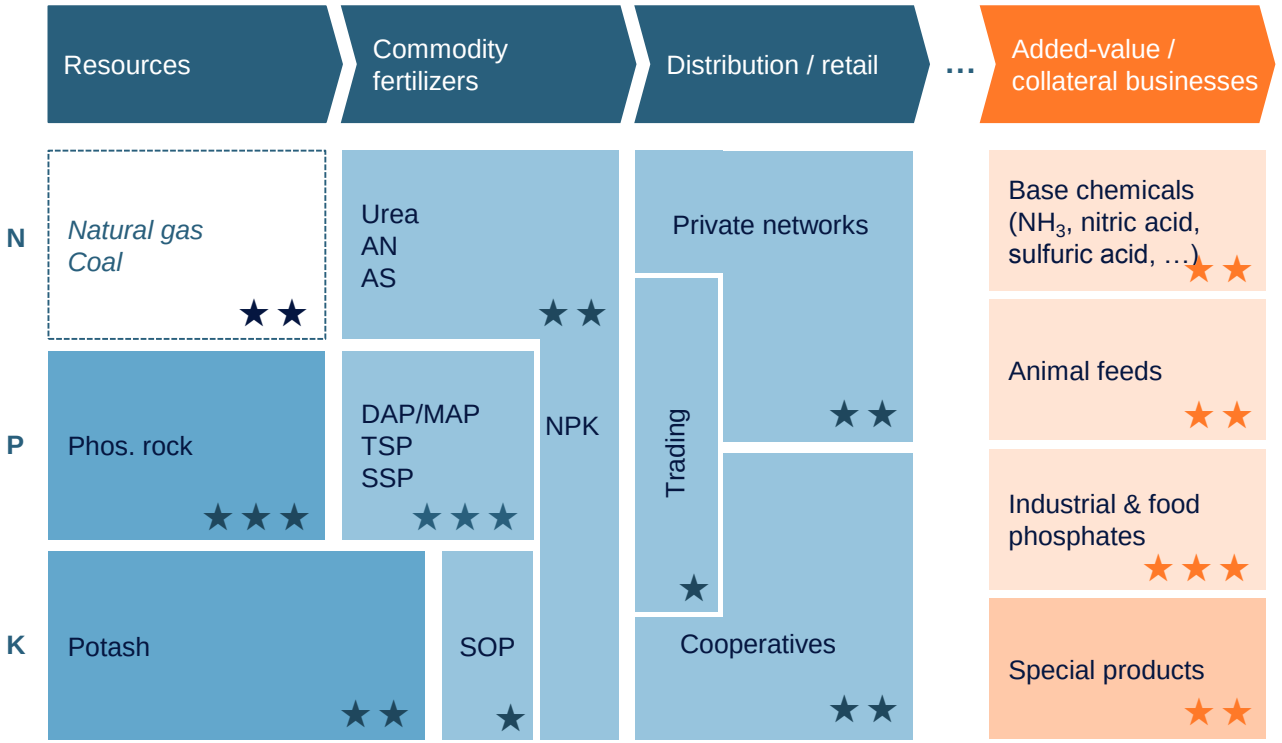
Introduction to RAMS & Co – Fertilizer industry experience

A 15-yr experience in the fertilizer industry



+ financial institutions:

- Private equities
- Sovereign funds

Recurrent topics

- Resource access
- Cycle-resilient growth (market agility)
- Disciplined capacity management
- Upstream / downstream integrations
- Routes-to-market (distribution or not)
- Partnerships to secure value (over volume)
- De-commoditization: new products / pricing premium
- Pricing (value-in-use, long term / volume contracts)
- Industrial / specialty markets development

★ ⋯ ★★★ *RAMS & Co's business coverage*

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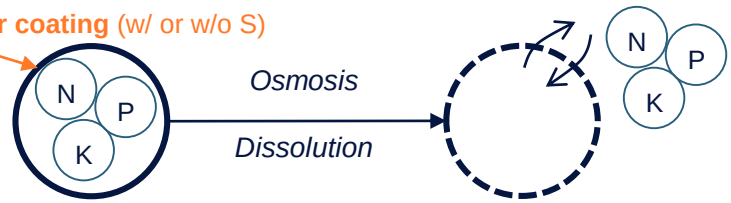
Key findings

Special products – Why's and how's

Special products bring additional services to the plant or the farmer by several ways: by enhancing nutrient availability, slowing down bacteria activity, bringing exact nutrients needs…

	Why's	Mode of action
Controlled release (CRF)	Control nutrient release to adapt to differential plants' needs during growth, over weeks to months	**Polymer coating** (w/ or w/o S) 
Sulfur coated (SCU)	Slow down nitrogen release over days to weeks, and bring sulfur in the long run	
Slow release (SRF)	Slow down nutrient release to fit plants' needs, over days to weeks	**Urea-based polymer** —*Microbial activity / Hydrolysis*→ Available N for plants
Stabilized nitrogen fertilizers (SNF)	Control enzyme and/or bacteria activity, to increase yield and enable nitrogen application savings	Urea —Urease inhibitor→ Ammonium (NH_3) —Nitrification inhibitors→ Nitrates → Leaching
Water soluble (WSF)	Optimize nutrient application while irrigate crops. Applied in high-tech hydroponics, micro drip irrigation, or fertigation systems	***Solid*** form, ***entirely soluble*** in water to avoid clogging
Liquid fertilizers	Use in fertigation, soil or foliar application systems	***Liquid*** form — Applied directly through fertigation systems
Micronutrients	Bring micronutrients (Zn, B, Mn, Cu, Fe, Mo), in ionic form (mostly sulfates) to improve crops quality and yields	***Sulfates, oxides*** form: secondary / micro-nutrient directly available to the plant
Chelated micronutrient	Bring micronutrients (Zn, B, Mn, Cu, Fe, Mo), in chelated form to improve transport and availability to the plant	***Chelated*** form: Chelating agent + Fe^{2+} (Ion) → Chelate —*Transport / Ion freeing*→ Fe^{2+}

Special products – Scope

CRF/SRF/SCU/SNF (UI+NI), water soluble solid CN/MAP/MKP/NOP/SOP, liquid fertilizers and micronutrient (chelates & boron) were assessed.

In scope

Out for now

Controlled release (CRF)	Polymer coated fertilizers, polymer-sulfur coated (urea, NPK, …)		
Sulfur coated (SCU)	Sulfur coated fertilizers (urea, NPK, …)		
Slow release (SRF)	UF/MU/IBDU/CDU …		
Stabilized nitrogen fertilizers (SNF)	Urease inhibited (NBPT, NPPT, …)		
	Nitrification inhibited (DCD, DMPP, ..)		
	Neem coated		*Only applied in India*
Water soluble (WSF)	CN, MAP, MKP, NOP, SOP	NPK	***Focus on "straight" nutrient, whether further blended into NPK or not***
	$Mg(NO_3)_2$ / $MgSO_4$		
Liquid fertilizers	CN/HNO_3/ H_3PO_4/KTS ….	Liquid NPKs	***New category in 2018 update*** ***Focus on liquid NPKs in North America***
Micronutrients	Boron		***New category added in 2018 update***
	Other micronutrients (Zn, B, Mn, Cu, Mo)		*Other micronutrients left for latter analysis*
Chelated micronutrient	Chelated micronutrients (Fe, Zn, Mn Cu)		***New category added in 2018 update***

Geographies

- All majors countries for assessment build-up
- Communicated as per IFA's geographical aggregates

Metrics

- Volumes (product and nutrients)
- Current market size
- *Temptative dynamics*

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Approach – Data collection & interviews

We developed a market assessment "*pièce à casser*" to create a momentum with members and optimize their contributions. Special product market coverage reaches 75%.

