



Global Fertilizer Industry: Meeting Agricultural Challenges

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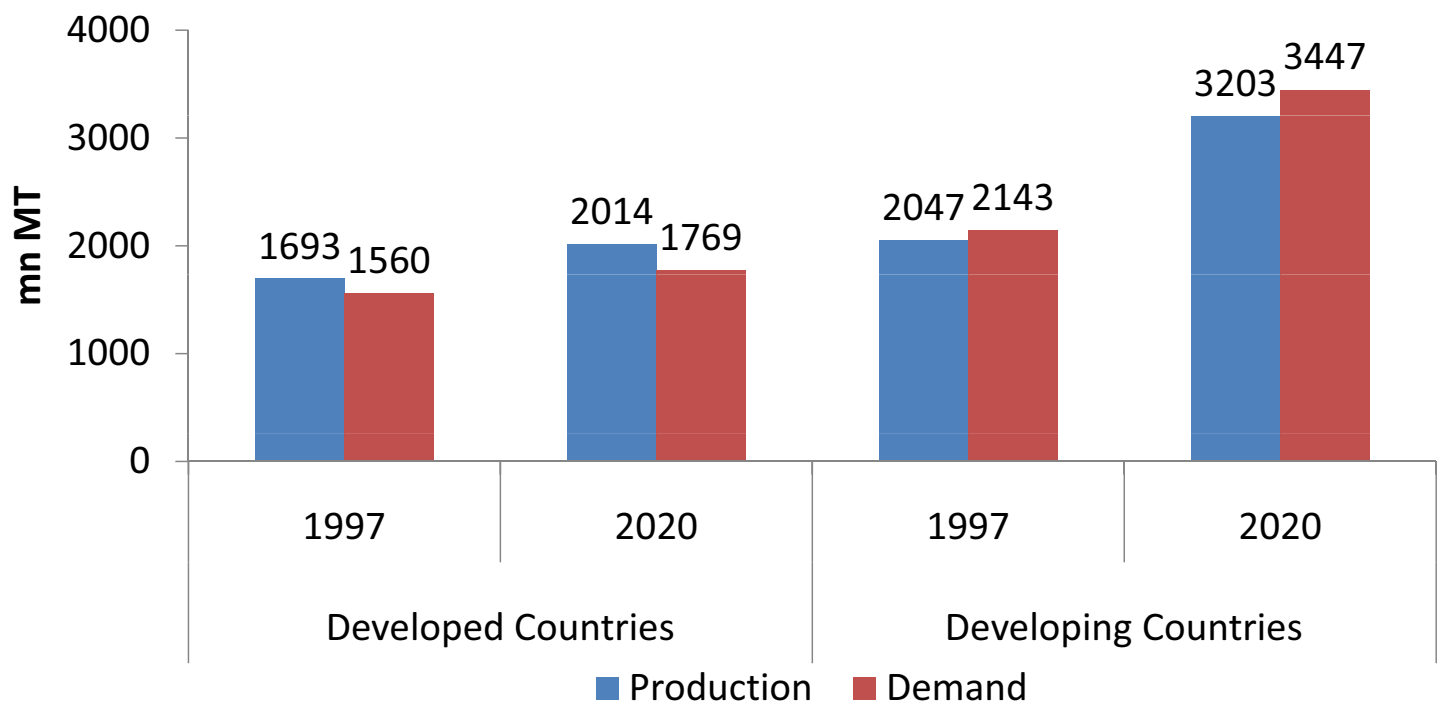


