Chemicals for the Non-Chemist

Crop Nutrients and Crop Nutrient Markets

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Topics

- Crop Nutrients
- Crop Nutrient Markets
- Forecasting
  - ⇨Key drivers
  - ⇨Scenario development
  - ⇨Scenario handicapping

Crop Nutrients

- Overview
  - ⇨Crop nutrients are plant food
  - ⇨16 chemical elements are required for plant growth
  - ⇨Limiting factor principle

	Macro		Micro
	Primary	**Secondary**	
Carbon **Hydrogen** **Oxygen**	**N Nitrogen** **P Phosphate** **K Potassium**	**Ca Calcium** **Mg Magnesium** **S Sulfur**	**Zn Zinc** **Mn Manganese** **Fe Iron** **Cu Copper** **Mo Molybdenum** **B Boron** **Cl Chlorine**

Crop Nutrient Products

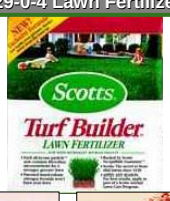
- Crop nutrients are contained in a variety of products
  - ⇨Much like nutrients for animals and people are contained in a variety of feed ingredients and food products
  - ⇨Each crop nutrient product is identified by three numbers
    - ✓ Referred to as its 'analysis' or the percentage of each primary nutrient contained in a unit of the product

Crop Nutrient Analysis

- ## -

N **P** **K**

29-0-4 Lawn Fertilizer



20-0-0 Liquid Fertilizer

20-27-5 Starter Fertilizer

Urea
46-0-0

Diammonium Phosphate (DAP)
18-46-0

Muriate of Potash (MOP)
0-0-60

Primary Crop Nutrients Overview

- Nitrogen (N)
  - ⇨Highly energy intensive (Haber-Bosch process to synthesize ammonia or NH_3)
  - ⇨Key input: natural gas (or another hydrocarbon feedstock)
  - ⇨Global ag use: ~ 100 million tonnes N or ~ 250 million tonnes product
  - ⇨Main products:
    - ✓ Anhydrous ammonia (82% N - gas at normal temperatures and pressures)
    - ✓ Urea-ammonium nitrate (UAN) solution (28%-32% N - liquid)
    - ✓ Urea (46% N - solid)
    - ✓ Ammonium nitrate (34% N - solid)
    - ✓ Ammonium sulphate (21% N - solid)
    - ✓ Ammonium phosphate (DAP and MAP) products (10%-18% N - solid)
  - ⇨Leading producers: China, FSU, India, Mideast, Caribbean, North America

Primary Crop Nutrients Overview

- Phosphate (P)
  - ⇨Mining and chemical production processes overview
  - ⇨Key inputs: phosphate rock mineral ore, sulphur and ammonia
  - ⇨Global ag use: ~ 40 million tonnes P_2O_5 or ~ 95 million tonnes product
  - ⇨Main products:
    - ✓ Diammonium phosphate (DAP)
    - ✓ Monoammonium phosphate (MAP)
    - ✓ Triple superphosphate (TSP)
    - ✓ Single superphosphate (SSP)
  - ⇨Leading producers: China, USA, Morocco/North Africa, Russia

Primary Crop Nutrients Overview

- Potash (K)
  - ⇨Key inputs: potash mineral ore
    - ✓ Deep shaft mines (1000+ meters deep)
    - ✓ Solution mines
    - ✓ Evaporation of lake brines (e.g. Dead Sea and Great Salt Lake)
  - ⇨Global ag use: ~ 29 million tonnes K_2O or 50 million tonnes product
  - ⇨Main products:
    - ✓ Potassium chloride or muriate of potash (MOP)
    - ✓ Potassium sulphate or sulphate of potash (SOP)
    - ✓ Potassium-magnesium-sulphate (Mosaic brand name K-Mag)
  - ⇨Leading producers: Canada, Russia/Belorussia, Germany, Israel/Jordan

Topics

- Crop Nutrients
- **Crop Nutrient Markets**
- Forecasting
  - ⇨Key drivers
  - ⇨Scenario development
  - ⇨Scenario handicapping