Phase I – "internal" market assessment *(Nov-Dec '18)*

- End-users interviews (coops, retailers, …)
- IFA sources / experts
- Market studies
- Trade data
- Players PR/IR communications

Modeling

First "pièce à casser"

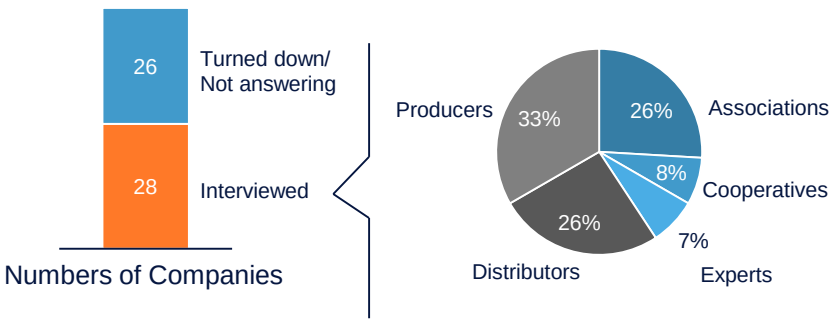
- ***High level estimates of market sizes***
- ***Key countries / regions estimates***
- ***Identification of drivers shaping the demand***

Phase II – sharing/challenging with members *(Jan-Feb '19)*

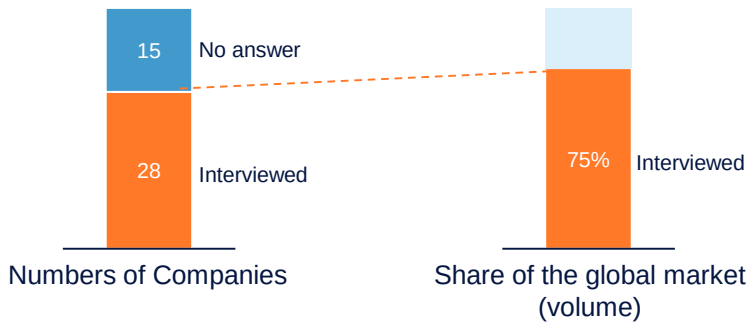
"Early members"' contributions
- Meetings
- Interviews

Market assessment V0

External interviews
(10/18-03/18, IFA special products initiative 1st phase)



WG members interviews
(12/18-05/19, IFA special products initiative 2nd phase)



Source: interviews, RAMS & Co analysis

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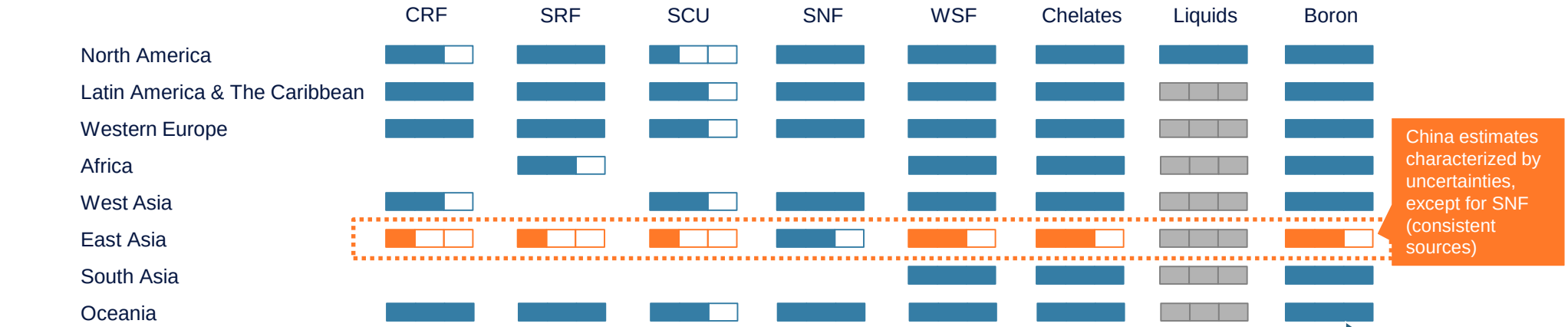
Confidence level in estimates, by region

Except for China, several and various sources were available (trade stats, interviews, market studies, web), leading to reliable market estimates

Level of confidence in market estimates by region and by product
(2018)



CRF
- Transparent trade stats
- Publicly available data
- Consistent feedback from interviews

SRF
- Transparent trade stats
- Consistent feedbacks from interviews
- Only few available market studies

SCU
- Very few and non transparent trade stats
- No SCU player interviewed
- Feedback from CRF interviewees

SNF
- Numerous and consistent trade stats
- Numerous interviews from non-members
- Consistent feedbacks from interviews

WSF
- Numerous, transparent and consistent trade stats
- Consistent feedback from interviews

Boron
- Numerous, transparent and consistent trade stats
- Consistent feedback from interviews

Source: trade stats, interviews, various publications, RAMS & Co analysis

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Overview – Key drivers

Five key drivers of special products demand have been identified.

Base drivers

Base fertilizer	Cropping systems	Soils & climate conditions	Regulation	Value-in-use
Special products used as substitutes / additives to commodity fertilizers	Technical constraints and specific objectives related to a given cropping systems favoring SP adoption	• Nutrients availability to be ensured in specific soils & climate conditions • Special products efficiency depending on soils & climate conditions	Environmental regulations aiming at lowering global warming, or protecting the environment likely to impact SP adoption (both ways)	Positive balance between cost premium and agronomic, economic and environmental benefits (improved nutrient availability and yields, fertilizer and labor costs savings, less clogging, lower GHG emissions, enhanced water quality)
SNF	WSF, Liq., Chel., SRF, CRF	SNF, Chel., Bor.	CRF, SNF, WSF	All
Illustrative examples				
Urease / nitrification inhibitors used with N-based fertilizers (urea, NH_3, UAN)	• SRF / SCU mostly applied in turf & landscape • WSF applied in high-tech drip irrigation systems (glasshouse hydroponics, tunnel horti)	• Micronutrients (boron, chelates) applied in deficient soils • NBPT (urease inhibitor) lower efficiency in acid & high temperature soils	• European regulation likely to limit CRF application • *0 growth strategy* in China favoring SP adoption	• CRF applied in Japan to save labor costs by lowering application frequency • SNF applied to maximize nutrient availability, hence yield

