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Sustainability and Sustainable Agriculture

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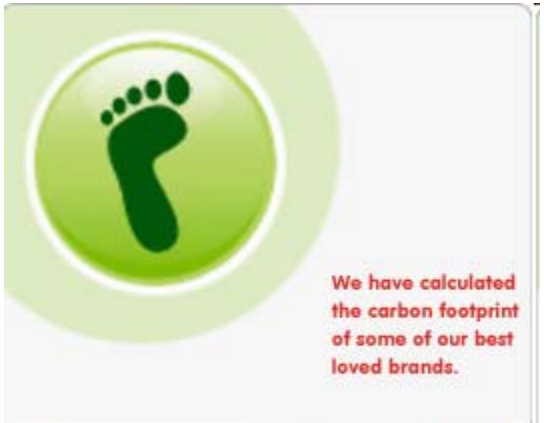
June 29, 2009

Sustainability is everywhere



SC Johnson
Is Committed to

Doing What's Right

As a family company, we care about every family. From the products you use, to the air you breathe, to the community you live in, we're working to make this world a cleaner, healthier, better place...today, for the next generation and beyond.

syngenta foundation for sustainable agriculture

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Late 1800s to mid-1900s

- science moves into agriculture
- early revolutionary technologies, e.g, hybrids and improved varieties, fertilizer, pesticides, equipment, etc.

Mid-1900s-late 1900s

- industrialization of agricultural production and food processing, rise of a globalized commodity economy, supermarkets and mass media marketing

Post 1960 or thereabouts

- recognition of complexity and inter-connectedness of ecosystems, and finiteness of planetary resources
- re-introduction of values-based dialogue about food and food production
- recognition of need to consider present choices in relation to the future
- rise of “organic agriculture”

Setting the stage

- The World Bank estimates 70%-90% of increases in global food production result from improvements in conventional agriculture rather than greater acreage under cultivation
- We expect a global population of 8-11 B by 2050
- 40,000 people died today from hunger & related causes (estimated)
- U.S. consumers have come to expect abundant, safe and inexpensive food
- Concerns have arisen in past 50 years regarding our ability to feed our species adequately and impacts of industrial agriculture on environment and human heath and planetary well being, strong consumer trends evident

-- USDA National Agricultural Library

And more recently, sustainability

- Wackernagel & Rees: Sustainability "…means living in material comfort and peacefully with each other within the means of nature."
- The "triple bottom line" concept requires a more comprehensive assessment but merely reflects where we are *now (which is also why it has such wide currency, it doesn't actually challenge anything).*
- My personal definition includes a commitment to estimating predictable future consequences of present actions or processes

USDA and Sustainability

- Alternative Farming Systems Information Center (1985)
  - Part of the National Agricultural Library
- National Sustainable Agriculture Information Service (1987)
  - Funded by the National Center for Appropriate Technology and USDA
- Sustainable Agriculture Research and Education (1988)
  - Invests in research and education
- CSREES Science for Sustainability Working Group (2004)
  - Expands the research and development agenda about sustainability
- Sustainable Operations Council (2007)
  - Provides executive leadership for agency operations

1990 Farm Bill

- Defined sustainable agriculture as “an integrated system of plant and animal production practices having site-specific application that will, over the long term:
  - Satisfy human food and fiber needs;
  - Enhance environmental quality and the natural resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls;
  - Sustain the economic viability of farm operations; and
  - Enhance the quality of life for farmers and society as a whole.” -- Public Law 101-624, Title XVI, Subtitle A, Section 1603

= THE TRIPLE BOTTOM LINE

During the 1990s

- Organic agriculture gained legitimacy and market share, creating opportunity and tension in the organic ag and food community and across the industry
- Increasingly, answers to questions regarding best practices were sought by some producers and some consumers without much success due to the reductionist paradigm for science in the 20th century