World Agriculture





Global Food Demand-Supply Scenario

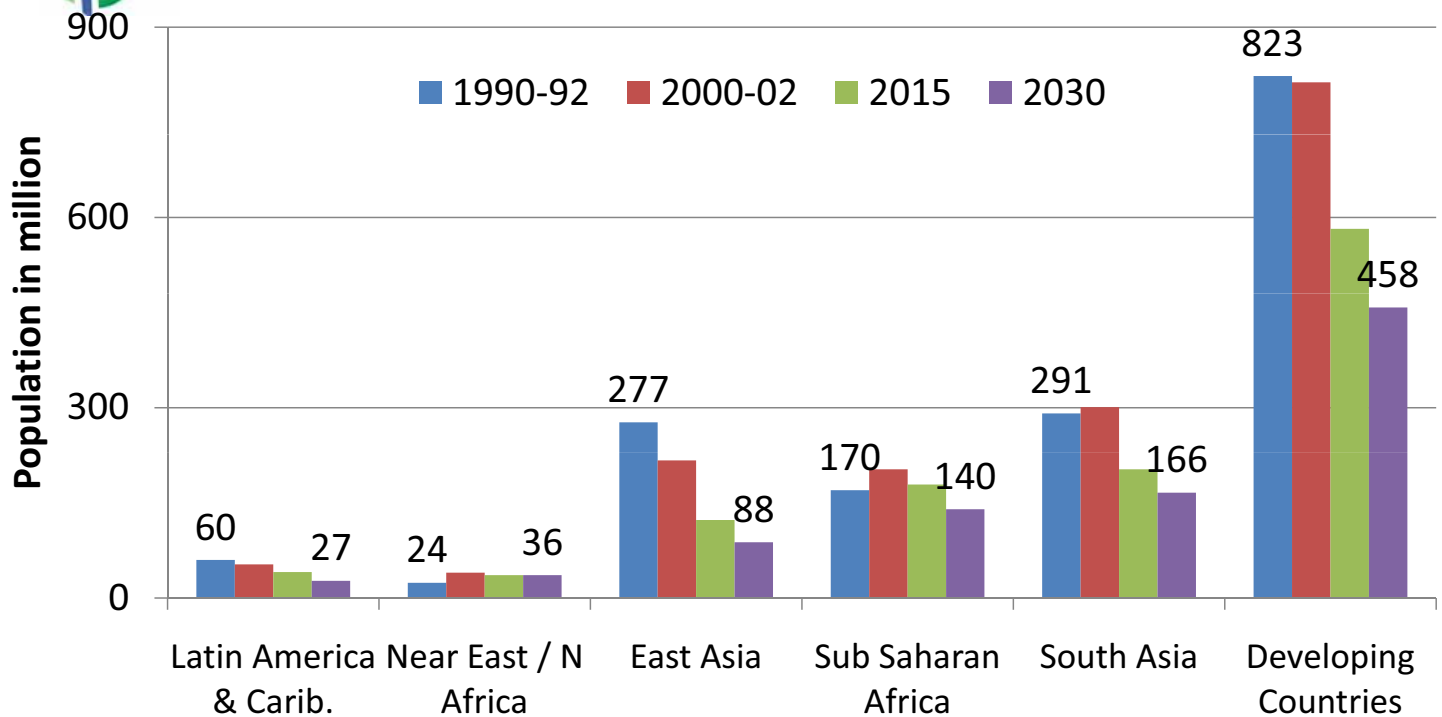


Source: Global Food Projections to 2020, IFPRI, 2001

Supply deficit increasing in developing countries



Undernourished Population



Source: The State of Food Insecurity in the World 2004, FAO

Undernourishment not decreasing fast enough



Demographic Changes

- Population Growth
 - World population to reach 8.13 bn by 2030; 95% of increase in developing and LDCs
- Developing countries will drive increased world food demand
 - With an expected 40 percent population increase and an average annual income growth rate of 4.3 percent
 - By 2020, developing countries' demand for cereals for direct human consumption is projected to increase by 47 percent

Source: The World Food Situation, 2006, IFPRI



Demographic Changes

- Urbanization
 - Much of the population increase is expected to be in the cities
 - Shift from basic staples like maize, sorghum etc. to cereals like wheat and rice (also fruits & vegetables)
- Income Levels
 - Substantial difference in income growth rates across and within countries / regions
 - Poverty likely to be entrenched in South Asia and Latin America and worsen in Sub-Saharan Africa

Demographic changes further aggravate nutrition challenges



In Summary ...

Despite economic growth, the international community faces an increasing challenge of meeting basic food & nutrition needs of a large proportion of global population – 460 million is the estimated number of undernourished in the developing countries by 2030



Agricultural Challenges





Agricultural Challenges

- Food Security
- Nutrition Security
- Ecological Issues
- Bio Fuels
- Productivity



Food Security

- Cereal output in 2007 to reach a record level of 2.1 bn tonnes; but
 - Carryover stocks at their lowest level since the early 80s
 - Demand to increase strongly boosted by the fast-growing bio-fuels industry
 - Output in developing countries is forecast to decline (excl China & India)
 - In S Africa, reduced cereal harvest for the second year in succession
- Food prices on the rise
 - International prices for most cereals have risen significantly in 2006/07 so far, and are likely to remain high in 2007/08 or further increase
 - Cereal import bill of the LIFDCs is forecast to increase by about 25%

Source: FAO

Sustainable answers needed for meeting food, feed, fibre
& bio energy demands



Nutrition Security

- Some startling facts
 - 2 bn people worldwide have inadequate iodine nutrition
 - Annually, 140 million preschoolers and more than 7 million pregnant women suffer from vitamin A deficiency
 - Iron deficiency annually cause an estimated 111,000 maternal deaths
- Green revolution concentrated on raising production
 - Specialization in very limited crops and crop genotypes; Narrow range of nutrients available for consumption
 - Displacement of traditional foods, raising issues of nutrition
 - Problem compounded by urbanization
 - Finland has mandated all fertilisers to contain Selenium, which is required to fight the high incidence of cardiovascular disease

Source: UN System, Standing Committee on Nutrition, 2004

Malnutrition is the one of the largest contributors to world disease



Ecological Concerns - Water

- The Crisis
 - Population increased 3 fold in the 20th century, but water use has increased 6 fold
 - Water withdrawal for irrigation has increased to 66% of total water use
 - Quantity of water (liters) needed to produce 1 kg of
 - Wheat: 1400; Rice: 1000 ; Beef: 13000
- The Projection – 2025
 - Water scarcity will cause losses of 350 mn tons of food production

Source: Global Water Outlook to 2025, IFPRI

Water use inefficiency will aggravate food insecurity



Ecological Concerns - Land

- About 11 per cent of the world's land surface is used for crop production
 - Virtually no additional land is available for agricultural expansion in the short term
- Arable land per person is shrinking
 - Will lead to increasingly more intensive agriculture and its associated environmental issues
- Land Degradation
 - About 20 to 30 per cent of irrigated land in the developing world has been damaged by water-logging or salinity
 - An estimated 250 million people have been directly affected by desertification and nearly 1 billion are at risk

Nutrient mining responsible for 40% of land degradation



Ecological Concerns – Nitrogen

- Fertilizer is one of the major human sources of fixed or reactive nitrogen
 - Eutrophication of surface water
 - Nitrate accumulation in ground water
 - Unwanted ammonia and nitrous oxide emissions to the atmosphere
- N leaching due to
 - Intensive cropping
 - Fertilizer application for over-optimistic yield expectations or as an insurance policy
 - Reduced N use efficiency due to deficiencies of secondary / micronutrients as well as application timing that does not match crop requirements