Source: trade stats, interviews, various publications, RAMS & Co analysis

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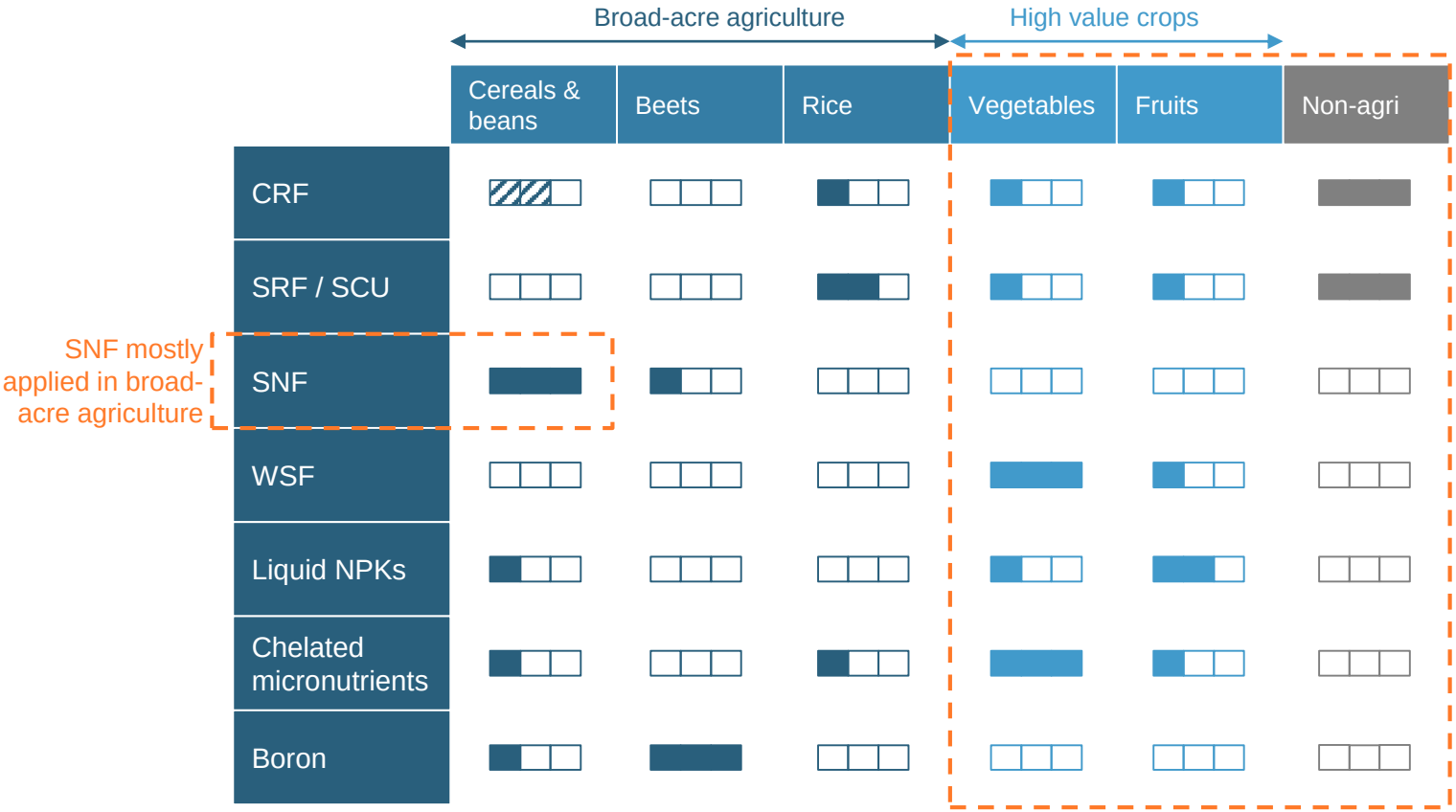
Special products and their use in specific cropping systems

Most of special products are currently applied in high value crops, turf and landscape, except for some exceptions that could serve as examples for SF de-commoditization.



Special products mostly applied in crops where cost premium might be justified:

- **High value crops**;
- **Horticulture**;
- **Non-agri applications** (turf, landscape, horti, …)

- Few exceptions:
  - One CRF product applied in broad-acre agriculture;
  - CRF being currently tested in palm oil (Indonesia), sugar cane (Brazil & Australia);
  - SRF applied in rice in China;
- Micronutrients (chelated or not) applied in deficient soils & for highly sensitive crops

Source: trade stats, interviews, various publications, RAMS & Co analysis

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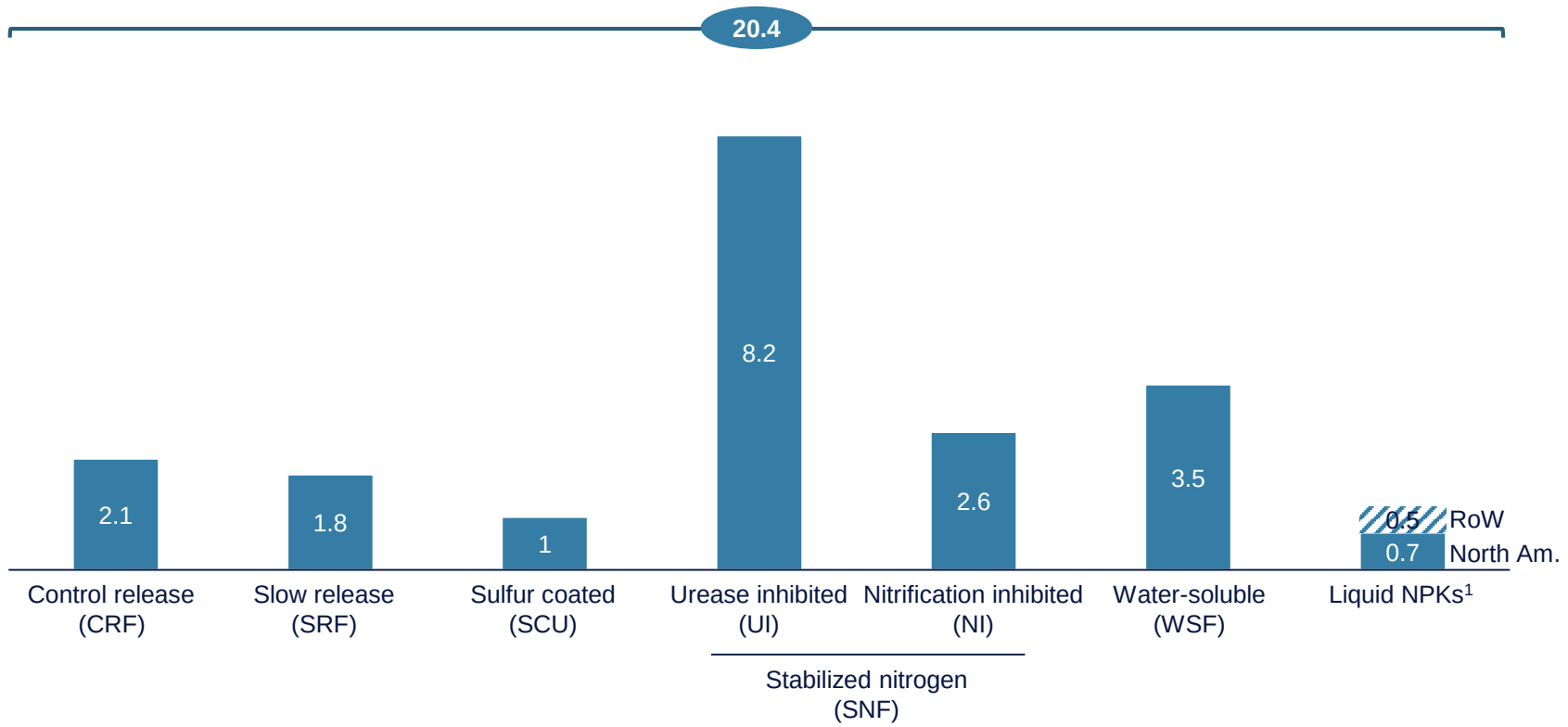
Overview – Demand by category (1/2)

Special products consumption in 2018 reaches 20.4 Mt product.

