Agricultural and Life Science Research at Texas A&M

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Texas Economy

1. Gross State Product = $1.33 trillion
2. If Texas were a country – 14th largest in the world (2010 World Bank rankings)
3. 8 billion barrels of known petroleum reserves; 1/3 of U.S. total
4. Largest producer of wind energy in the U.S.

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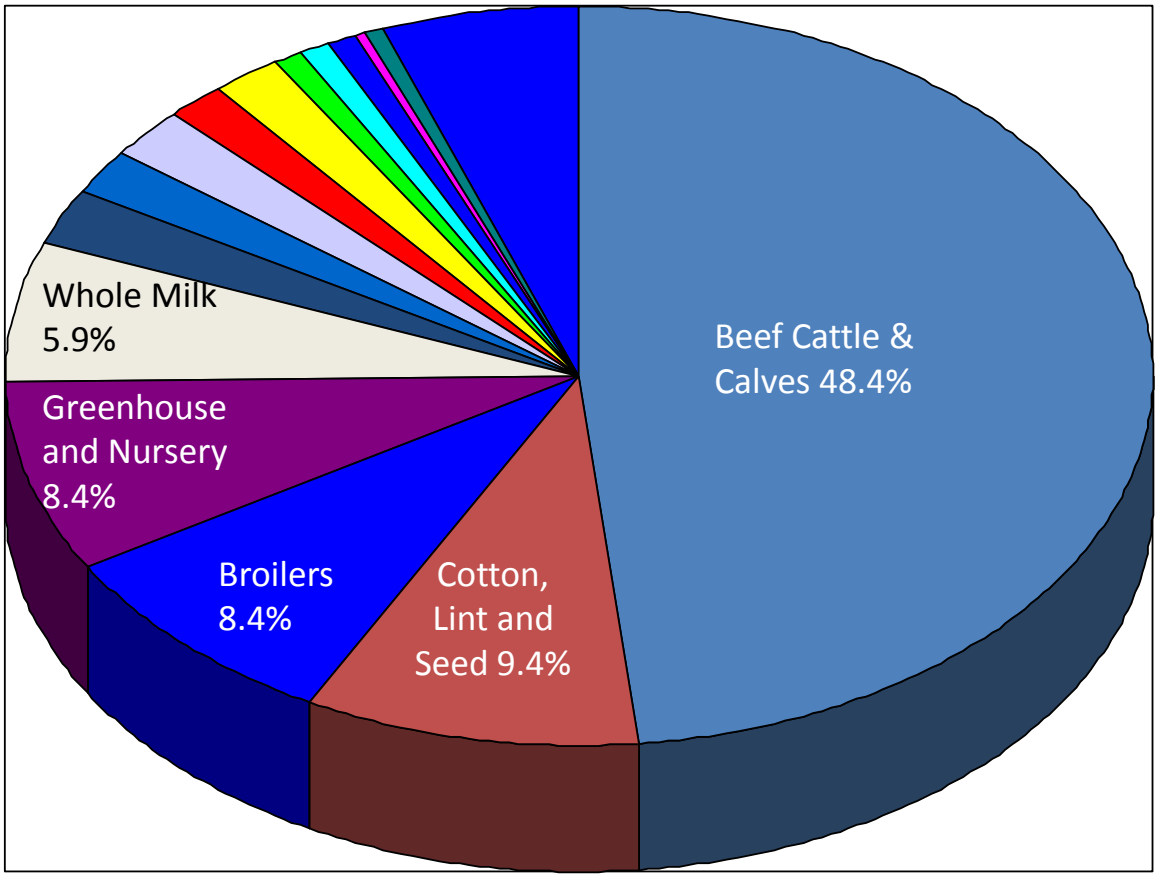
Agriculture's Economic Impact: >$100 billion



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Texas A&M System

1. 11 universities – 125,000 students
2. 7 state agencies, comprehensive health science center, and law school
3. 22 million educational contacts annually through service and outreach
4. Physical presence in 250 of 254 counties and programmatic presence in all counties
5. $3.8 billion total operating budget