Crop Nutrient Markets

- Each nutrient is a separate and unique market
  - ⇨Common demand drivers
  - ⇨Different supply drivers
    - ✓Natural resources required
    - ✓Other raw materials
    - ✓Location of resources
    - ✓Technological processes
- Market characteristics
  - ⇨Global
  - ⇨Commodity based
  - ⇨Cyclical

World Fertilizer and Grain Trade 2008
(million metric tonnes)

	World Use	Total Exports	Exports as a Percent of Use
Coarse Grain	1,072.8	107.4	10%
Wheat	632.6	137.4	22%
Rice	435.2	27.7	6%
Total Grain	2,140.7	272.5	13%
Nitrogen (N)	98.8	28.5	29%
Phosphate (P_2O_5)	34.5	11.2	32%
Potash (K_2O)	23.2	21.0	90%
Total Nutrients	156.5	60.7	39%

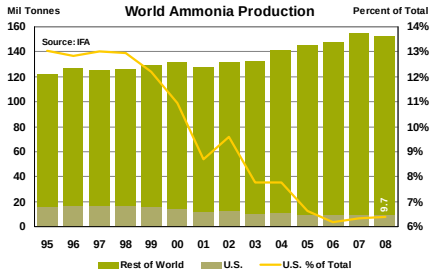
Source: USDA, IFA, Fertecon, Mosaic

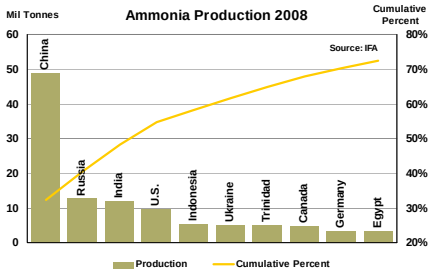
Note: Nitrogen includes urea, ammonia, ammonium nitrate, ammonium sulphate and calcium ammonium nitrate. Phosphate includes phosphoric acid, DAP, MAP, TSP, SSP. Phosphate rock is not included. Potash includes MOP, SOP and potash exports do not include Canadian shipments to the United States.

Crop Nutrient Markets

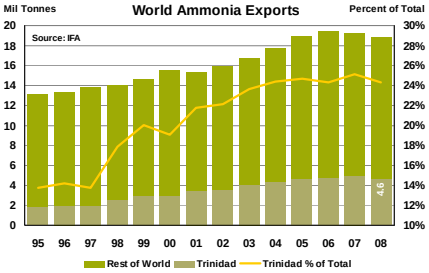
- Long and large supply chain or distribution pipeline
  - ⇨Production
    - ✓ Typically located near the source of the natural resource (i.e. long pipeline)
    - ✓ Operates 24-7-365
  - ⇨Farm application
    - ✓ One or two short application windows (i.e. large pipeline)
      - Post-harvest (~ 40% in the United States)
      - Pre-plant/side dress (~ 60% in the United States)
  - ⇨Pipeline flow
    - ✓ Regular flow required to:
      - Have product in place when farmers want to apply it
      - Keep mines and plants running
    - ✓ Flow impacted by:
      - Weather
      - Price expectations
      - Supply/demand changes