Special products demand, by category
(Mt product, 2018 estimates)



(1) NA / RoW distinction only true for liquid NPKs. RoW high level estimate
Source: various publications, interviews, trade stats, RAMS & Co analysis

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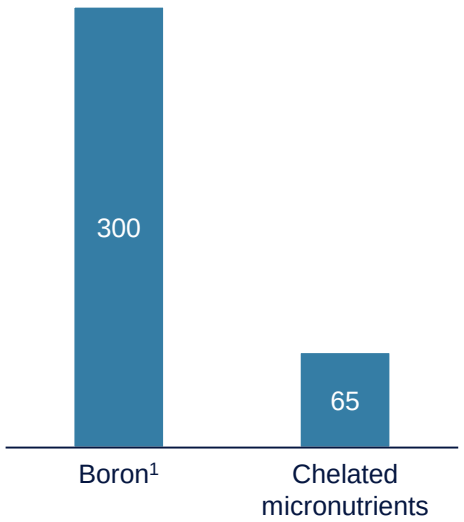
Overview – Demand by category (2/2)

Boron application in agriculture reaches 300 kt B2O3 (~15% of global B consumption). Global demand for chelated micronutrients reaches ~65 kt (dry product).

Special products demand, by category
(kt, 2018 estimates)



(1) Boron in kt B_2O_3
(2) Chelates in kt dry product
Source: various publications, interviews, trade stats, RAMS & Co analysis

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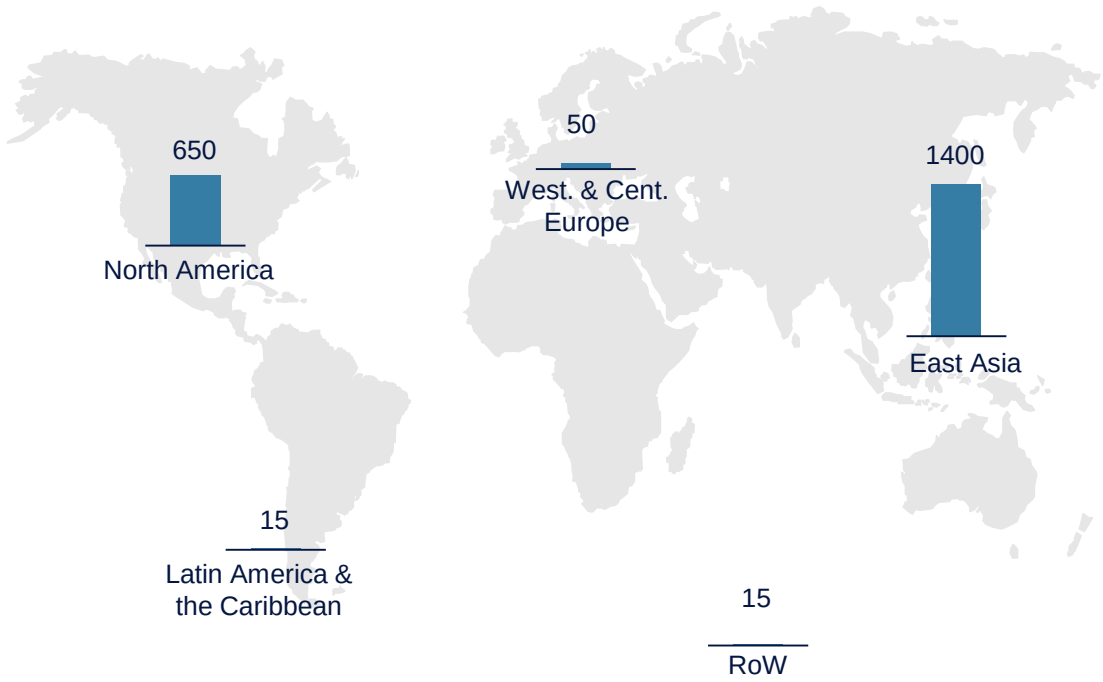
Overview – CRF demand by region

Global CRF demand reaches 2.1 Mt product in 2018, mostly supported by China, and the use of one CRF product in broad acre agriculture in North America.

CRF consumption by region
(product kt, 2018 estimates – regional total figures)



North America

- One lower cost product applied in broad-acre agriculture, mostly corn

China

- CRF applied in NPK blends to lower cosr and make it accessible to cash-limited farmers

Europe

- New regulation on polymer biodegradability likely to limit CRF demand in the medium term

CRF potential in plantations

- Tests currently being carried out in palm oil (Indonesia), and in sugar cane (Brazil, Australia)

Source: various publications, interviews, trade stats, RAMS & Co analysis

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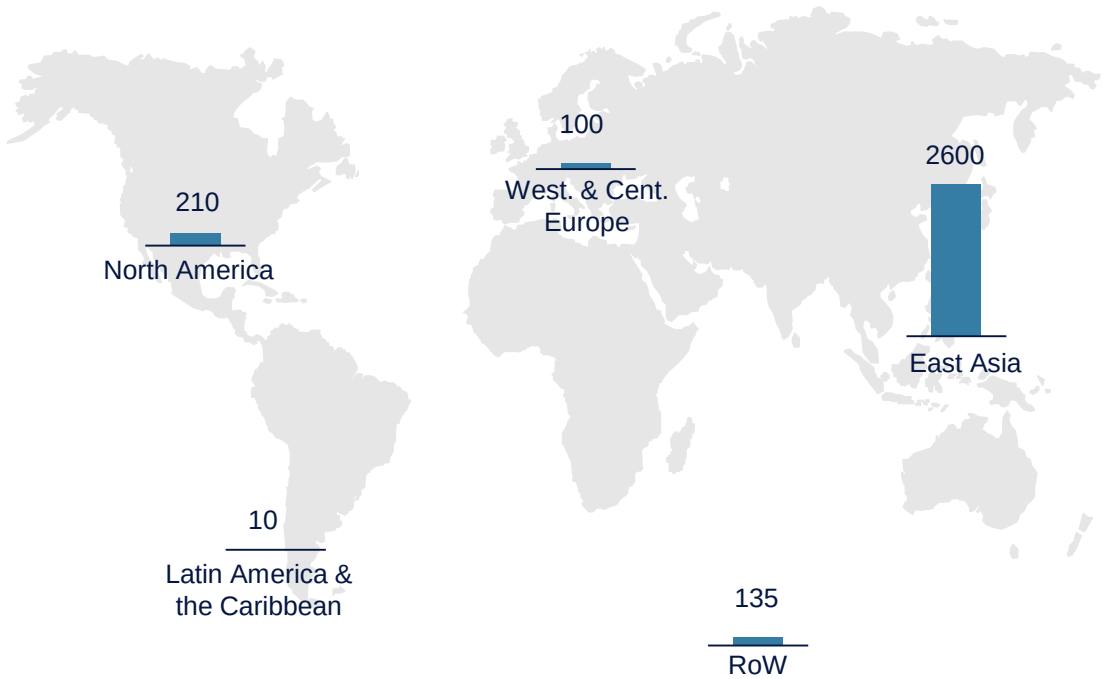
Overview – SRF & SCU demand by region

SRF & SCU demand reaches 2.8 Mt, mostly in China (~90% of global demand), driven by professional and consumer turf.

