Feeding 9 Billion, Maintaining the Planet
The Challenge by 2050

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“You can’t wake a person who’s pretending to sleep”  
Oromo Proverb
population \times consumption \neq \text{planet}
We need to use less . . .

. . . to produce more from less.
On a finite planet should consumers have a choice about sustainable products?
Or, should every product be sustainable?
If so, we need collusion to address sustainability.
it’s how to think, not what to think
1 latte > 200 liters of water

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Volume (liters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Lid</td>
<td>2.5</td>
</tr>
<tr>
<td>Cup &amp; Sleeve</td>
<td>5.5</td>
</tr>
<tr>
<td>Sugar</td>
<td>7.5</td>
</tr>
<tr>
<td>Milk</td>
<td>49.5</td>
</tr>
<tr>
<td>Coffee</td>
<td>142.8</td>
</tr>
</tbody>
</table>

= 1 liter
World Projected Caloric Distribution Change

Total Calories Delivered Per Capita Per Day in 2000
World Average 2,712

Cereals 47.7%
Sugar & Sweeteners 8.6%
Vegetables 2.6%
Fruits 2.7%
Pork 4.0%
Beef 1.3%
Oils 1.7%
Pulses 5.5%
Vegetable Oils 10.9%

Other 4.8%

Total Calories Delivered Per Capita Per Day in 2050
World Average 3,226

Cereals 41.0%
Sugar & Sweeteners 9.1%
Vegetables 2.5%
Fruits 3.0%
Pork 2.6%
Beef 3.6%
Oils 1.2%
Pulses 1.7%
Starchy Roots 4.3%
Vegetable Oils 15.0%

Source: Calories in 2000 as reported by the Food and Agricultural Organization of the United Nations
What does increasing egg production by >100% by 2050 mean for the planet?
Brazilian Soy & Pigs in China

Million Metric Tons

- Brazil Soy Production
- China Soy Production
- China Pig Production
China Imports Soy, Cotton and Sugar from Brazil, but...

...is buying water, soil, efficiency, and reduced pollution
Status of Global Marine Fisheries

1974: 51% Underexploited, 40% Fully Exploited, 9% Overexploited
1990: 51% Underexploited, 31% Fully Exploited, 18% Overexploited
2006: 52% Underexploited, 25% Fully Exploited, 23% Overexploited

Source: FAO (2008)
<table>
<thead>
<tr>
<th></th>
<th>1925</th>
<th>1945</th>
<th>1965</th>
<th>1985</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion - kg feed/kg live</td>
<td>4.7</td>
<td>4.0</td>
<td>2.4</td>
<td>2.0</td>
<td>1.8</td>
</tr>
<tr>
<td>Mortality %</td>
<td>18%</td>
<td>10%</td>
<td>6%</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Age</td>
<td>112</td>
<td>84</td>
<td>63</td>
<td>49</td>
<td>42</td>
</tr>
<tr>
<td>Live commercial weight - kg</td>
<td>1.0</td>
<td>1.4</td>
<td>1.6</td>
<td>1.9</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Source: Dr. Paul Aho The World Chicken Meat Industry 1984 to 2004 - May 2004
Agriculture’s Global Footprint

33% of Earth’s surface in crops or grazing but 58% of habitable area
Beef—
60% of all land used to produce food
1.3% of all calories
Producing Cattle—Better and Worse

- Same rainfall, soils and species
  - Same place (1 mile apart)
  - Pictures taken the same day
- 4 times more cattle and more wildlife

The only difference is management
Agriculture uses 70% of water used by humans
Global Water Scarcity

![Map showing global water scarcity](image)

- **Extreme Scarcity**: <500 m³/person/year
- **Scarcity**: 500-1,000 m³/person/year
- **Stress**: 1,000-1,700 m³/person/year
- **Adequate**: 1,700-4,000 m³/person/year
- **Abundant**: 4,000-10,000 m³/person/year
- **Surplus**: >10,000 m³/person/year
- **Ocean/Inland Water**
- **No Data**
Key water-related challenges:

Introduction

The Water Content of Things

Source: Peter Gleick, Pacific Institute
Graphic: Eric Daigh for Circle of Blue
# Selected Products, Water Use and Farmer Income