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Texas A&M AgriLife Research

1. 13 research centers across the state
2. 1,600 full-time employees (606 Ph.D.)
3. 1,000 graduate students and other part-time employees
4. 582 research projects
5. $200 million in annual expenditures

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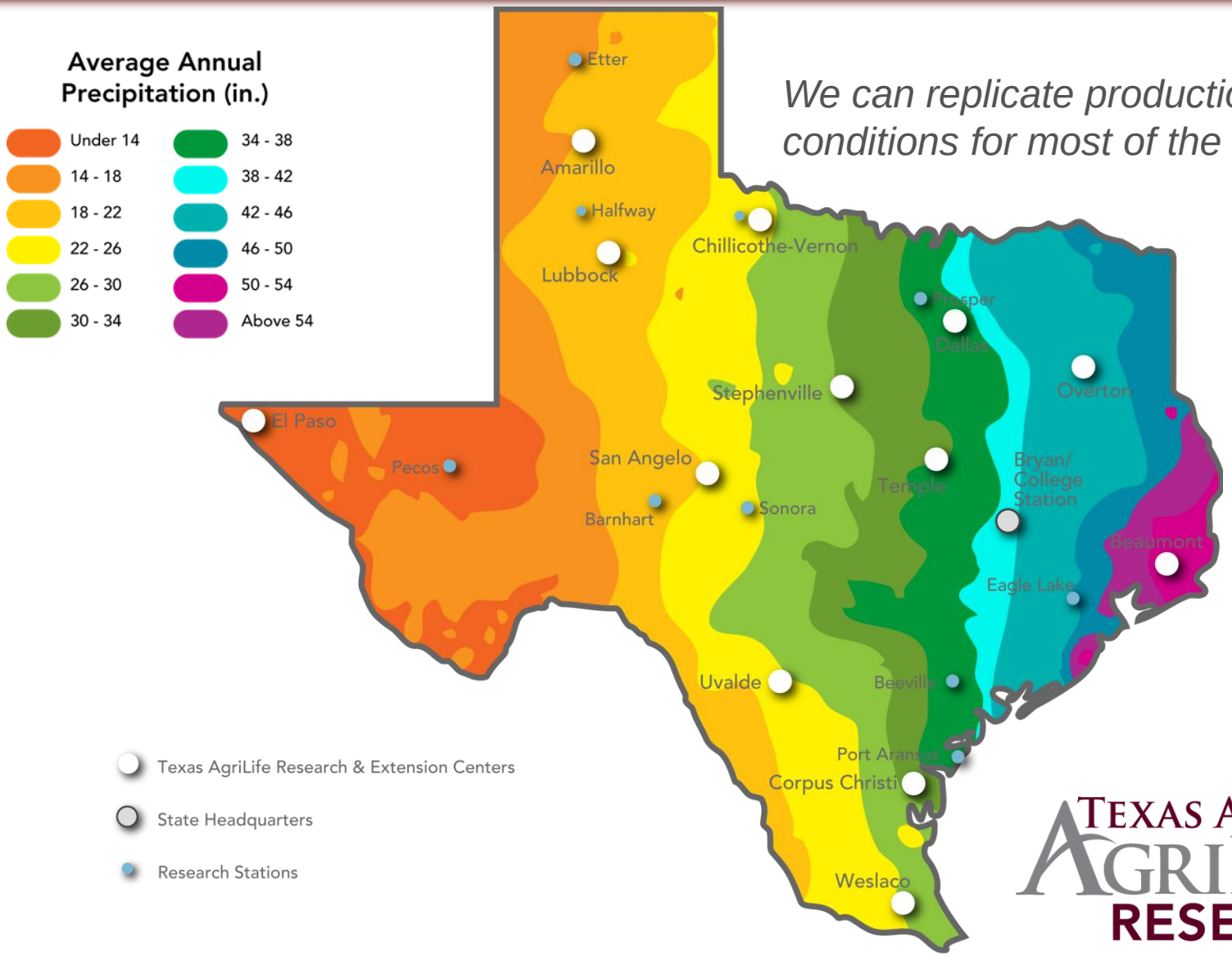
Precipitation Gradient