SRF & SCU consumption by region
(product kt, 2018 estimates – regional total figures)



SRF / SCU in non-agri applications

- Mostly applied in non-agriculture applications (turf, landscape, sport fields, …)
- Key markets in developed countries with mature consumer, golf courses, and other turf markets

Specific case of China

- SRF applied in NPK blends in China to lower cost premium
- As well, SRF applied in rice in South East China

SCU integrity issues

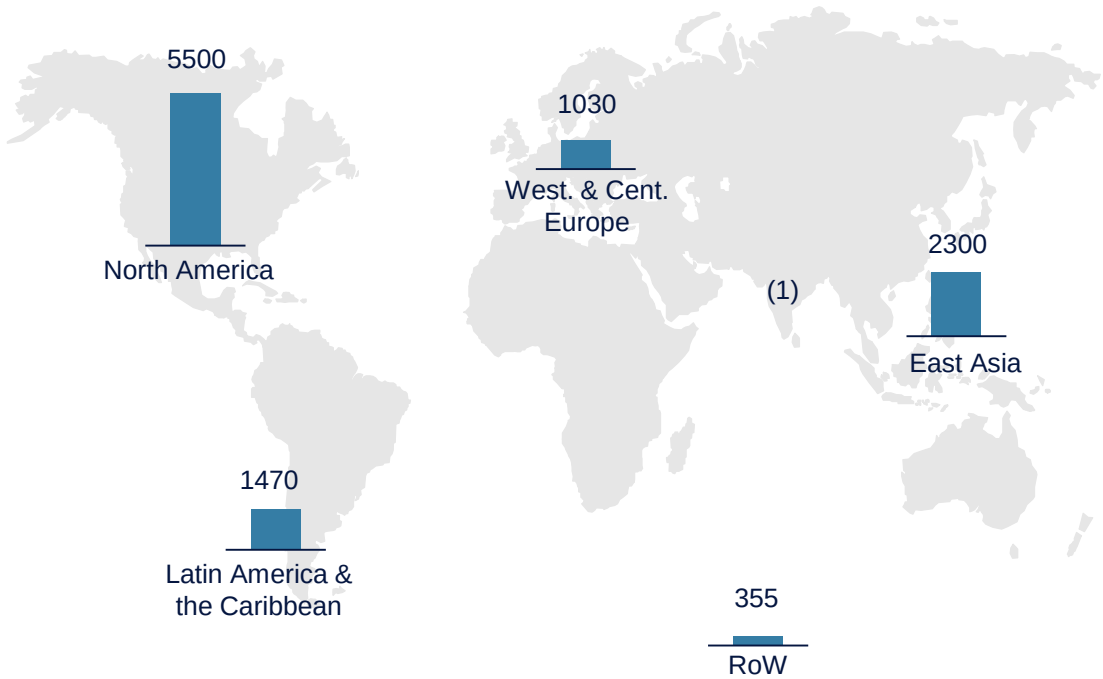
- SCU still struggling with integrity issues, especially during transport

Source: various publications, interviews, trade stats, RAMS & Co analysis

Overview – SNF demand by region

SNF global consumption is estimated at 10.7Mt product (8.2 UI-treated and 2.6 NI-treated). Maturity rates vary widely from a country to another and depends on local specificities

SNF consumption by region
(product kt, 2018 estimates – regional total figures)



Urea / NH_3 market size

- Very large urea market in China
- Large urea / NH_3 market in North America
- Large and growing urea market in Brazil
- Small urea market in Europe

Varying maturity rate among regions

- Historical development of urease / nitrification inhibitors in North America, with large-scale, economic driven farming inclined to use special products, hence high penetration rates
- In Brazil, innovative, large-scale, economic driven farming inclined to apply special products
- No adoption rate take-off in China yet

Regulations

- Growing penetration rate, supported by *RenovaBio* regulation
- 0 growth strategy in China favoring SNF use
- Complex registration process hindering SNF development

(1) Indian consumption of NCU reaches ~30 Mt product

Source: various publications, interviews, trade stats, RAMS & Co analysis

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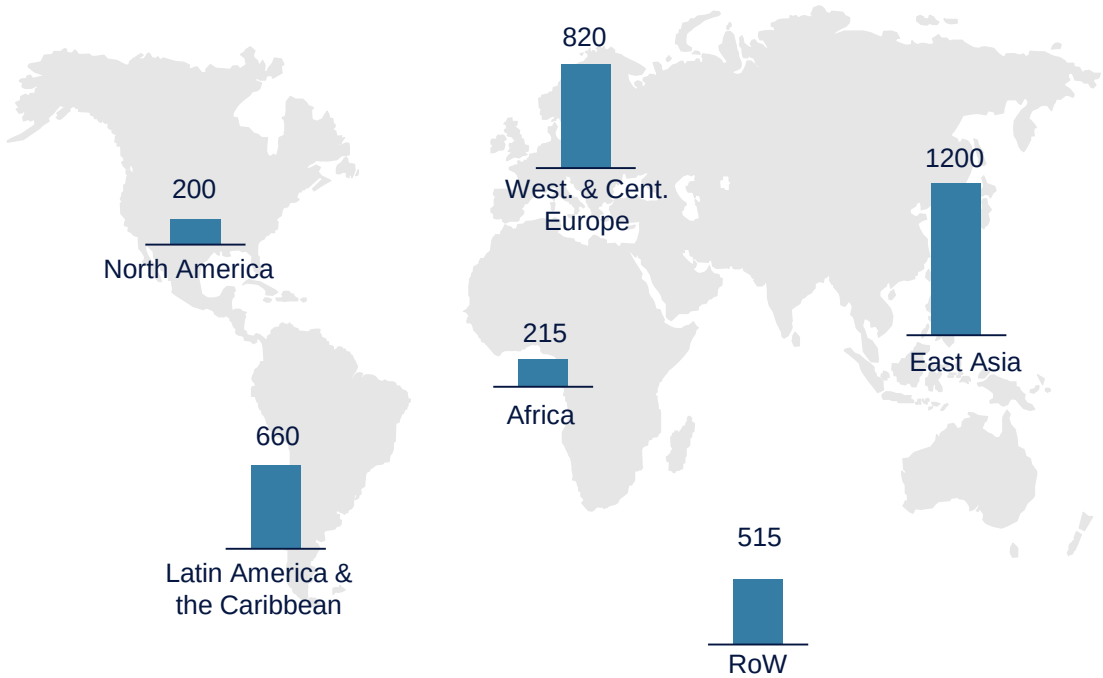
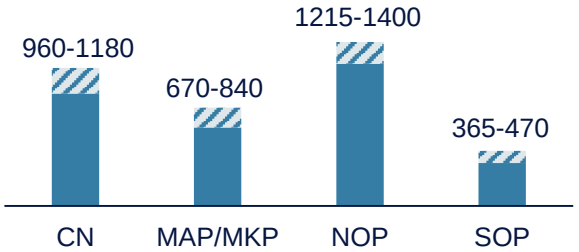
Overview – WSF demand by region

WSF global consumption is estimated at 3.6Mt product. Demand is mainly driven by high-tech irrigation systems, as well as local weather conditions and water availability

WSF consumption by region
(product kt, 2018 estimates – regional total figures)



WSF worldwide consumption by product
(2018 estimates, kt product)



WSF demand following the development of drip irrigation systems for vegetables

- Mature markets in Europe with well developed high-tech hydroponics, micro drip irrigation systems
- In North America, WSF in competition with liquid fertilizers, and historically small vegetables market leading to relatively small WSF market
- Africa (Mediterranean, Eastern and Southern Africa) – WSF demand benefiting from delocalization of European horticulture and development of drip irrigation systems
- India – Still small, but skyrocketing growth market