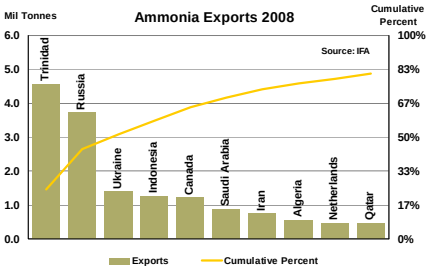
World Ammonia Production and Trade

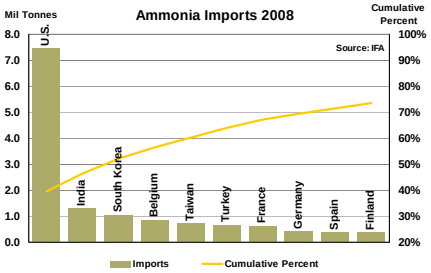




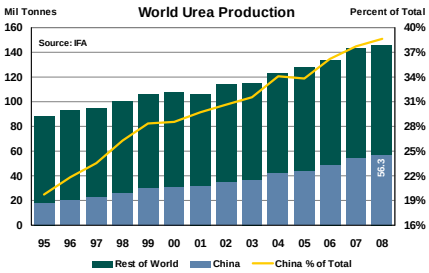
World Ammonia Production and Trade

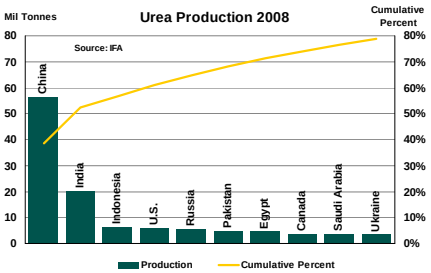




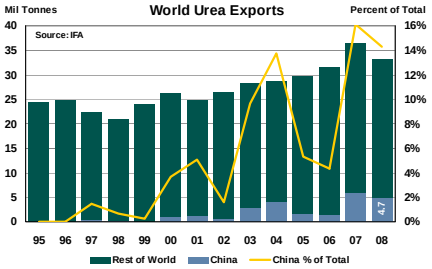


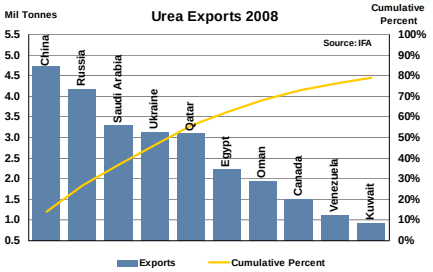
World Urea Production

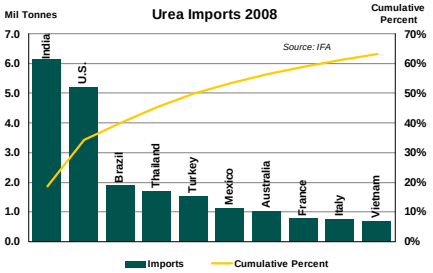




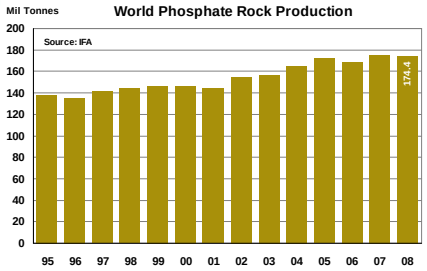
World Urea Trade

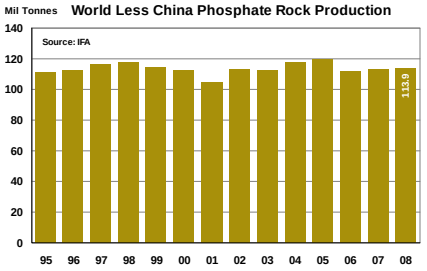


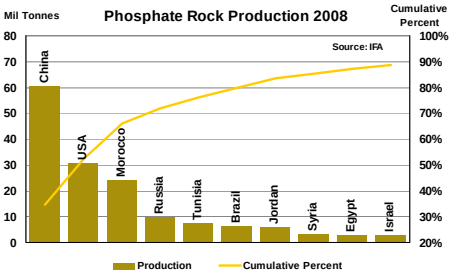