N losses are due to inappropriate fertilizer use / crop management



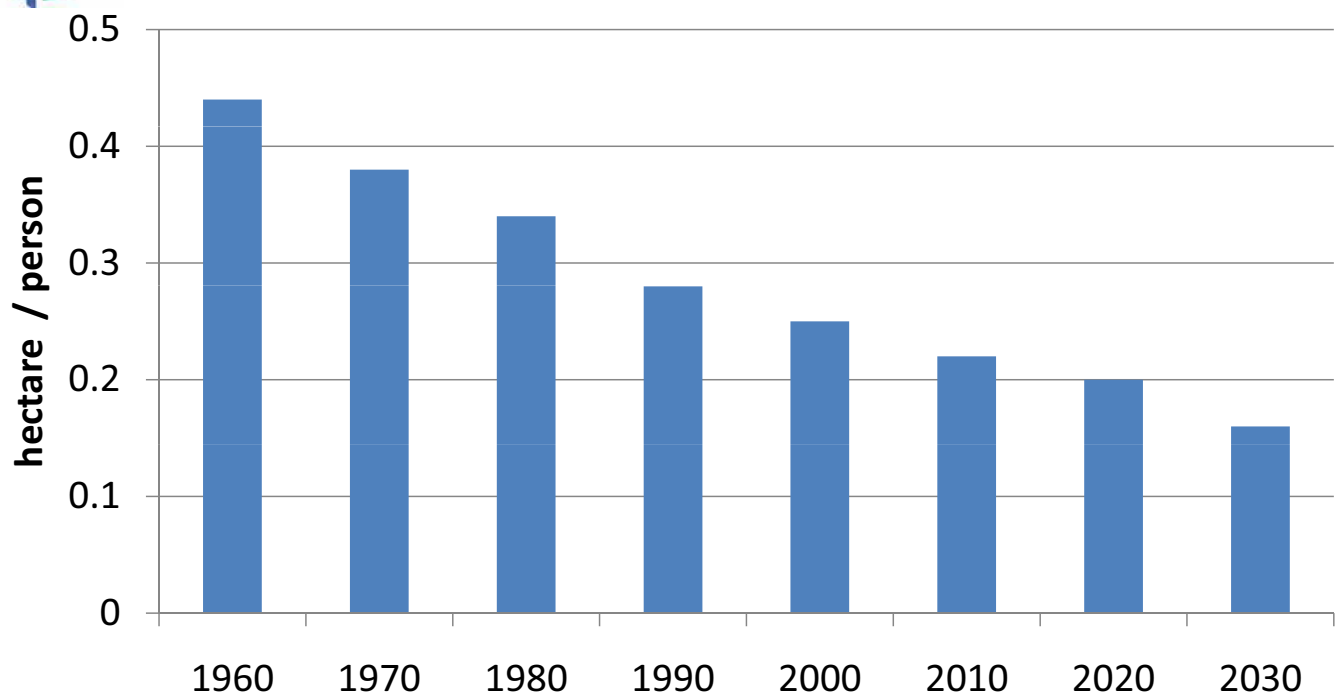
Bio Fuels

- Robust growth of bio-fuel industry. Between 2006 & 2016
 - Maize-based ethanol output is expected to double
 - The amount of oilseeds used for bio-fuels is set to grow from just over 10 mn tonnes to 21 mn tonnes in EU
 - In Brazil, annual ethanol production is projected to reach some 44 billion litres from around 21 billion litres
 - Chinese ethanol output is expected to rise to an annual 3.8 billion litres, a 2 billion litres increase from current levels
 - Increased palm oil production is likely in S E Asia
- Structural impact on agricultural markets
 - Growing use of cereals, sugar, oilseed and vegetable oils to produce fossil fuel substitutes, ethanol and bio-diesel
 - Higher animal feed costs and livestock products
 - Feedstock prices increasingly linked to crude oil prices

Higher & more volatile agri commodity prices



Productivity Challenge



Source: FAO

How do we sustainably increase productivity?



Productivity Challenge

	1995	Updated 2025 prediction	Updated annual rate change
Population (bn)	5.66	7.90	1.12
Demand for maize, rice and wheat (mn Mt)	1657	2436	1.29
Production area (mn ha)	506	556	0.31
Mean grain yield (t/ha)*	3.27	4.38	0.98

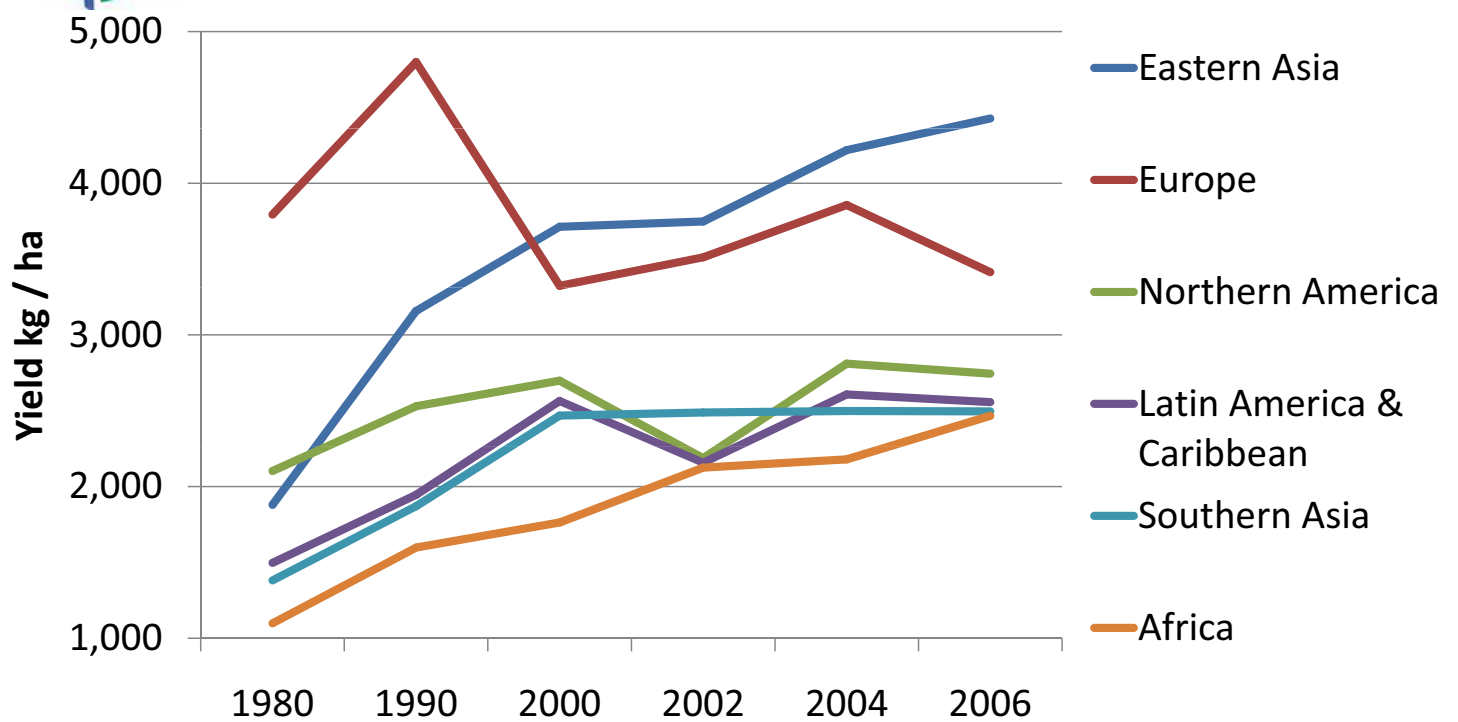
* Weighted average for the three major cereals

Source: Cassman 2006, Rosegrant et al. 2002. IFPRI

How do we sustainably increase productivity?