Source: various publications, interviews, trade stats, RAMS & Co analysis

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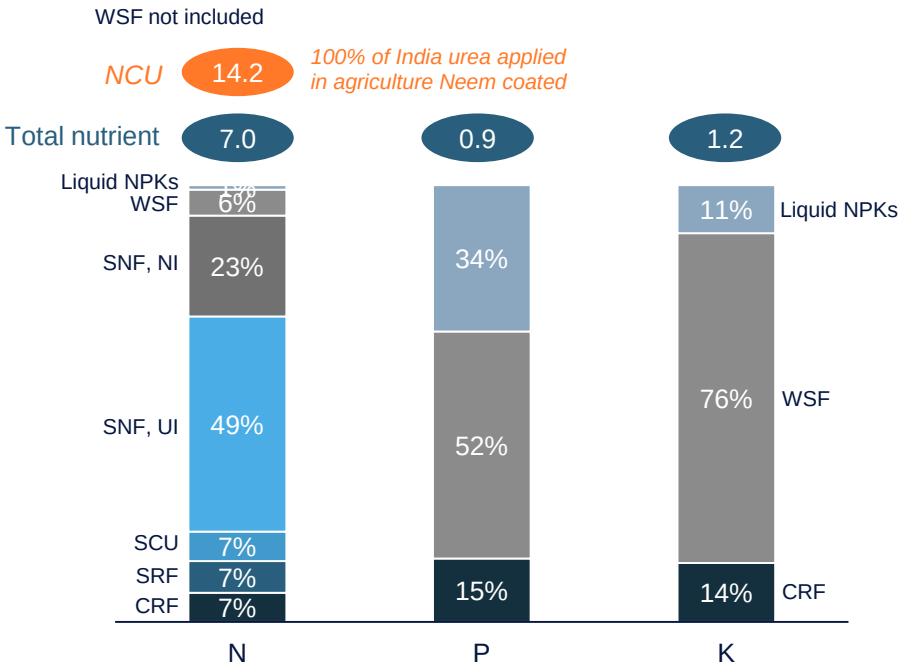
Overview – Demand, nutrient wise

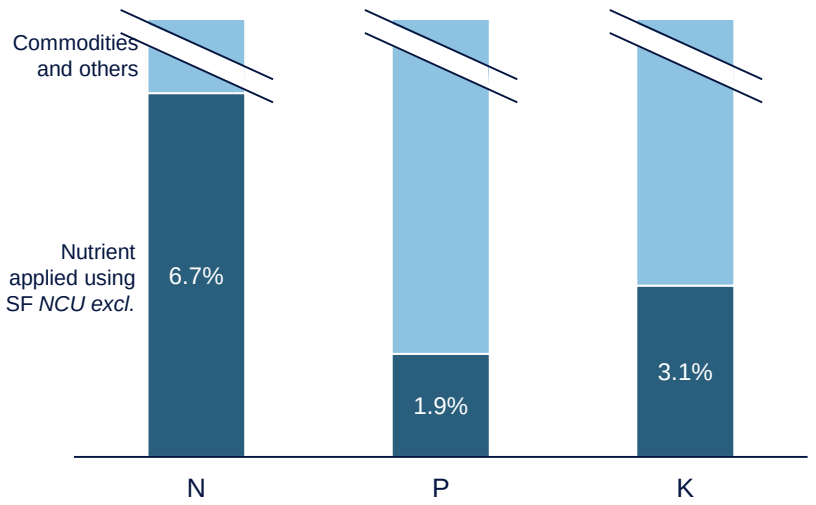
2018 global demand reaches 9 Mt nutrients or 4.8% of total nutrient consumption. 55% is nitrogen driven by SNF, …

Special products demand, in nutrient volumes
(2018 SF demand estimates – totals in Mt nutrient)



Nearly 9 Mt nutrients in special products, reaching 23.2 Mt when including NCU

Special products as a share of global nutrient consumption
(%N,P,K, 2018 SF demand estimates)



4.8% of total nutrients are applied as special products

Source: interviews, trade stats, various publications, RAMS & Co analysis

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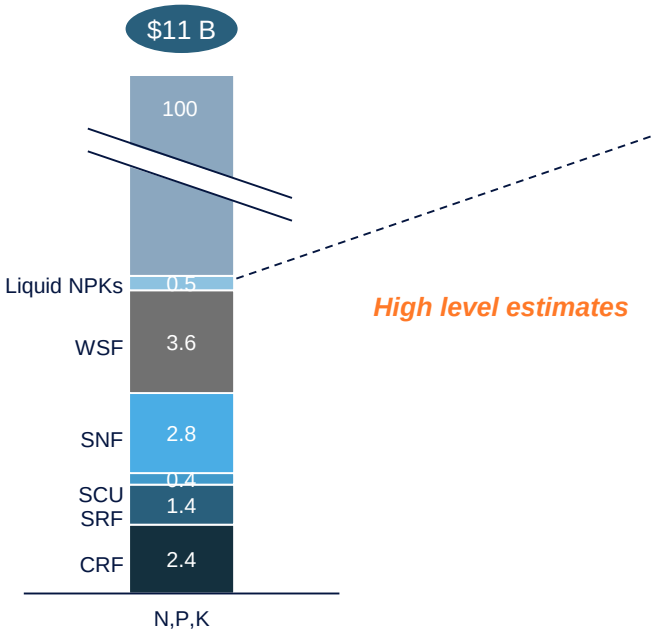
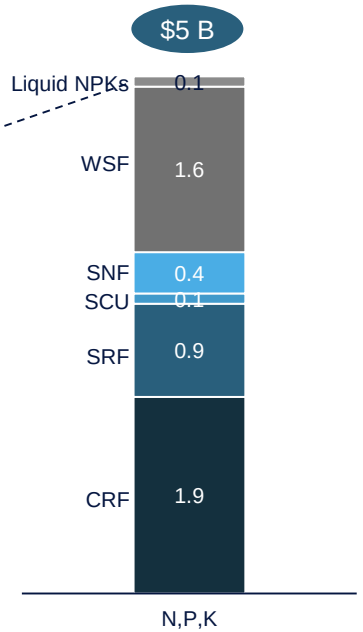
Overview – Demand, value wise

… however it represents ~10% of the global market wholesale revenue.

Wholesale revenue
($B, 2018)



Added value on top of commodity
($B, 2018)



High level estimates

- ***9.9% of the total fertilizer wholesale revenues***
- ***4.3% added-value on top of "commodity" nutrients***

Source: interviews, trade stats, various publications, RAMS & Co analysis

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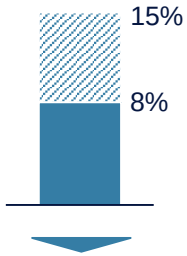
Overview – Forecasted growth

Long-run growth fundamentals are positive. Special products demand should grow at a high pace over the next 8-10 years.

CRF

Forecasted 10-yr growth, per year



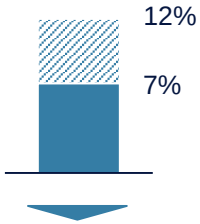
Potential market by 2028
6.2 Mt
(mid-range growth)

↑ Development of lower cost product suitable for broad-acre agriculture
↑ Potential development in sugar cane (Australia, Brazil), oil plam (Indonesia, Malaysia)

↓ European regulation hindering CRF development

SRF

Forecasted 10-yr growth, per year



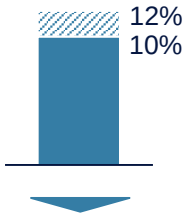
Potential market by 2028
4.4 Mt
(mid-range growth)

↑ Potential for higher penetration in rice in China
↑ Labor shortage in plantations
↑ Consumer market growth in BRICS

↓ Low potential for cost competitiveness to enlarge accessible markets

SNF

Forecasted 10-yr growth, per year



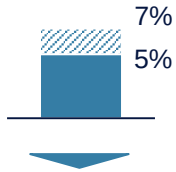
Potential market by 2028
30.5 Mt
(mid-range growth)

↑ Strong potential for further penetration in China (very large urea market)
↑ Environmental regulations likely to favor SNF adoption

↓ US market slower adoption path (early birds already conquered)