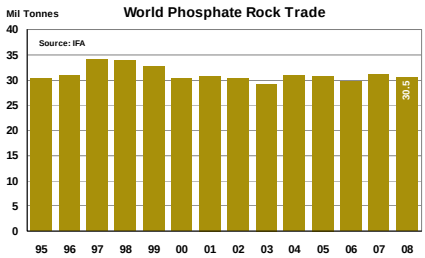
World Phosphate Rock Production

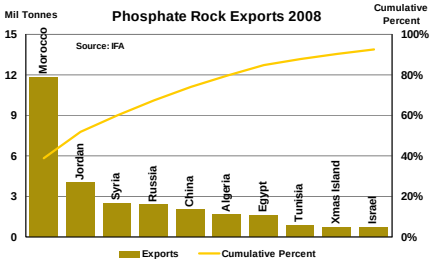


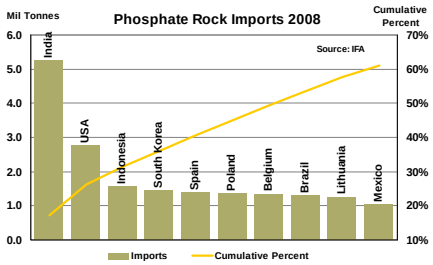




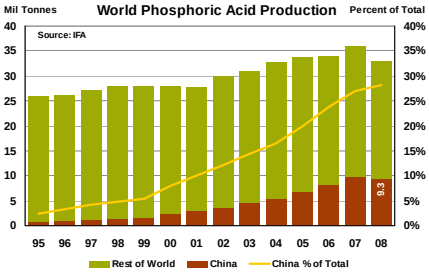
World Phosphate Rock Trade

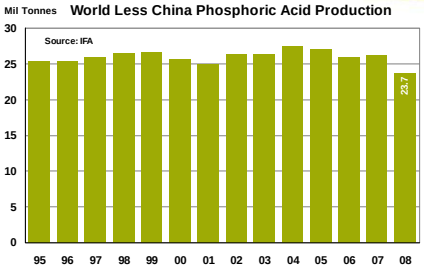


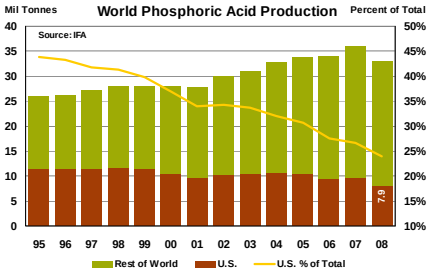


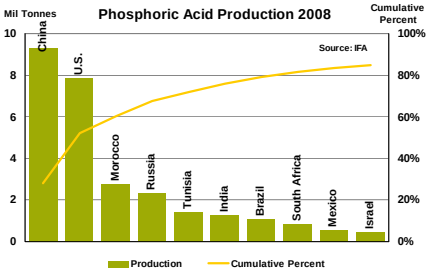


World Phosphoric Acid Production

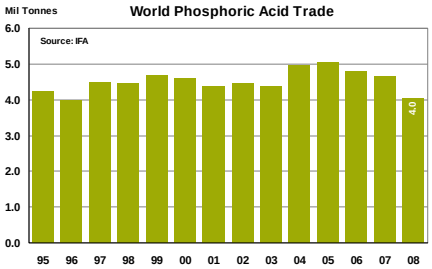


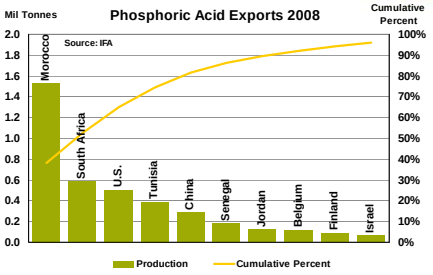


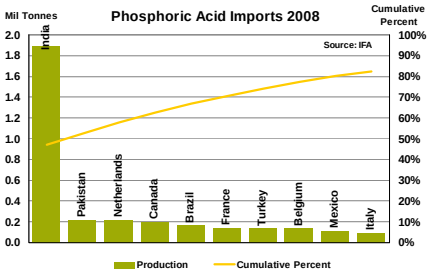




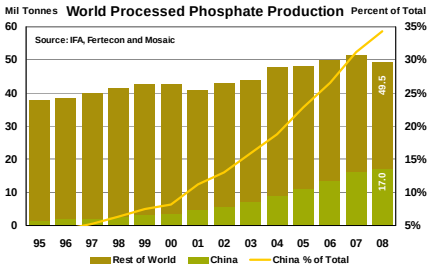