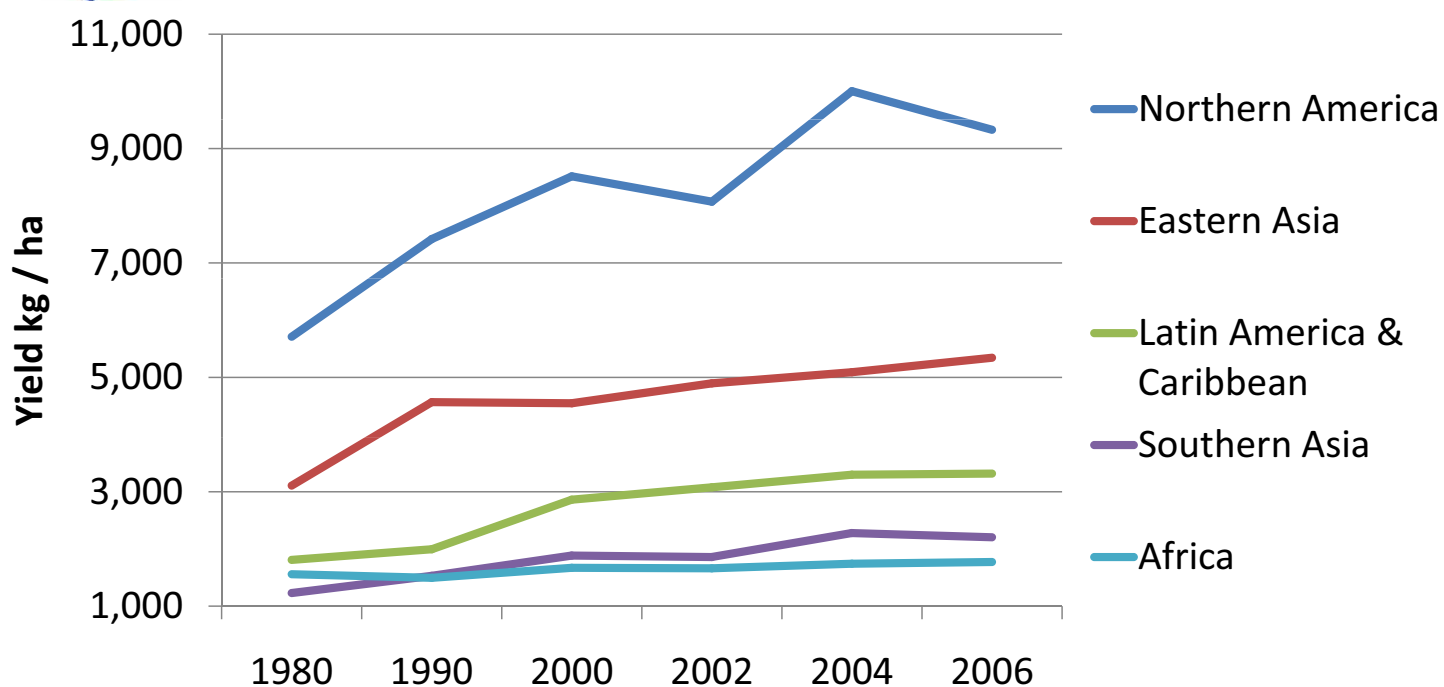
Productivity Reality - Wheat



Source: FAOSTAT



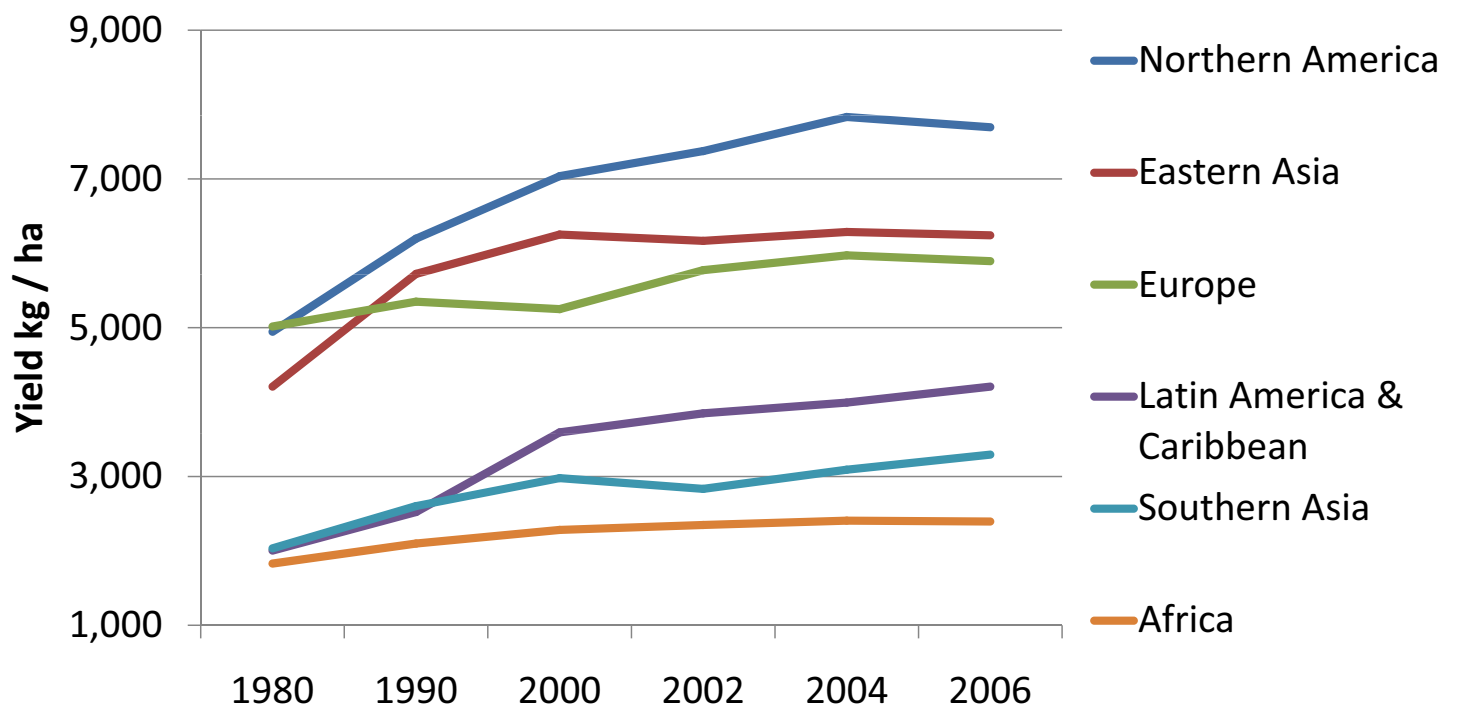
Productivity Reality - Maize



Source: FAOSTAT



Productivity Reality - Rice



Source: FAOSTAT

Near stagnant productivity in many regions!

