Feeding the World: Time for a New Green Revolution

**Speakers**

Bill Cordingley, Managing Director and Head of Food and Agribusiness Research and Advisory-The Americas, Rabobank International

Richard Kottmeyer, Global Agriculture and Food Production Leader, IBM Global Services

David Morgan, President, Syngenta Seeds, Inc.; Region Director - North America, Syngenta

Iris Yedidia, Group Leader, Agricultural Microbiology and Biotechnology, Agricultural Research Organization, Israeli Ministry of Agriculture

**Moderator**

Carole Brookins, Managing Director, Public Capital Advisors, LLC
World GDP growth

The world economy is expected to recover from the global financial crisis

Source: World Economic Outlook, April 2012.
Note: Projections are shaded.
World population

*World population is continuously increasing – 7 billion in Oct. 2011*

Arable land

Arable land as percent of total land is much less than it twenty years ago

Climate change in the world

*Change in mean precipitation (mm per year) for 2040, projected, relative to 1970-1999*

World food consumption

The consumption of major crops and livestock increases continuously.

World commodity price (2005=100)

*Food price and commodity price are increasing*

Source: World Economic Outlook, April 2012.
Agriculture productivity for the U.S.

Total factor productivity in the U.S. has been increasing since 1948

Food expenditures

U.S. food expenditures as a share of disposable personal income have been decreasing

Global Hunger Index and its distribution

Global Hunger Index tends to decrease in the world and in regions

Agricultural export destinations
Top 10 U.S. agricultural export destinations by US$, 2011

- Mexico, 14.8%
- Japan, 13.4%
- Nigeria, 11.0%
- South Korea, 16.4%
- Philippines, 10.3%
- Taiwan, 4.5%
- Indonesia, 1.7%
- EU-27, 1.3%
- Dominican Republic, 1.7%
- Thailand, 5.4%
- Japan, 13.4%
- Nigeria, 11.0%

Food export commodities

Top 10 U.S. food export commodities by US$, 2011

Soybean exports

Top 10 U.S. soybean export destinations by volume, February, 2012

World agriculture R&D input

Private R&D expenditures for food and agriculture, 2010

Crop protection chemicals: 28.3%
Crop seed & biotech: 33.8%
Farm machinery: 21.7%
Food animal health: 8.5%
Fertilizer: 0.9%
Animal breeding & genetics: 3.1%
Animal nutrition: 3.7%

U.S. agricultural research funding

U.S. agricultural research funding in public and private sectors, 1970-2009

Technology - Genetically Engineered (GE) crops

Varieties of GE crops in the United States are increasing

Carole Brookins
Managing Director, Public Capital Advisors, LLC
THINKING ABOUT “FEEDING THE WORLD”?

• “…We (are) made ominously conscious of the thin edge between hope and hunger, and the world’s dependence on the surplus production of a few nations…We must begin here with the challenge of food…”

- Henry Kissinger, US Secretary of State, 1974 World Food Conference

• “Between now and 2040…Water problems will hinder the ability of key countries to produce food and generate energy, posing a risk to global food markets and hobbling economic growth..North Africa, the Middle East and South Asia will face major (water) challenges…”

U.S. real agricultural R&D spending

Source: Council on Agricultural Science and Technology.
Disparate global maize yields

Source: FAO.
1.4 trillion 2012 global R&D spending: How much in Food/Ag?

USA-Private Industry $275; USG $125 bln

Source: Battelle-R&D Magazine.
FY2013 US federal government R&D budget $140.8 bln

US Government FY2013 R&D Priority Agency Spending:
DOD, HHS, DOE : $115 Bln

Priority Tech/Innovation:
1. Clean Energy
2. Smart Infrastructure
3. Wireless Broadband
4. Cybersecurity
5. Aerospace

FY2013 Agriculture R&D Budget – (BlnUS $2.3)

- Crop Protection
- Food Safety
- New Products/Quality/Value...
- Human Nutrition
- Livestock Protection
- Livestock Production

0 50 100 150 200
Bill Cordingley
Managing Director and Head of Food and Agribusiness Research and Advisory-The Americas, Rabobank International
Population growth forecast, selected regions, 2011-2021f

Source: UN Population Division, 2011.
Food markets to grow by 109% in ten years

Source: Rabobank, based on KEO, Economist Intelligence Unit and FAO.
Economic growth effects consumption

<table>
<thead>
<tr>
<th>Per capita income level</th>
<th>Effect of economic growth on food consumption</th>
<th>Number of people affected (selected countries)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;USD 2 per day</td>
<td>Eat more (increase calorie intake)</td>
<td>2.6 billion (Africa, India, Indonesia, China)</td>
</tr>
<tr>
<td>USD 2-10 per day</td>
<td>Switch from grains to meat and dairy</td>
<td>1.6 billion (mostly in China)</td>
</tr>
<tr>
<td>&gt;USD 10 per day</td>
<td>Increase spending on services/quality (convenience, brands, fresh/cooled)</td>
<td>1.6 billion (developed world)</td>
</tr>
</tbody>
</table>
Global yields sound the supply alarm bells!