World Phosphate Acid Trade

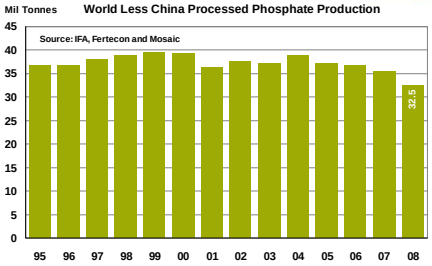


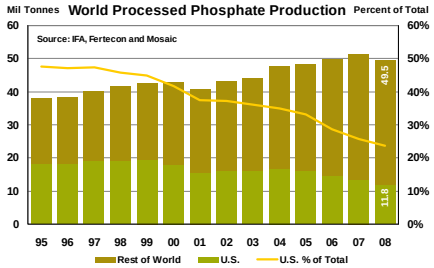


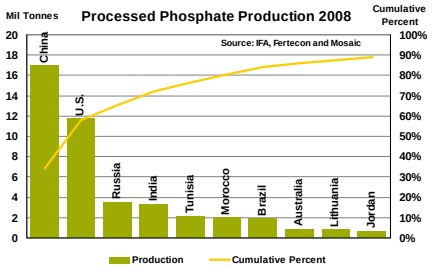


World Processed Phosphate Production









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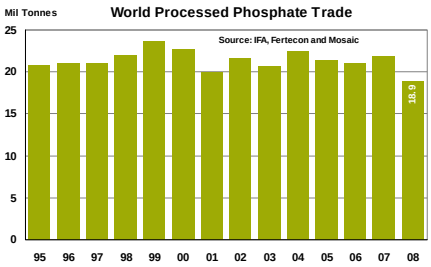
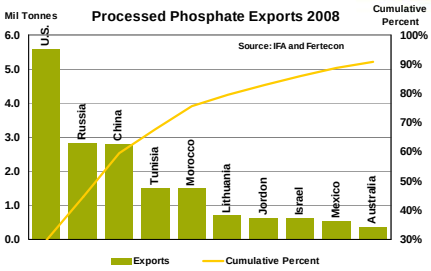
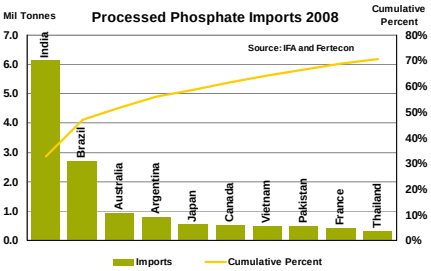
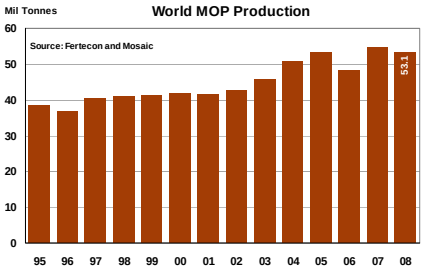


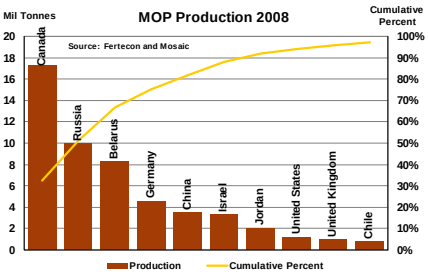




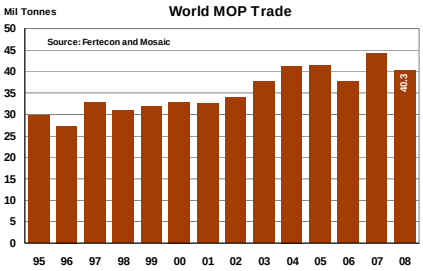
Processed phosphate included DAP, MAP and TSP