WSF

Forecasted 10-yr growth, per year



Potential market by 2028
6.4 Mt
(mid-range growth)

↑ Strong growth potential in Asian F&V
↑ Positive Chinese dynamic (environment protection, rising labor costs, efficiency improvement)

↓ Indian subsidies momentum
↓ Food chain modernization in Asia (less F&V)

Source: various publications, interviews, trade stats, RAMS & Co analysis

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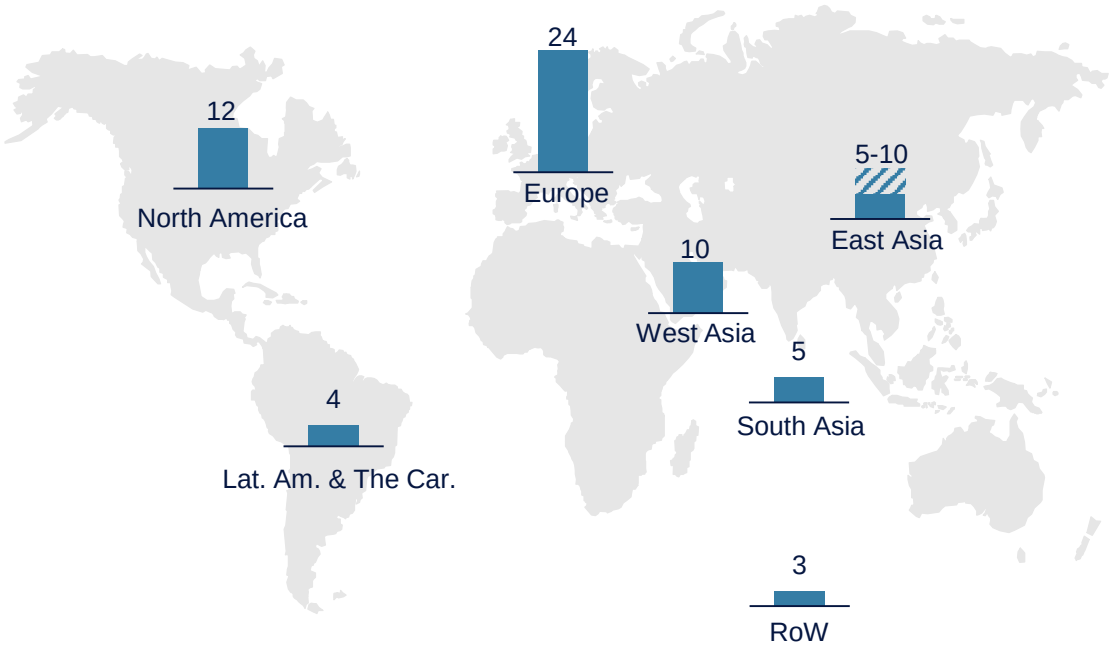
Overview – Chelates market assessment

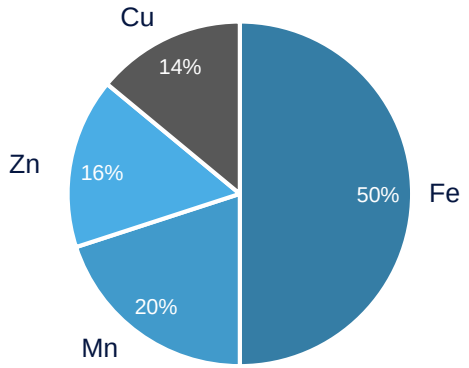
2018 chelates consumption in agriculture is estimated at 63-68 kt dry product, mainly dominated by Western Europe. Iron is the most chelated MN, followed by Mn, Zn and Cu.

Chelated micronutrients worldwide consumption by region
(kt dry product, 2018 estimates – regional total figures)



Europe: Western and Central Europe

Chelated MN consumption by MN and by region
(kt dry product, 2018 estimates – agriculture only)



Chelated micronutrient following WSF demand

- Historically developed in Europe, for vegetables
- Premium still high for Chinese and Indian markets, hence not yet widely adopted

Source: various publications, trade stats, RAMS & Co analysis

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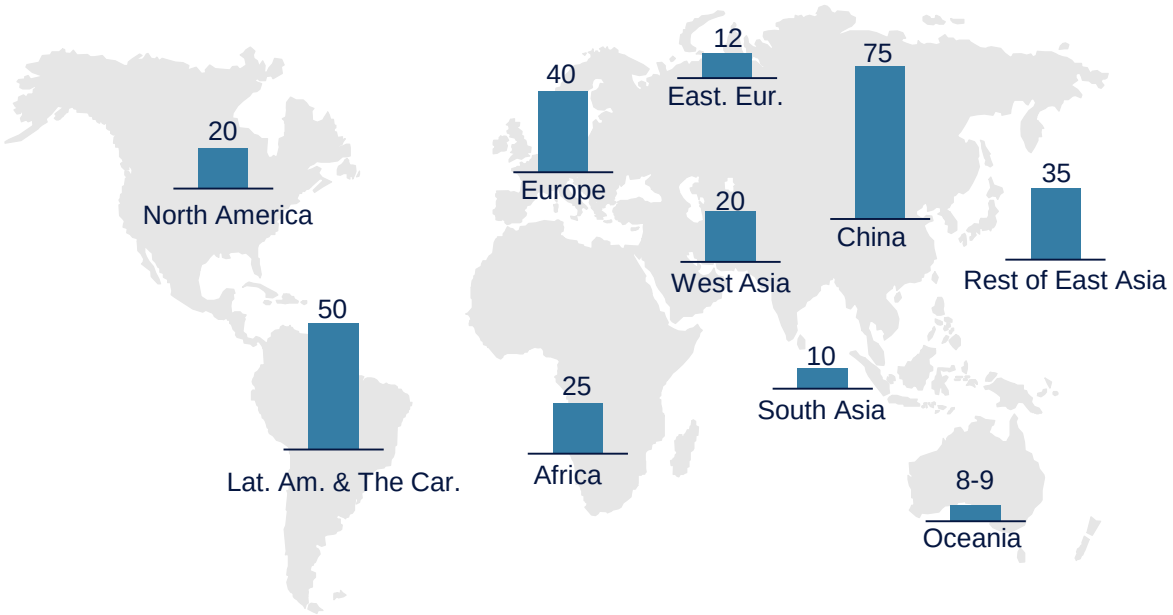
Overview – Boron market assessment

Boron consumption in agriculture reaches 300 kt B_2O_3 in 2018, which represents 15% of global boron consumption. Main consumption regions are East Asia, Lat. Am. And West. Europe

Boron worldwide consumption by region
(kt B_2O_3, 2017 estimates – regional total figures)



Demand following sensitive crops and deficient soils

- ~35% of Chinese soils deficient in boron
- Warm and acid soils in Brazil leading to boron deficiency
- In Northern Europe, boron deficiencies due to acid and sandy soils

Europe: Western and Central Europe

Source: various publications, trade stats, interviews, RAMS & Co analysis

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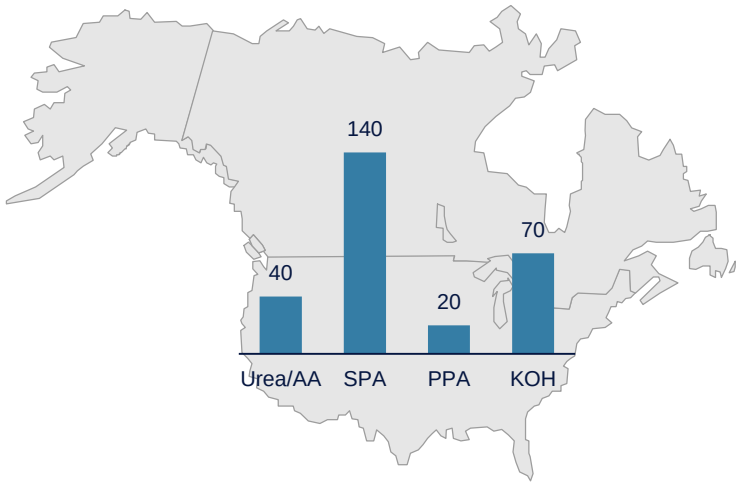
Overview – Liquid fertilizers in North America

North American liquid fertilizers consumption to produce liquid NPK reaches ~270-300 kt nutrient.