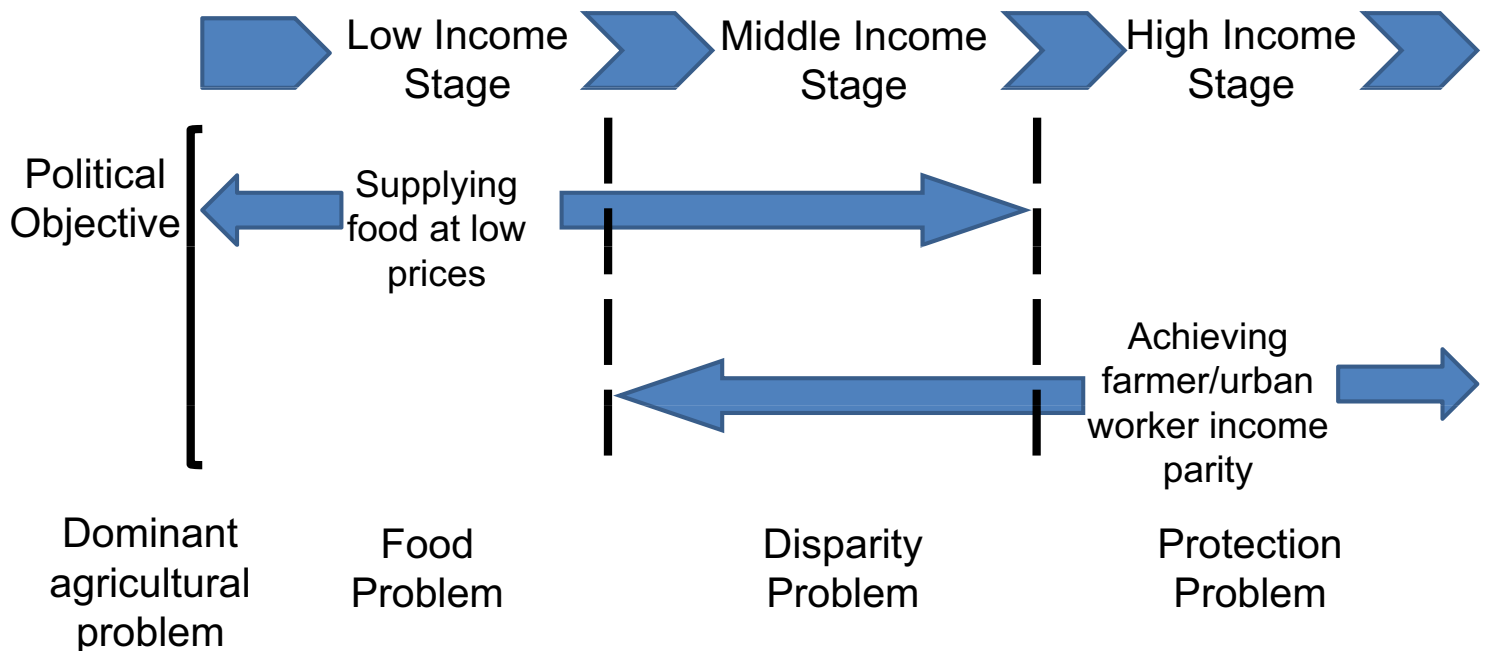


Productivity Reality

- Significant variation in productivity levels across regions
- Near stagnant growth in productivity in recent years
- Similar trends for other crops like oil seeds & pulses
- Achieving sustainable increase in productivity requires
 - Understanding of geography specific challenges
 - Prioritisation of challenges



The Political Economic Dimension



Yujiro Hayami

Foundation for Advanced Studies in International Development, Japan

Appropriate policy responses required



Prioritizing Agricultural Challenges

	Markets		
	Mature	Growing	Stagnating
Productivity	4	1	2
Food Security	5	2	1
Nutrition Security	3	3	3
Ecological Concerns	1	4	4
Bio Fuels	2	5	5

Author's Notional Prioritisation

Region specific priorities to be addressed



Addressing Challenges – The India Story





Indian Agriculture – A Snapshot

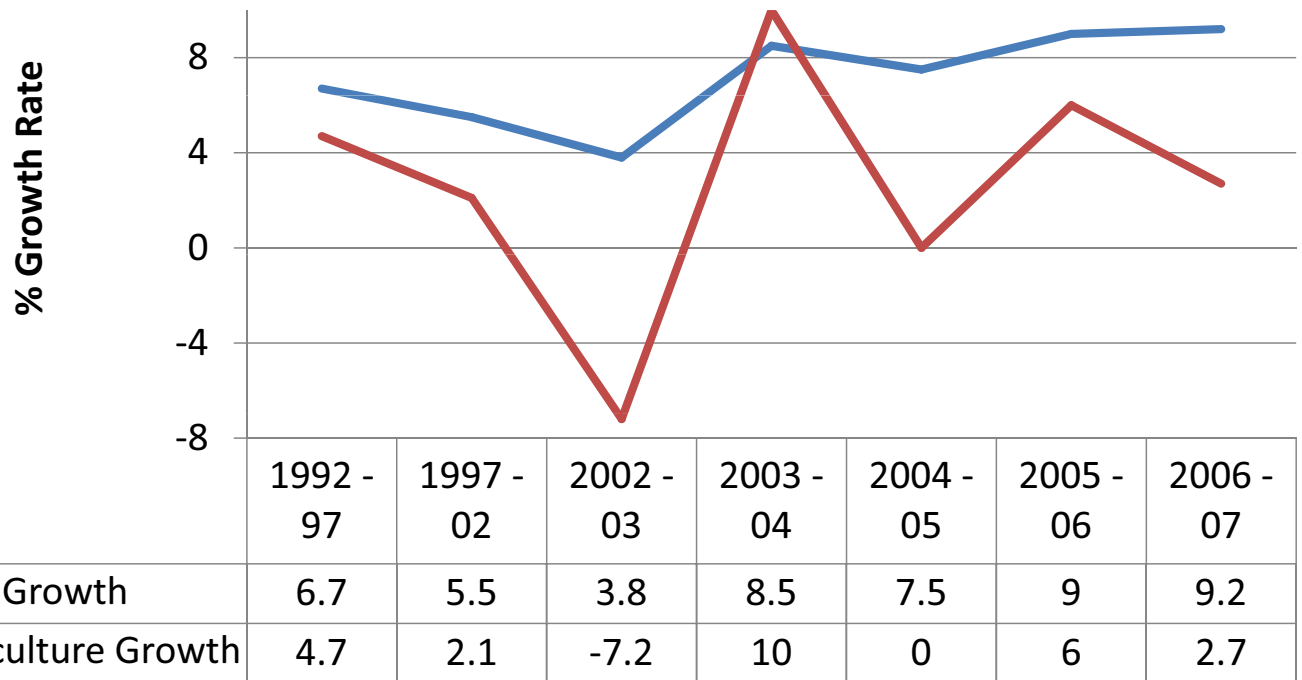
- Most populous nation by 2030
 - 234 million involved in farming & 89 million households
- Fragmented land holding
 - 78% of marginal & small farmers (holding less than 2 ha)
- Increasing land degradation
 - 57% of land is under some form of degradation
- Land diversion
 - Rapid urbanization, Special Economic Zones
- Irrigation
 - 39% of cultivated area (Total area: 192 mn ha)
- Infrastructure Constraints