*World yield growth, 5-year moving average, 1966-2009*

**Wheat**

**Corn**

Source: Food and Agriculture Organization of the United Nations, 2011.
Global yields sound the supply alarm bells!

*World yield growth, 5-year moving average, 1966-2009*

**Soybeans**

**Rice, paddy**

Source: Food and Agriculture Organization of the United Nations, 2011.
The supply/demand mismatch is the biggest challenge

*Arable land per capita, selected regions, 2009*
## Potential land availability

<table>
<thead>
<tr>
<th>Region</th>
<th>Currently cultivated</th>
<th>Potential supply of additional land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Saharan Africa</td>
<td>210,149</td>
<td>201,540</td>
</tr>
<tr>
<td>Sudan</td>
<td>16,311</td>
<td>46,025</td>
</tr>
<tr>
<td>Dem. Rep. of Congo</td>
<td>14,739</td>
<td>22,498</td>
</tr>
<tr>
<td>South America and Caribbean</td>
<td>162,289</td>
<td>123,342</td>
</tr>
<tr>
<td>Brazil</td>
<td>62,293</td>
<td>45,472</td>
</tr>
<tr>
<td>Argentina</td>
<td>28,154</td>
<td>29,500</td>
</tr>
<tr>
<td>Eastern Europe and Central Asia</td>
<td>251,811</td>
<td>52,387</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>119,985</td>
<td>38,434</td>
</tr>
<tr>
<td>Rest of the world</td>
<td>878,113</td>
<td>68,355</td>
</tr>
</tbody>
</table>

Its more than agronomic potential that determines Ag output

Unmet yield potential of key production regions

Farm structures vary hugely between continents

Increasing trade will play a role, but can’t be the whole solution

Source: USDA/ERS 2011.
<table>
<thead>
<tr>
<th>Country</th>
<th>Million tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2000</td>
</tr>
<tr>
<td>Egypt</td>
<td>-14</td>
</tr>
<tr>
<td>Algeria</td>
<td>-8</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>-9</td>
</tr>
<tr>
<td>China</td>
<td>-10</td>
</tr>
<tr>
<td>India</td>
<td>3</td>
</tr>
<tr>
<td>Japan</td>
<td>-48</td>
</tr>
<tr>
<td>South Korea</td>
<td>-20</td>
</tr>
</tbody>
</table>

Source: Rabobank, Food and Agriculture Organization of the United Nations, OECD, 2011.
Case study: India’s so big, but so much potential

- Agriculture represents 17.1% of GDP (2009)
- Employs 52% of the total workforce
- 126 million farming families engaged in primary agriculture
- Average farm size – 1.41 Ha
- Favourable government policies

India has the potential to be:
- One of the largest food markets in the world
- One of the top global exporters
- The home base for many Indian Multinational Corporations

#1 – Milk producer (108 million tonne)
#1 – Cattle/buffaloes (283 mn)
#2 – Arable land area (161 mn ha)
#2 – Fruit and Vegetables (188 mn tonnes)
#2 – Food grains (229 mn tonnes)
#2 – Sugarcane (271 mn tonnes)
#3 – Agri commodities
Farmer consolidation is one ingredient to meeting the food challenge!

Number of US hog operations vs. US pork production

Source: USDA, NASS, 2011.
David Morgan
President, Syngenta Seeds, Inc.; Region Director - North America, Syngenta
Did you know that…?

By 2050, global population will rise by about a third to 9 billion people but

Global calorie demand will increase by 50%

Source: FAO, World Bank statistics, Syngenta
Demand for food is driven by population growth and rising calorie consumption

World population
> 80% of growth happens in emerging markets

World demand for major crops*

- Food
- Feed

Source: FAO, Syngenta analysis
Environmental stresses are increasing

The change in climate is already reducing water and arable land . . .

Climate change impact
- High
- Medium
- Low

. . . requiring better use of existing farm land

1 hectare fed 2 people

1 hectare needs to feed 5 people

Source: UNEP, Cline, Syngenta
Modern Agriculture has enabled real progress

We are growing more from less, but we need to do more

Source: USDA, January 2010
Environmental Benefits of Modern Agriculture

Cotton, 1987-2007

Soybeans, 1987-2007

Corn, 1987-2007

Wheat, 1987-2007
Agricultural production: emerging markets drive future growth

Global field crop production*
Billion tons, est.