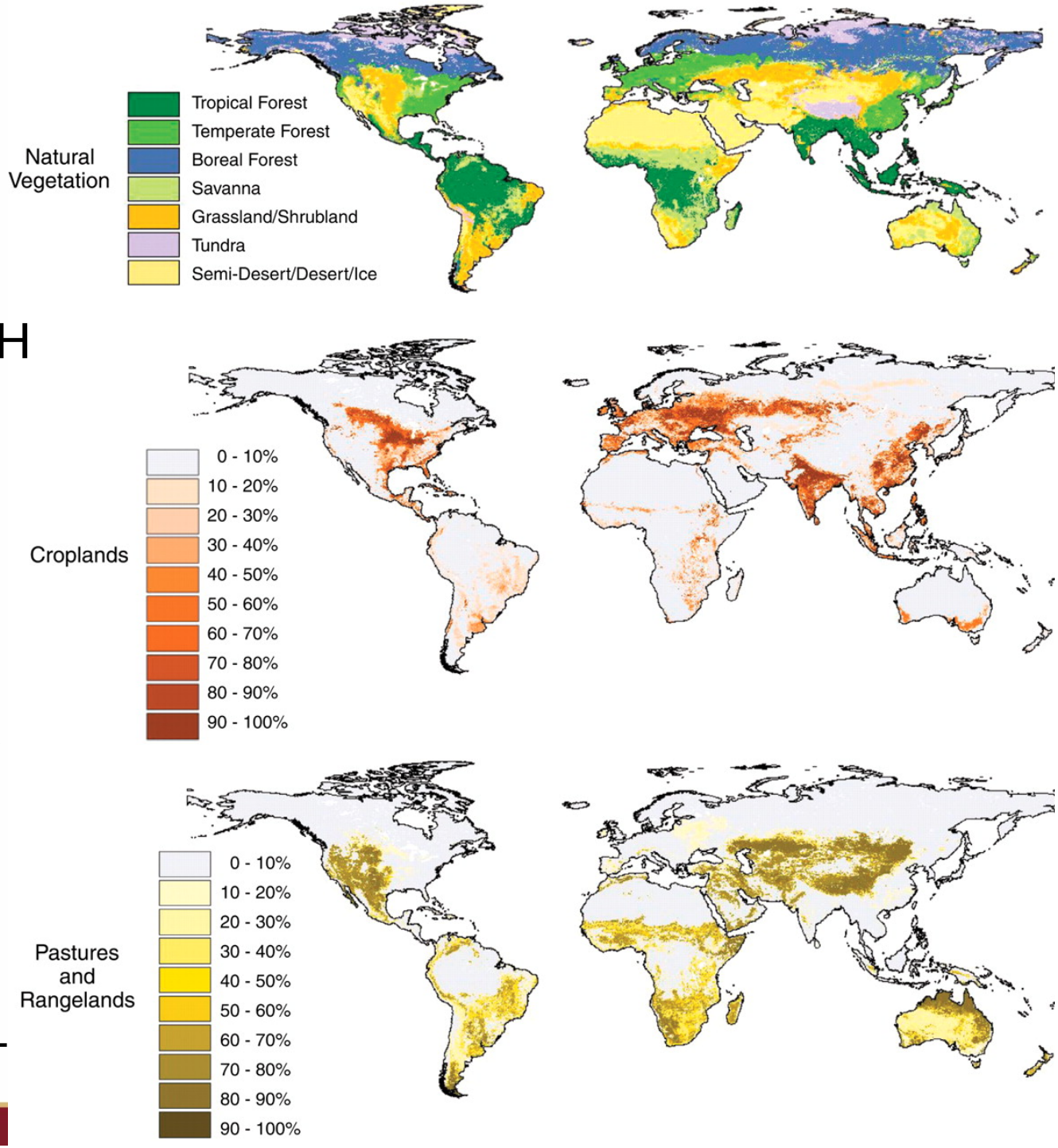
We needed new vocabulary and new tools

- *Ecological Services* are those things we derive from ecosystems directly or indirectly
- *Life Cycle Analysis* provides a comprehensive accounting of materials needed for a process and its outputs both desired and ancillary
- Well-defined *definitions of production practices* sufficient for consumers to make informed choice
- Room for discussions of *values*