Source: Census of India 2001, SAARC Coastal Management Center

GDP growth of 8% requires agriculture to grow at 4%



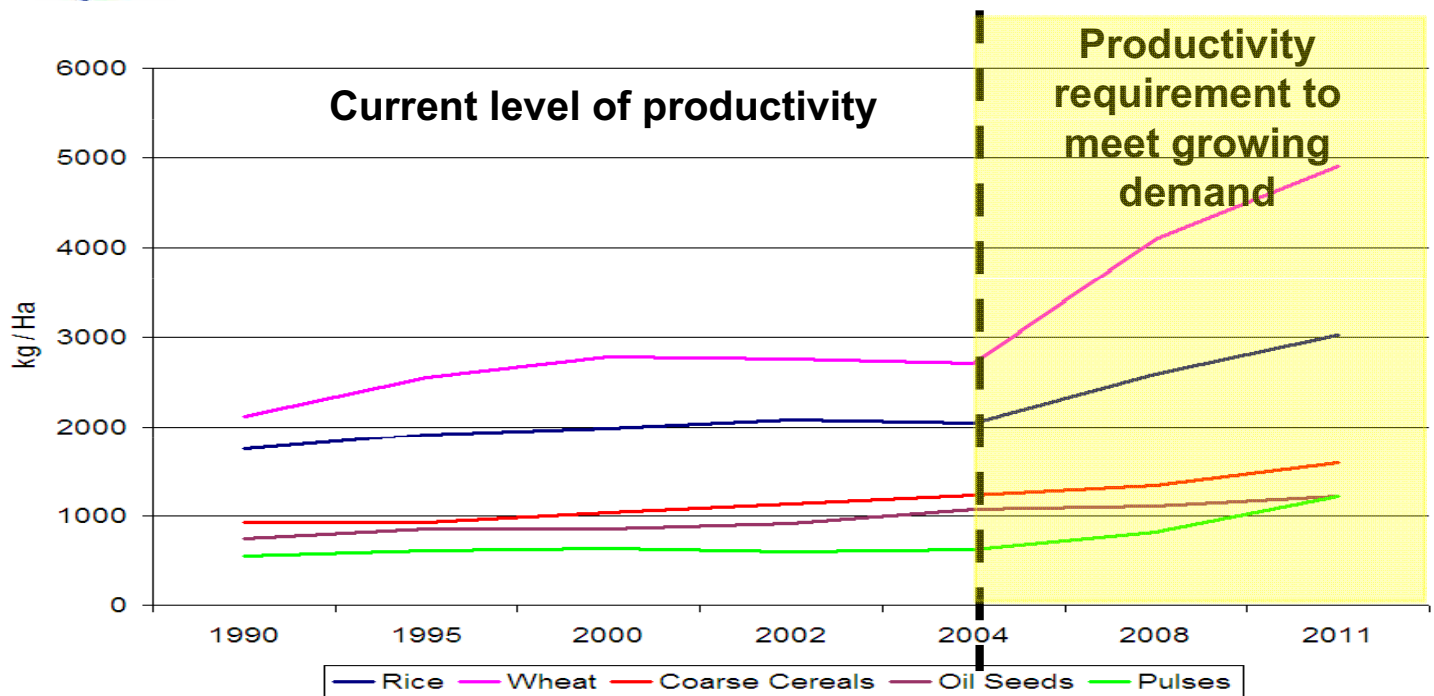
The Indian Context



Source: Economic Survey 2006-07



The Productivity Gap



Source: Ministry of Agriculture & Cooperation, India

Rapid productivity growth needed to cater to food requirement



Addressing Challenges

- The response of India has been a mixed bag
- Policy interventions have started recently
 - National Food Security Mission 2007
 - National Project on Balanced Use of Fertilisers 2007
 - Micro Irrigation Task Force 2004
 - National Horticulture Mission 2006
 - Promotion of Food Processing / Agri Export Zones 2006
 - Public Private Partnership Models 2006



Addressing Food Security

- National Food Security Mission 2007
 - Increase production of rice by 10 mn tons, wheat by 8 mn tons and pulses by 2 mn tons by 2011-12
 - Increasing production through area expansion and productivity enhancement in a sustainable manner
 - Bridging the yield gap through dissemination of improved technologies and farm management practices
 - Financial outlay of US \$ 1 bn
- National Project on Balanced use of Fertilizers 2007
 - To facilitate and promote Integrated Nutrient Management
 - Investment outlay of US \$ 220 mn over the next 5 years



Addressing Ecological Concerns

- Micro Irrigation task Force 2004
 - Micro Irrigation to the pivotal element of Integrated water use and farming system
 - Target to cover an area of about 14.0 mn ha under MI by 2011
 - Govt. investment outlay of US \$ 12 bn
- Road map for agricultural diversification
 - Diversifying from food grains to other crops
 - Being developed for Fruits, Vegetables, flowers, pulses & oil seeds