<table>
<thead>
<tr>
<th></th>
<th>Avg 2007-2009</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed countries**</td>
<td>~75% of global production growth</td>
<td></td>
</tr>
<tr>
<td>Rest of World</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRIC**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Includes: wheat, oilseeds, rice, coarse grains
** BRIC = Brazil, Russia, India, China; Developed = NAFTA, EU, Japan, Australia

Source: FAO-OECD 2010/19 Agricultural Outlook, Syngenta Analysis

Classification: PUBLIC
Challenges for global agriculture

- Huge rise in demand
- Limited farmland
- Limited water supplies
- Need to continue raising yields

We must grow more from less

Only sustainable approach is to unlock the potential of plants through innovation
PLENE: Focus on efficiency and sustainability

The first integrated mechanized planting system for sugar cane

Healthy seedlings production at Syngenta nurseries
- Disease-free
- Traceable
- Genetic warranty

Production and processing units
- Cleaning and cutting
- Treatment with Syngenta technologies
- Packaging

Planting
- Minimal tillage
- High productivity
- Better use of natural resources

Labor
- Less manpower
- Greater efficiency
- Better working conditions

Continued value creation
- Faster germination
- Increased resistance
- Complete crop protection program
- Greater convenience and reduced cost

15% Cost reduction for growers

Classification: PUBLIC
in sugarcane: anticipating customer needs
TEGRA: transforming rice production

Securing yield and reducing labor for smallholders: introducing a revolutionary transplanting system

Preferred retailers place direct Farmer orders

High quality treated seeds

Integrated technology in seedling tray

Agronomy protocol to maximize yields

Transplant franchisees offer seedlings-in-the-field

Nursery franchisees raise healthy seedlings

30% yield advantage

150% return on investment
“If our new varieties had been subjected to the kinds of regulatory strictures and requirements that are being inflicted upon the new biotechnology, they never would have become available.”

Norman Borlaug
Iris Yedidia
Group Leader, Agricultural Microbiology and Biotechnology, Agricultural Research
The main challenges of Israeli agriculture

Challenges:
• Shortage of water resources
• Scarcity of precipitation
• Two thirds of the land area defined as semi-arid or arid
• Complex geopolitical environment
• Distance from export markets

These limitations compel Israeli agriculture to:
• Ensure a high degree of self supply
• Protect domestic produce
• Develop intensive production
• Maintain peripheral areas
Current research priorities & areas at ARO

• Facing agricultural threats (global & local):
  - Climate change
  - Food security crisis
  - Alternative energy

• Precision agriculture (ICT = Information & Communication Technologies)

• Agricultural biotechnology and its legal and societal regulation

• Market-oriented novel agricultural products

• Economics, marketing and rural development policy
Evolution of productivity in agriculture and other sectors

Productivity in different sectors

Agriculture productivity and efficiency

Source: Bank of Israel.
Potential irrigation water sources

Irrigation technologies, purification and recycling, desalination

- Existing potable water resources (lakes, aquifers, streams)
- Marginal water (saline water, recycled water)
- Rainfall enhancement
- Desalination
- Water saving: improved irrigation practices and technology (precision agriculture, leak prevention, drip irrigation), education

Moving irrigation systems increased efficiency

Thermal imaging water status
Breeding

*Functional plant biology at the Agriculture Research Organization*

- Development of genetic material for breeding programs, mapping genetic markers for important genes in fruits and vegetables
- Resistance to pathogens, drought and salinity
- Extended seasonal productivity
- Effecting size & shape, pigments
- Enhancement of taste, aroma, shelf life & quality (vitamins, antioxidants)
Fruit breeding

Sample: pomegranate development at the ARO

Breeding for quality and year round production

Technology development: agricultural engineering and postharvest technologies

New Israeli varieties

Final product: arils and peel

Automatic peeling and arils retrieving
Netting technology

Climate and growth control

- Protection from environmental hazards
- Water saving
- Different colors for plant growth control
- Shadowing for climate control
- Pest control
Precision agriculture
The right thing in the right place at the right time

- Site specific weed management
- Site specific pest management
- Spatial variability for disease control
- Thermal imaging – water status variability

- Over/under-application of resources
- Ground water contamination by chemicals
- Reduction in yield quality
Development of new cultivation methods

Cultivars selection, irrigation and technology assimilation

Olive orchards:
- New varieties
- Use of recycled and brackish water
- Transformation of grape-harvester to olive-harvester

Traditional cultivation

Irrigation

New plantations

Cultivation methods

Oil quality

Thank You

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