ECOSYSTEM SERVICES

HUMAN ACTIVITIES DOMINATE EARTH

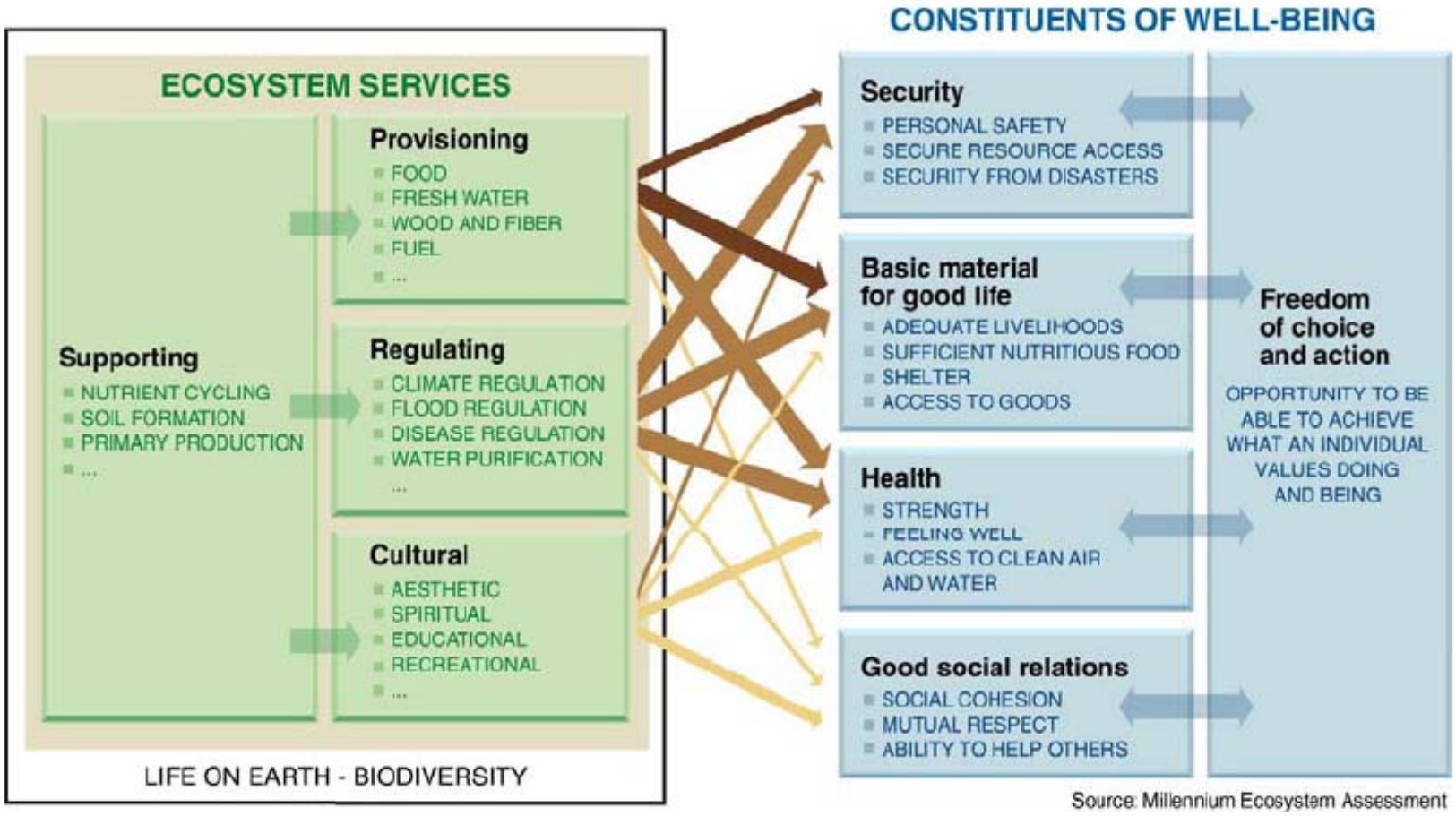
Croplands and pasture/range comprise 40% of earth's terrestrial biome, but the quality of the land use data and metrics are often quite primitive



J. A. Foley et al., Science 309, 570 - 574 (2005)

Published by AAAS

Ecological Services



Source: Millennium Ecosystem Assessment

ARROW'S COLOR
Potential for mediation by socioeconomic factors

- Low
- Medium
- High

ARROW'S WIDTH
Intensity of linkages between ecosystem services and human well-being

- Weak
- Medium
- Strong

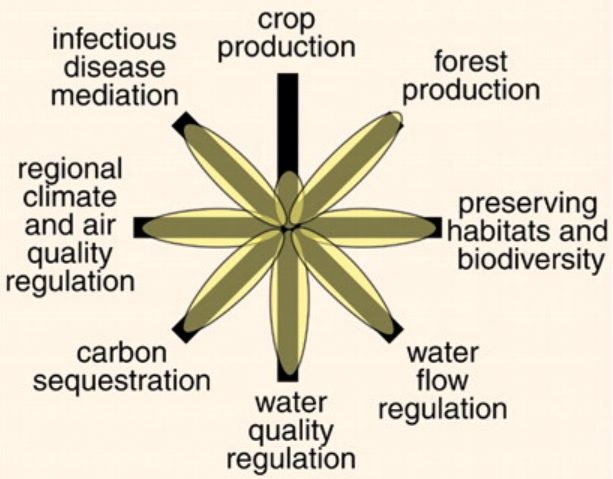
MILLENNIUM ECOSYSTEM ASSESSMENT

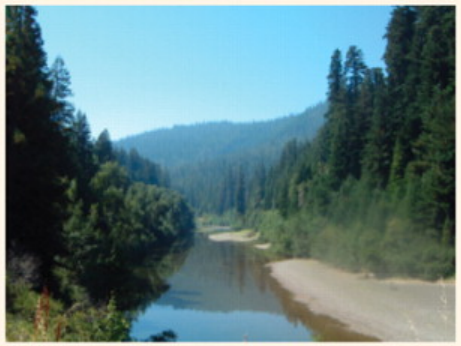
Results of ecosystem service analysis, e.g., water resources

5% to possibly 25% of global freshwater use exceeds long-term accessible supplies (*low to medium certainty)*