<table>
<thead>
<tr>
<th></th>
<th>Raw material input</th>
<th>Water to produce input</th>
<th>Farm gate price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Cotton T-shirt</td>
<td>4 oz ginned</td>
<td>500 to 2,000 liters of water</td>
<td>US$0.20 (Aust.)</td>
</tr>
<tr>
<td>1 liter of soda</td>
<td>6 T sugar</td>
<td>175-250 liters of water</td>
<td>US$0.006 (Brazil)</td>
</tr>
<tr>
<td>1 oz. slice of cheese</td>
<td>6 oz milk</td>
<td>40 liters of water</td>
<td>US$0.03 (US)</td>
</tr>
<tr>
<td>1 double quarter-pounder</td>
<td>8 oz hamburger</td>
<td>3,000 to 15,000 liters of water</td>
<td>US$0.25 (US)</td>
</tr>
</tbody>
</table>
Consumers should pay the true cost of products.
Food as a % of US Household Income

<table>
<thead>
<tr>
<th>Year</th>
<th>Food as a % of US Household Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>'29</td>
<td>25%</td>
</tr>
<tr>
<td>'07</td>
<td>10%</td>
</tr>
</tbody>
</table>

Data: Pacific Ethanol
But today, 1 billion don’t have enough food.
Half of the world’s farmers can’t feed their own families.
Global Trends by 2050

- Population—3 billion more
- Income will increase by 2.9 times
- Consumption will double
- 70% will live in cities—as many as are alive today
Freezing the Footprint of Food

How to triple food production on the same amount of land by 2050
Impacts that are acceptable with 6.7 billion
Will not be with 9 billion people
You manage what you measure. But, producing anything has impacts. So, what should we measure?
What are the right metrics for animal agriculture?

Head per hectare land?
Kg per hectare of land?
Kg of product per M3 of water?
Calories per hectare?
Grams of protein per hectare?
Grams of protein in per grams of protein out?
Cost of production per calorie of production?
Kg of C avoided or sequestered /ha, /MT, /calorie of production?
We must shift our thinking from trying to maximize any one variable
to optimizing the key ones
Possible “efficiency” metrics for eggs

- Weight of bird at first laying
- Days at first laying
- Mortality before first laying
- Average laying life
- FCR for eggs
- Energy use per kg of eggs
- Volume of eggs per week
- Broken eggs per week
Likely metrics for eggs going forward

- CO2e emissions per kg of eggs
- Water use per kg of eggs (direct and indirect)
- Waste per kg of eggs
- Fishmeal and fish oil as percent of feed
- Medication use per month (interventions and total)
- Space per layer
- Occurrence of unacceptable levels of salmonella, bacteria, e-coli, etc.
- Worker sick days per year
Does stocking density = animal welfare?

Possible indicators from aquaculture include:

- Feed conversion ratios (FCRs)
- Time to market
- Survival rates
- Disease outbreaks
- Medicines used per MT of product
- Medical interventions per MT of product
- Air quality
Key issues for egg production goals

- Production efficiencies (FCR, CO2e, water, etc.)
- Scarce resources (reduction fisheries)
- Indirect resource impacts (feed production)
- Increased awareness of impacts (CO2e, water)
- Other issues (animal welfare, medication)
- Grams of protein in and out
How do we produce twice as much with fewer resources?
Intensify production.
Sustainability—Better Practices or Performance?
To Improve Egg Production . . . .

Need to be science based
Don’t focus on just one thing
Don’t try to focus on everything
Need consensus on 6-8 key impacts
Understand the global performance baseline as well as regional variations
To Summarize

Focus on results, not just BMPs
Insist on continuous improvement
Be technology neutral, again focus on results
Address cumulative impacts
Externalities (e.g. C and water) will change the economics
Market Trends—You’re Not in a Vacuum

Supply chains are longer than ever—but fewer players
Supply chains are moving more to partnerships
Purchases are trending toward long-term contracts
Finance is following suit
Carbon (and water) will change the economics
Consumers aren’t always (often) informed, but they can always be made to care

The egg industry needs to anticipate issues and pre-empt them identifying and raising key issues
“If you don’t know where you’re going any road will get you there.”