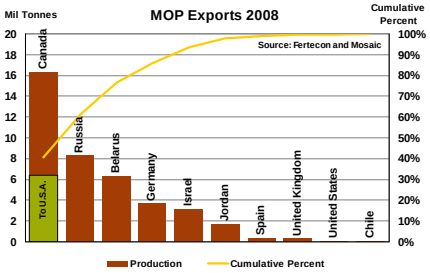
World Potash Production

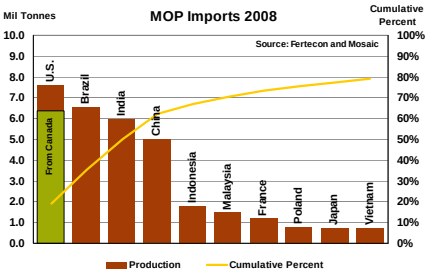




World Potash Trade







Topics

- Crop Nutrients and Crop Nutrient Products
- Crop Nutrient Markets
- Forecasting
  - ⇨Key drivers
  - ⇨Scenario development
  - ⇨Scenario handicapping

Forecasting: Handicapping Scenarios

Uncontrollable and Unpredictable Variables

- Mother Nature
- Human Nature/Intangibles
- Government Policies
- Macroeconomic Factors
- Technological Change

→ Game Changers →

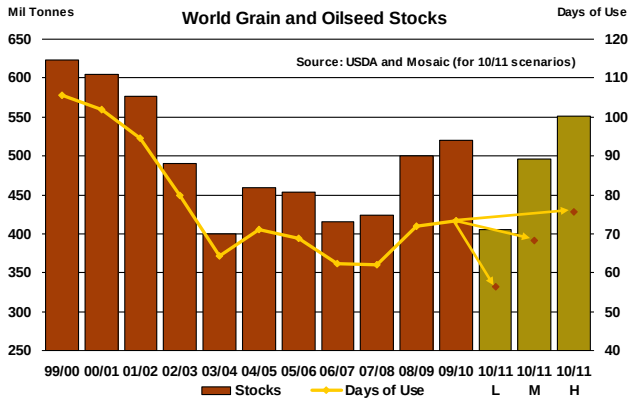
Key Crop Nutrient Market Drivers

- Ag Commodity Prices
- Farm Economics
- Energy Costs
- Raw Materials Costs
- Exchange Rates
- Credit Availability
- New Project Development
- Nutrient Demand

Factors to Watch in 2009/10

- Agricultural commodity prices and farm economics
  - ⇨ Weather during the next six months
    - ✓ Northern Hemisphere: harvest progress, crop size and fertilizer application window
    - ✓ Southern Hemisphere: planting progress and size of 2010 crop -- especially in Brazil
  - ⇨ Impact of stronger economic growth and lower prices on grain demand
  - ⇨ Impact of the value of dollar, oil prices and ethanol prices on corn demand
  - ⇨ Behavior of hedge fund managers
- Macroeconomic environment
  - ⇨ Exchange rates (impact of weaker dollar on crop nutrient imports and grain exports)
  - ⇨ Improved credit availability
- Government policies
  - ⇨ Chinese phosphate export taxes and potash import policies
  - ⇨ Indian fertilizer subsidy reform and impact on retail prices
  - ⇨ U.S. ethanol blending rate (EPA ruling expected by December 1 or early 2010)
- The intangibles
  - ⇨ Price expectations
  - ⇨ Distributor and retailer market sentiment
  - ⇨ More tightly controlled buying processes

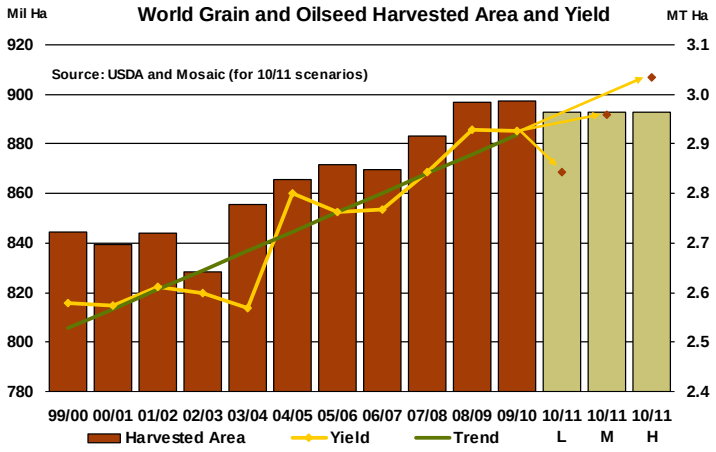
But another large crop is needed in 2010