Addressing Market Access

- Infrastructure Development
 - National Highways Development
 - Plans for telecom and power sectors
 - Development of inland water ways
- National Horticulture Mission
 - End to end approach for forward and backward linkages
 - Envisaging Research, Production, Post Harvest management, Processing & Marketing
- Govt. / Private Enterprise for Agricultural Marketing Infrastructure
 - Pepsi is partnering with Punjab government for farming, procurement and processing of citrus produce
 - Partial dismantling of APMC Act in different states



Implications for the Fertilizer Industry

- Most of these initiatives have a far reaching impact on the fertilizer industry
- The Industry needs to understand clearly
 - Agricultural challenges
 - Opportunities that emerge from these challenges



Fertilizer Demand Drivers & Emerging Opportunities





Fertilizers Requirement

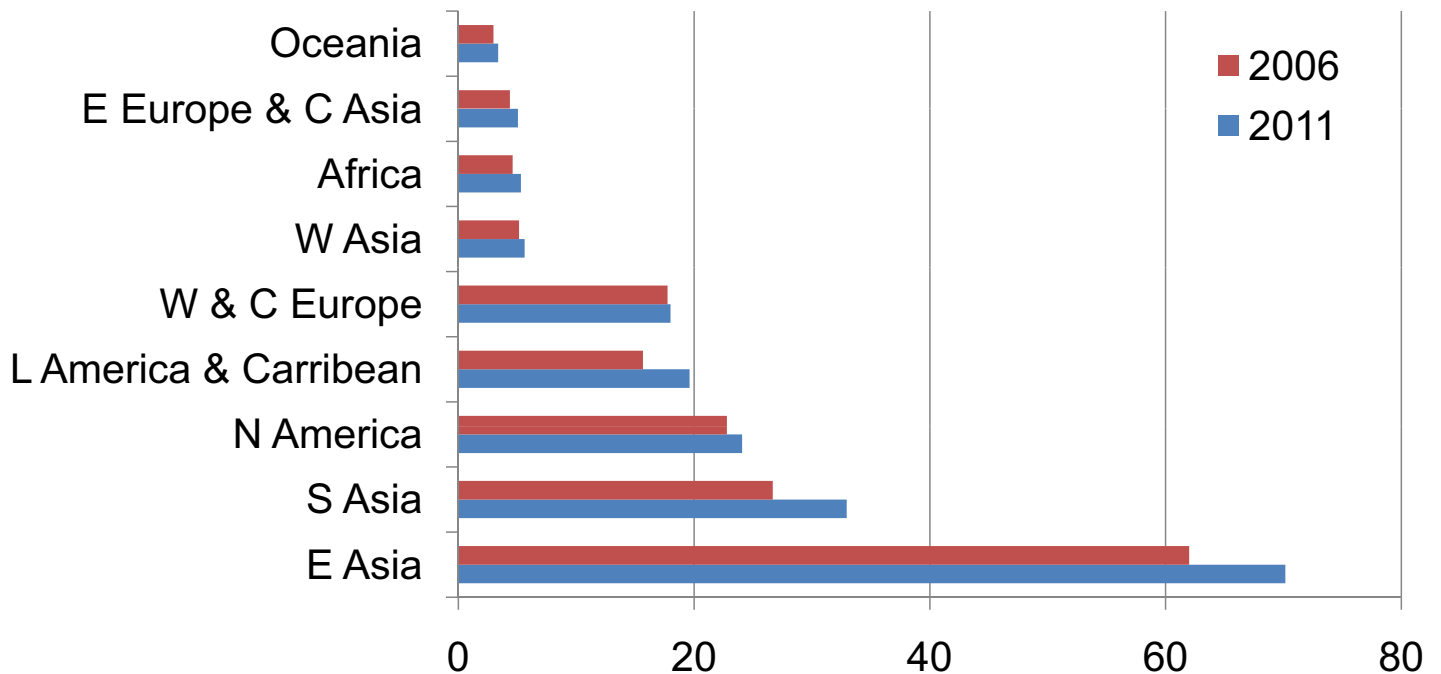
Global Fertilizer Consumption (mn MT nutrients)					
	2006	2007 (e)	Change (%)	2011(f)	Demand CAGR (%)
N	96.6	99.9	3.5	107.7	2.3
P ₂ O ₅	38.3	39.7	3.7	44.5	2.9
K ₂ O	27.0	28.2	4.2	31.9	3.2
Total	161.9	167.9	3.6	184.1	2.6

Source: IFA Working Group on Fertilizer Demand Forecasts

Opportunity: Robust growth in fertilizer demand



Fertilizers (N+P+K) Requirement



Source: IFA Working Group on Fertilizer Demand Forecasts

Opportunity: Huge demand in developing countries



Fertilizers & Productivity

Country	Nutrient Consumption	N:P:K	Yield (ton / ha)			
	kg / ha		Rice	Wheat	Maize	Potato
Australia	46.0	3.9 : 4.3 : 1	8.4	1.6	5.6	3.6
Bangladesh	188.6	6.8 : 1.6 : 1	3.6	1.9	5.1	14.4
Brazil	171.9	0.6 : 0.8 : 1	3.6	2.0	3.4	20.5
China	275.1	5.3 : 2.1 : 1	6.3	4.2	5.1	15.6
France	215.9	2.5 : 0.8 : 1	5.7	7.6	9.0	45.4
India	104.7	6.9 : 2.6 : 1	3.1	2.7	2.0	17.9
USA	122.4	2.4 : 0.9 : 1	7.8	2.9	10.1	43.8
World	105.5	3.4 : 1.4 : 1	4.0	2.9	4.9	17.4

Source: Fertiliser Statistics 2005-06; Fertiliser Association of India

Opportunity: Correcting consumption skew



Land Degradation

**Production without
plant nutrition is
mining the soil**

**Fertilizer increases
yield by 3-4 times**



Photo: Dr. Paul Seward, maize in Kenya

No nutrient
replacement

Nutrient
replacement with
fertilizers

Opportunity: Nutrient replacement



Stewardship Role of Fertilizer Industry





Ever-Green revolution

“What nations with small farms and resource poor farmers need is the enhancement of productivity in perpetuity, without associated ecological or social harm. The green revolution should become an ever-green revolution rooted in the principles of ecology, economics and social and gender equity.”