We can replicate production conditions for most of the world

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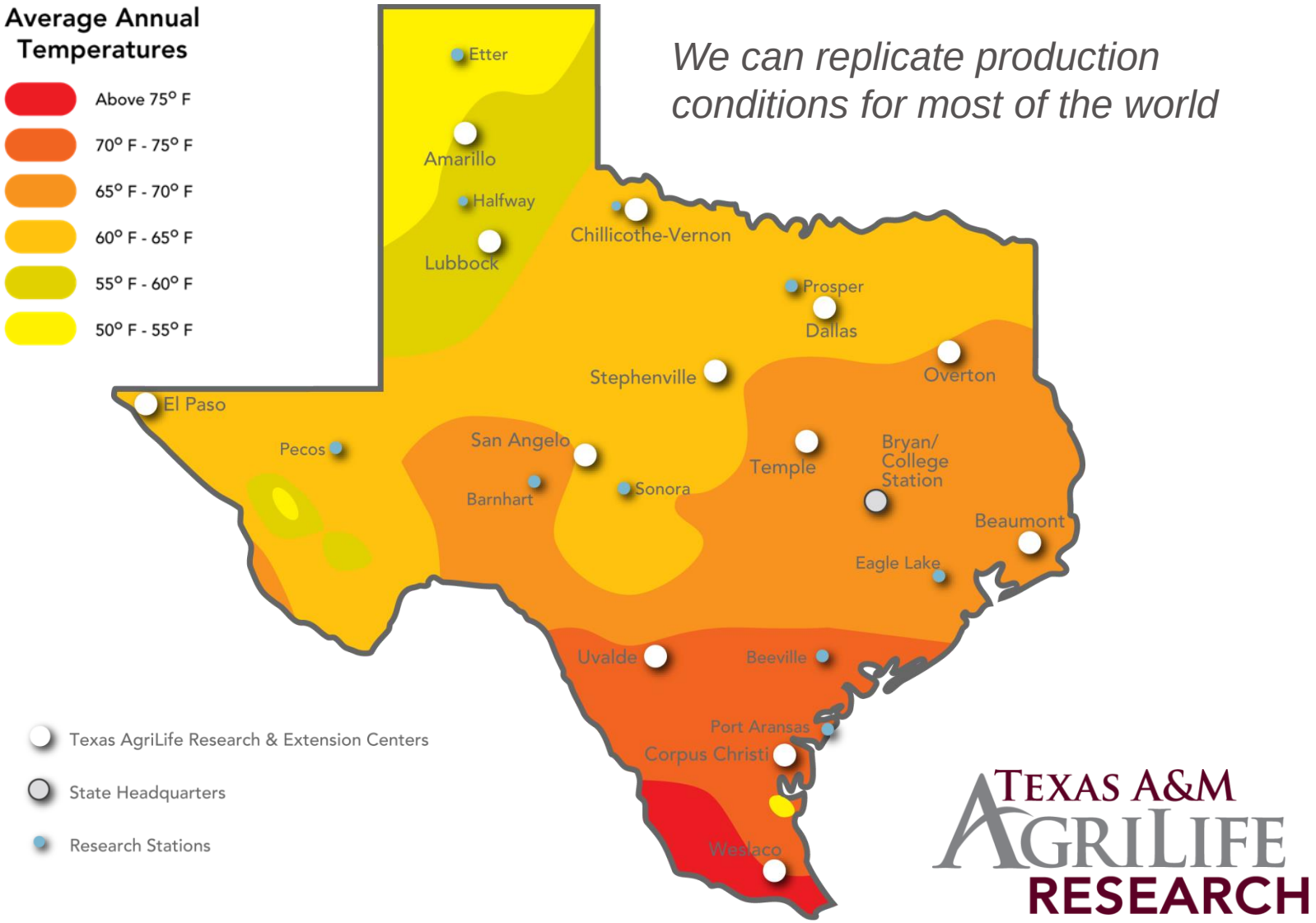
Temperature Gradient



We can replicate production conditions for most of the world

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Variation in Soil Types

We can replicate production conditions for most of the world

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Evolution of Business Model for Public Research

1. Business model has radically changed at Land Grant university systems
2. One size does not fit all
3. Relationships among university systems and companies are evolving, but increasingly customized to meet the needs of each partner in the private sector