Base fertilizers consumption in liquid NPK production
(2017 estimates, kt N,P_2O_5,K_2O – NA only)



Two key demand drivers
- ✓ Logistics
- ✓ Value-in-use (premium justified by enhanced efficiency)

Source: various publications, interviews, trade stats, RAMS & Co analysis

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Key findings – Demand

Demand for special products has known a significant historical growth over the last decade. Growth should be maintained in the long run.

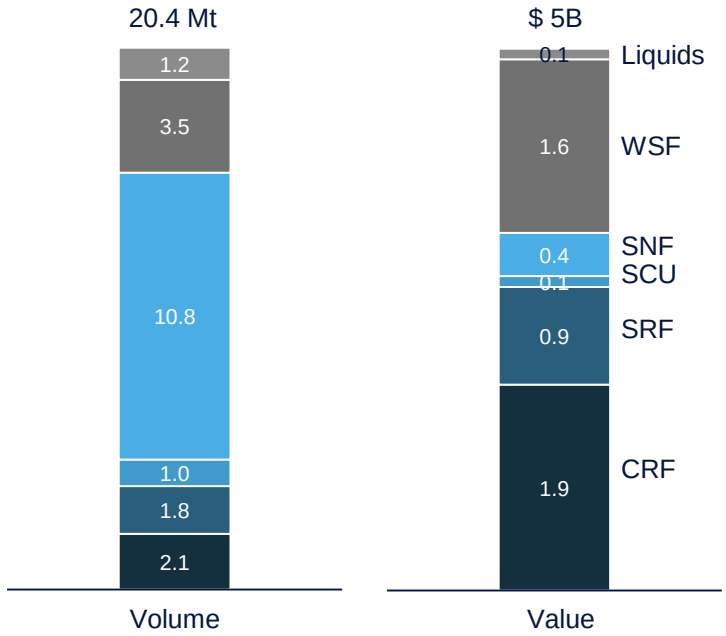
1 A small volume – high value market
- Limited volumes compared to global fertilizers markets (~5% of applied nutrients) but significant value (~10% of global wholesale revenue)

2 Significant historical growth
- CAGR from 6% (WSF) to more than 16% (CRF) per year over the last decade
- Positive fundamental growth drivers

3 Potential growth enablers & disablers
- Growing requirement for high quality crops and environmental concerns towards enhanced water quality, lower GHG emissions, and air pollution reduction
- Growing concerns toward improved nutrient use efficiency
- Local regulations likely to impact SP demand (both way)

4 Toward de-commoditization and mass market?
- Positive growth drivers should be maintained in the medium / long term
- Likely to be supported by production costs reduction and technological improvement

Special products demand & associated added value
(Mt & B$, 2018 - global market)



Source: RAMS & Co analysis

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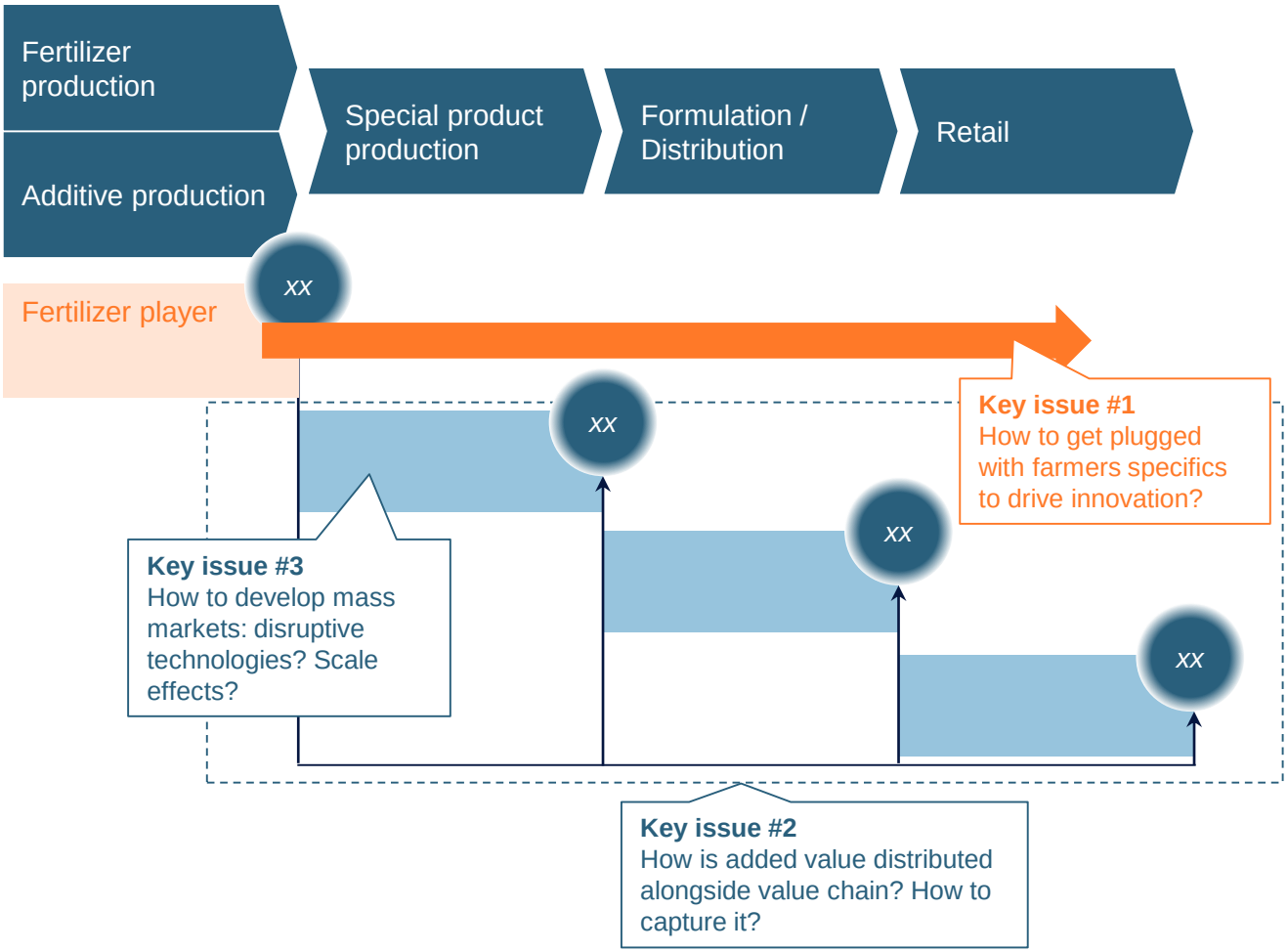
Key findings – Strategy take-aways

Special products represent 10% of fertilizer market value for ~5% of nutrient volume. From niche markets to de-commoditization, SP could become mainstream products, and add significant value remaining to be captured all along the value chain.



Source: RAMS & Co analysis

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