M S Swaminathan
“Father of Economic Ecology”



Paradigm Shift

Green Revolution



Ever-Green Revolution



Commodity centered
and Laboratory Research



Integrated Nutrient
Management centered
and Participatory
Research

M S Swaminathan



Call for Action 1: FBMPs

Right Product

Soil Testing

N, P, K, secondary and
micronutrients

Enhanced efficiency
fertilizers

Nutrient management
plans

Right Time

Application timing

Controlled-release
technologies

Inhibitors

Fertilizer product choice

Right Place

Application method

Incorporation of fertilizer

Buffer strips

Conservation tillage

Cover cropping

Right Rate

Soil testing

Yield goal analysis

Crop removal balance

Nutrient management
planning

Plant tissue analysis

Applicator calibration

Crop scouting

Record keeping

Variable rate technology

Site-specific management

Source: CFI

Maximising yields & profitability; minimising impact on
environment



Call for Action 2: Nutrition Security

- Micronutrient deficiencies are widespread



Zn deficiency:
global nutritional problem



- 50% of world cereal soils are deficient in zinc; 30% of global cultivated area is deficient in iron



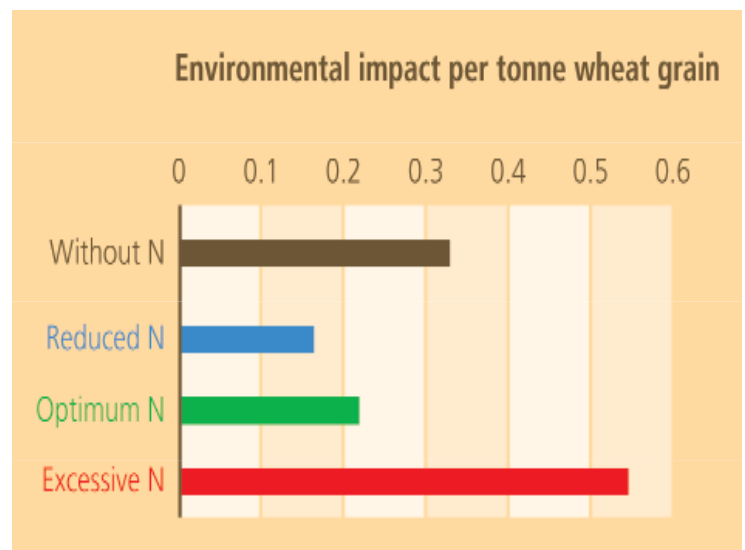
- Direct impact on crop and human well-being
 - Zinc, boron and selenium can be effectively supplied through fertilization
 - Eliminating micronutrient deficiencies could improve GDP by 5%, worker productivity by 30% - 70% and reduce maternal deaths by 50% (World Bank)

Opportunity: Improving human nutrition through effective fertilization



Call for Action 3: Conservation

- **Balanced fertility**
 - increased nutrient use efficiency
 - less likelihood of nutrient loss to the environment due to leaching and/or runoff



Source: The Broadbalk Experiment at Rothamsted Research (UK)

Efficient use of fertilizers & other nutrient sources is key



Call for Action 3: Conservation

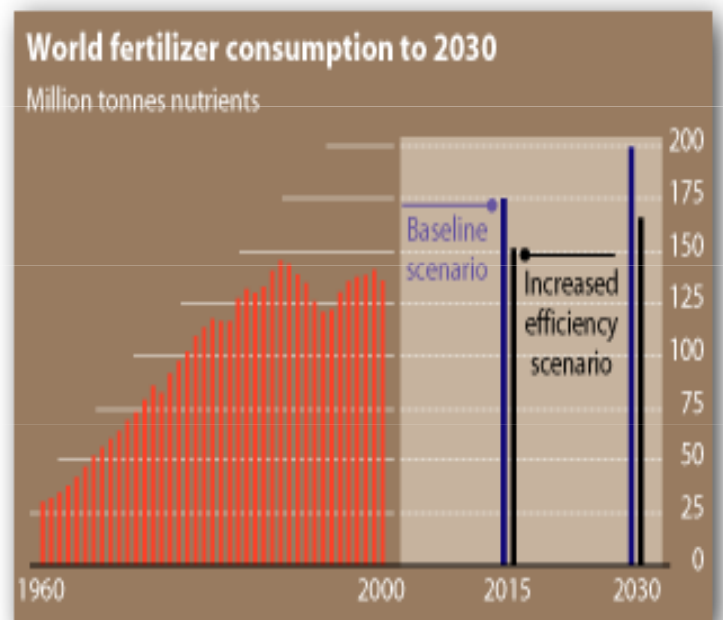


Source: Sustainable Development and the Fertilizer Industry, IFA



Call for Action 4: Innovation

- More research
 - Products with improved efficiency
 - Adapted to specific conditions in developing countries / new cropping patterns
- Adoption of existing innovations
 - Focus on last mile delivery



Source: "Fertilizer Requirements in 2015 and 2030" FAO, Rome. 2000



Call for Action 5: Collaboration

- Collaborative approach for enabling environment
 - Policy framework for adoption of FBMPs
 - Partnerships for ensuring widespread adoption of appropriate micro nutrients
 - Extension services for effective knowledge transfer
- Many countries around the world are introducing policies and legislation that impact the fertilizer industry
 - Policy change can have wide reaching effects on fertilizer production and distribution
 - Stakeholders in the food chain need to stay abreast of global and local trends, as well as policies and current thinking - not only in the fertilizer industry, but also across the agricultural sector as a whole.

Fertilizer industry as a responsible stakeholder



Inevitably, these challenges have to be addressed.

Can the fertilizer industry take the lead?



IFA Vision 2027 – Moving Beyond

- Placing human well-being back at the centre of agricultural policies;
- Achieving food security for all nations;
- Eradicating micronutrient deficiencies;
- Focusing attention on adequate, balanced nutrition as the foundation for a long, healthy and productive life;
- Halting and reversing soil degradation;
- Producing bio-energy;
- Fostering partnerships between farmers, consumers, governments and scientists in pursuit of these aims



Ever-Green revolution

“We need a second green revolution, to address the needs of the Third World's poor: a focus on increasing productivity from small farms on marginal land with low-input agricultural methods. These technologies, which include financial and political components, may be the key to satisfying the land hunger of the disadvantaged and the desperate who are slashing daily into the rain forest of Amazonia. It may also be the key to arresting the desertification of sub-Saharan Africa, where human need and climate stress now operate in a deadly partnership.”

Al Gore

*Earth's fate is the No. 1 National Security Issue,
Washington Post, October 2007*



Thank You

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