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Public-Private Partnerships

1. Why do university systems seek partnerships in the private sector?
   a. Bayh-Dole Act of 1980
   b. Texas State law regarding IP protection and fiduciary responsibility of officers
2. Follow the money
   a. Industry accounts for 72% of R&D spending in the U.S.
   b. Universities (all sources of funding) – 13%
   c. Public funding for university research has declined 25% per student during the past 20 years

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Private Sector Perspective

Why do companies sponsor research or collaborate with public universities?

a. Flexibility in R&D portfolio
b. Access to public investment in infrastructure
c. Outsourcing upstream, “basic” research
d. Leveraging human capital (facilitate regular interaction with faculty under NDA)
e. Competitive advantage in recruiting talent

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Interaction with the Private Sector

1. Transactional
   a. Fee for service – validation or demonstration
   b. Sponsored research – project and publication driven
2. Relationship-Based
   a. Comprehensive combined R&D strategy
   b. Master research agreement, including IP protection and pathway to commercialization
   c. Taking IP to scale through start-up or joint venture with pre-defined exit strategy

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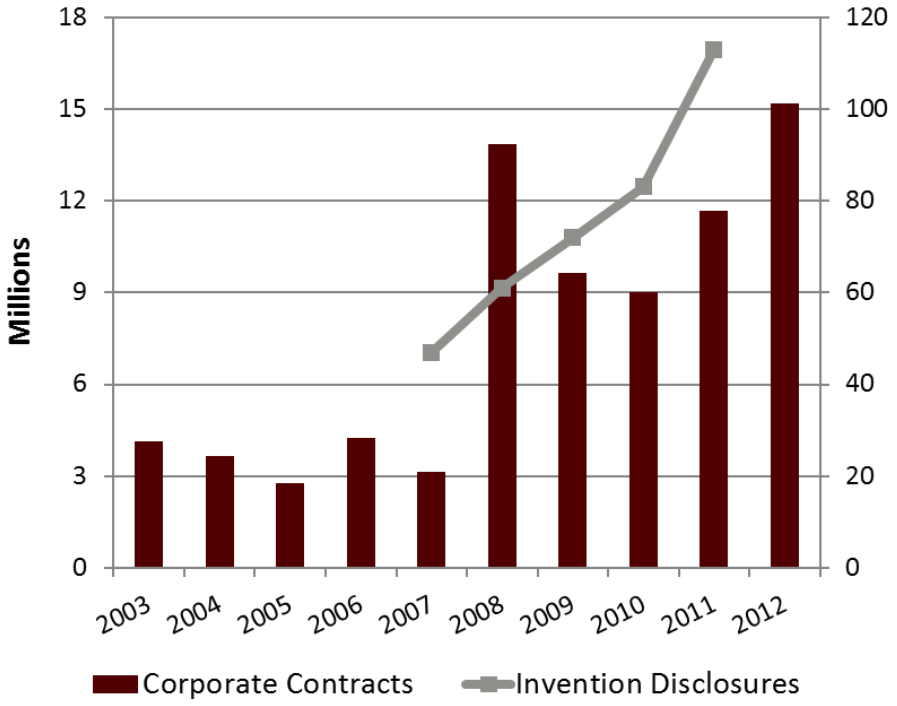
Generating Real Value

Office of Corporate Relations

a. Established in 2007
b. Dedicated channel of communication
c. Collaborative partnerships
d. Project manager for single POC
e. Deliverable-driven strategy
f. $100M in R&D contracts
g. 390 invention disclosures
h. >100 commercial licenses (1/3 exclusive rights)



AgriLife Research is now the #1 Texas A&M System member for disclosures, licenses and royalties

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Selected Strategic Partners

syngenta

MONSANTO

Ceres

Chevron

BAYER Bayer CropScience

DEPARTMENT OF DEFENSE · UNITED STATES OF AMERICA

OAK RIDGE National Laboratory

Los Alamos NATIONAL LABORATORY

DONALD DANFORTH PLANT SCIENCE CENTER

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Drivers of Global Change

1. Food security
2. Water
3. Distributed energy
4. Political risk and public policy

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Food Security

1. Population growth – 7B to 9B in 2050
2. Rising disposable income effect: Global demand for meat and poultry up from 172 MMT in 1990 to 279 MMT in 2010 (fish and seafood – 97 to 149 MMT): FAO
3. Moral and ethical considerations - Albert Einstein: “Our technology has exceeded our humanity.”
4. National and global security – Hunger and armed conflict go hand-in-hand.