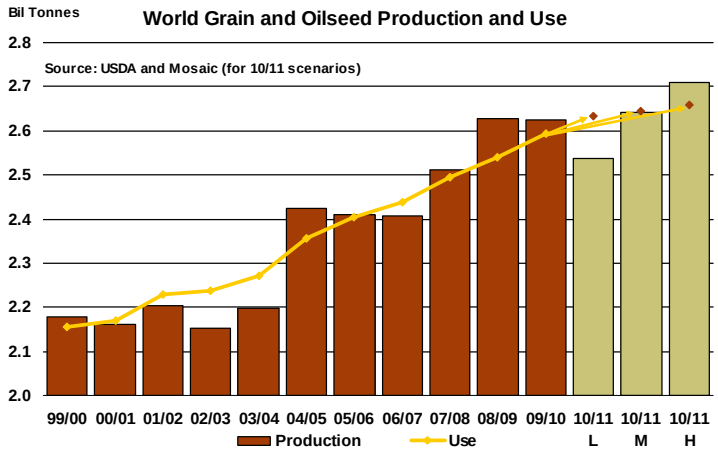
2010/11 Scenario Assumptions

	Low	Medium	High
Harvested Area Change	-0.5%	-0.5%	-0.5%
Yield Ddeviation from 11-Year Trend	Largest Negative	0	Largest Positve
Demand Growth	1.5%	2.0%	2.5%