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SUSTAINABLE DEVELOPMENT SOLUTIONS NETWORK
A GLOBAL INITIATIVE FOR THE UNITED NATIONS

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Water

1. Texas Water Resources Institute
2. Institute for Renewable Natural Resources
3. Salt tolerance, drought tolerance, irrigation efficiency, cropping system modeling, alternative crops (guar, guayule, castor, salicornia, etc.)
4. Zero-valent iron system for water treatment at coal-fired power plants, mining, fracking (hydraulic fracturing), and other industrial applications
5. Electron beam treatment of municipal waste water
6. Fluidized gas bed reactor/water treatment combination

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Distributed Energy – Opportunities and Challenges

1. Energy Independence and Security Act of 2007 – 36 billion gallons of biofuel by 2022
2. Sustainability of initiative
   a. Food and feed vs. fuel controversy
      i. Must use marginal land and/or impaired water
   b. Economic viability without subsidies
      i. Added value co-products
      ii. Yield and conversion must be improved
      iii. Logistics of feedstock supply chain

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Distributed Energy – Dedicated Energy Crops

1. Energy cane
   a. Extend sugarcane season for Brazilian ethanol refineries
2. Wide hybrids – sorcane and miscane
   a. Crop establishment
   b. Cold and drought tolerance

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Distributed Energy – Algae

1. Genetically engineer new strains of algae
2. Evaluate new reactor designs
3. Improve agronomic practices
4. Integrate CO_2 from coal fired power plants
5. Develop real-time process control systems
6. Optimize oil extraction technologies
7. Add value to co-products

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Demographic Shifts and Political Risk

1. Aging population in developed economies
    - Demand shifts in market basket
2. Negative population growth in developed economies (45 countries)
    - Technology dilemma: fewer workers but anti-science bias in media, activists, and some consumers
3. GM corn and soybeans are industry standard but regulatory cost for new approvals is enormous (citrus greening)
4. GM animals may never be accepted by consumers

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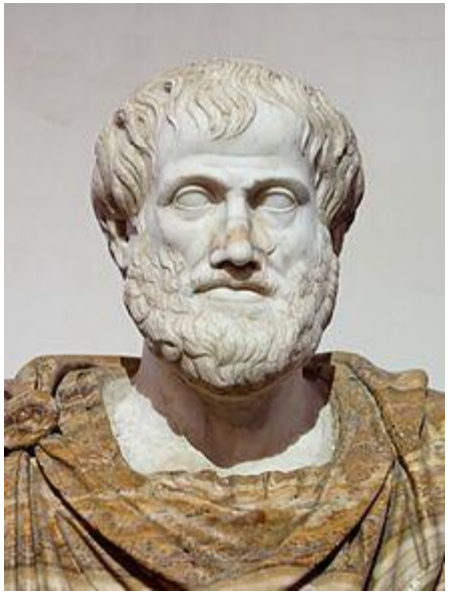
Battle for the Hearts and Minds of Consumers

1. Scientific agriculture is a victim of its own success
   a. Mass migration to cities
   b. Majority of population has no direct tie to the land or food production
2. Aristotle's means of persuasion
   a. Logos – appeal to reason
   b. Pathos – appeal to emotion
   c. Ethos – appeal to credibility



Aristotle: 384-322 BC

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Upstream R&D on the Horizon

1. RNAi for disease resistance
2. GM animals for vaccine delivery
3. New strategies for bovine genomics
   a. Metagenomics of the rumen
   b. Epigenetics - copy number variants
4. Raman scatter laser technology
   a. Bioterrorism (anthrax)
   b. Real-time detection of aflatoxin and other mycotoxins
   c. Non-invasive blood tests (insulin, HDL, LDL, etc.)

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Greatest Asset: Farmer's Optimism

Sunrise or sunset: An issue of perspective.

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