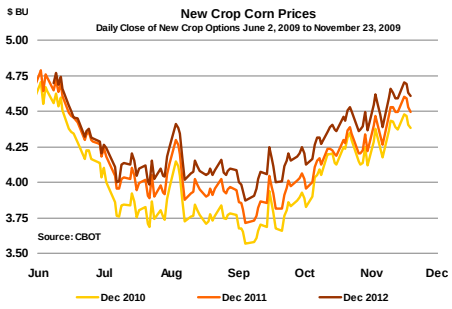
Yields still are key

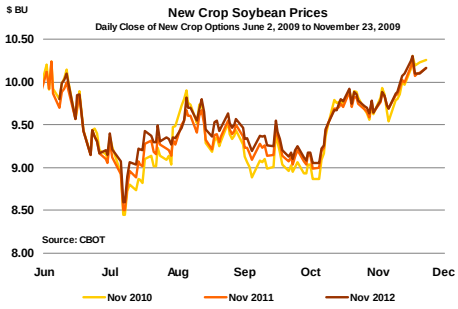


Grain and oilseed use marches upward



Futures markets agree



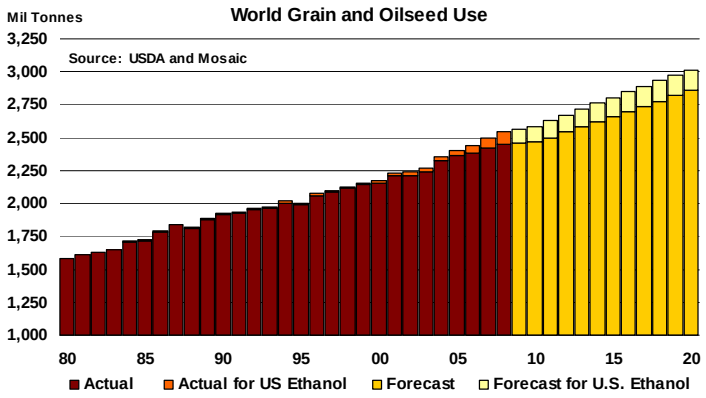


Long term scenarios with the highest handicap

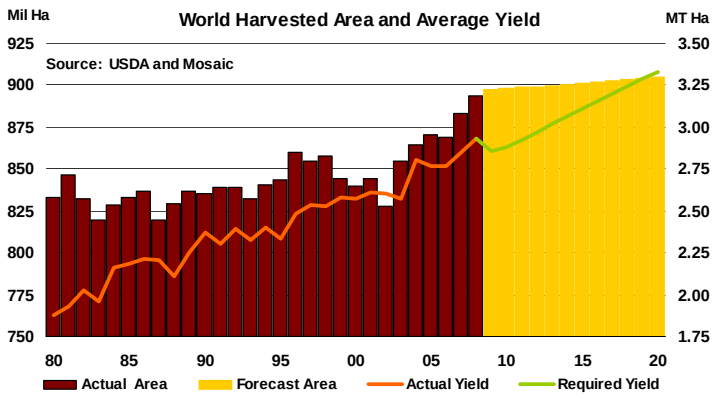
- The food and energy stories
  - ⇨ Rapid economic development is expected to stress basic resource markets
  - ⇨ Productivity gains in agriculture likely with exceed those in energy
- Food security in key developing countries
  - ⇨ At top of the policy agenda
  - ⇨ How to feed a growing and more affluent population
  - ⇨ How to improve the well-being of large rural populations
- U.S. grain-based biofuels programs
  - ⇨ Controversial but solid political support
  - ⇨ Economics depends on long term corn and oil prices
- Next generation seed varieties (i.e. don't bet against biotech)
  - ⇨ Potential yield increases and the need for strong food and fuel demand growth
  - ⇨ Traits such as improved nutrient use efficiency and drought tolerance

The food story – by the numbers

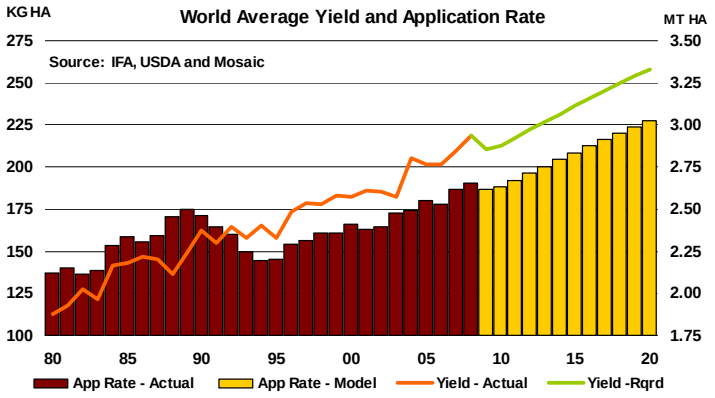
The 500 million tonne challenge next decade



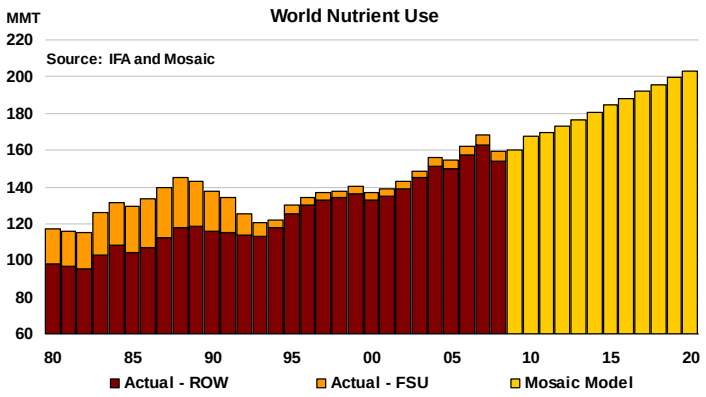
Area and yield increases required to meet demand



Higher yields require higher application rates



Model demand forecasts



Mosaic

THANK YOU!

Chemicals for the Non-Chemist

Crop Nutrients and Crop Nutrient Markets

Questions?

Dr. Michael Rahm
Vice President
Market and Strategic Analysis

Citi Conference
New York, NY
November 30, 2009