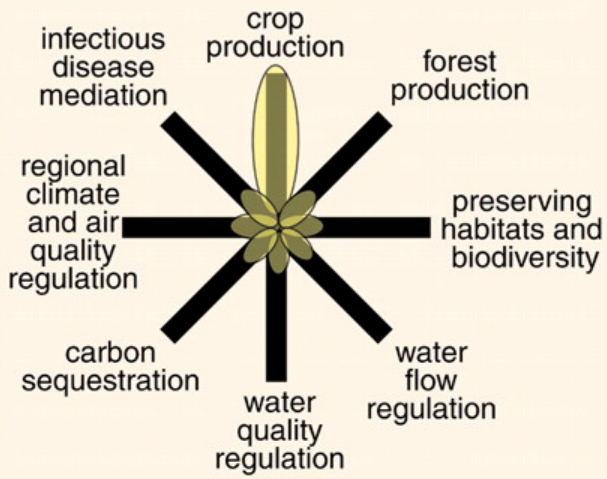
15 - 35% of irrigation withdrawals exceed supply rates and are therefore unsustainable (*low to medium certainty)*

Conceptual framework for comparing land use and trade-offs of ecosystem services

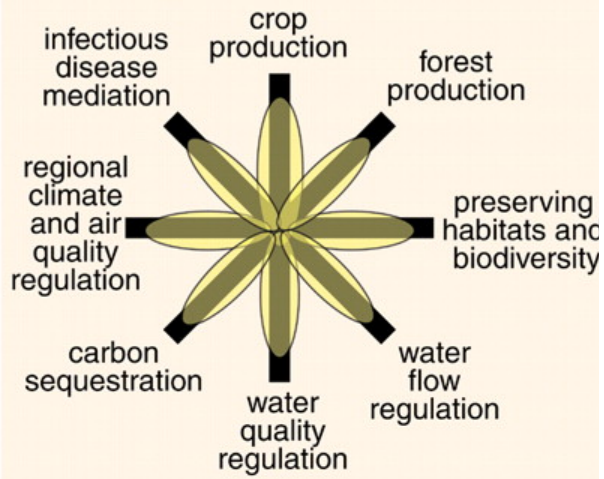




natural ecosystem



intensive cropland



cropland with restored ecosystem services

Science AAAS

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J. A. Foley et al., Science 309, 570 -574 (2005)

Conceptual framework for comparing land use and trade-offs of ecosystem services

- **Globally 30% of ecological services are in decline**
- **Increasing ecological services in cropland areas could restore global services**

J. A. Foley et al., Science 309, 570 -574 (2005)

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Managing Ecological Services

- The ecological services upon which our businesses, our economy, and perhaps our civilization depend appear to be in decline
- Managing ecological services requires:
  - Assessment
  - Restoration
  - Design
- Metrics should reflect these priorities
- Better data is imperative

Some current Sustainability Metrics Initiatives in Agriculture

Field to Market – The Keystone Alliance

- Focused on Commodity Agriculture
- Metrics are outcomes based, technology neutral
- Metrics are national and regional in scale

ANSI Standard – Leonardo Academy

- Focused on ALL Agriculture at farm gate (Phase 1)
- Metrics are outcomes based, technology neutral
- Metrics are national, regional and local in scale?

Stewardship Index for Specialty Crops

- Focused on Specialty Crops
- Metrics are outcomes based, technology neutral
- Metrics are regional and local in scale

Steering Committee Members and Participants

- American Farm Bureau Federation
- American Soybean Association
- Bayer CropScience
- Bunge
- Cargill
- Conservation International
- Conservation Technology Information Center
- Cotton Incorporated
- CropLife America
- CropLife International
- DuPont
- Fleishman-Hillard
- General Mills
- Grocery Manufacturers of America
- John Deere
- Kellogg Company
- Land O'Lakes
- Manomet Center for Conservation Science
- Mars, Incorporated
- Monsanto Company
- National Association of Conservation Districts
- National Association of Wheat Growers
- National Corn Growers Association
- National Cotton Council of America
- National Potato Council
- Syngenta
- The Coca-Cola Company
- The Fertilizer Institute
- The Nature Conservancy
- United Soybean Board
- World Resources Institute
- World Wildlife Fund
- University of Arkansas Division of Agriculture
- University of Wisconsin-Madison College of Agricultural and Life Sciences

Field to Market

Components of a Sustainability Index

	Environmental Outcomes							Social and Economic Outcomes							Health and Safety Outcomes	
	Land	Soil	Water Use	Water Quality	Energy	Climate	Biodiversity	Producer Income	Labor	Productivity	Competing Land and product uses	Availability	Post Harvest Loss	Consumer Demand	Nutrition (access to calories, etc)	Safety
International Scale																
National Scale	x	x	X		x	x				x						
Regional Scale																
Local Scale																

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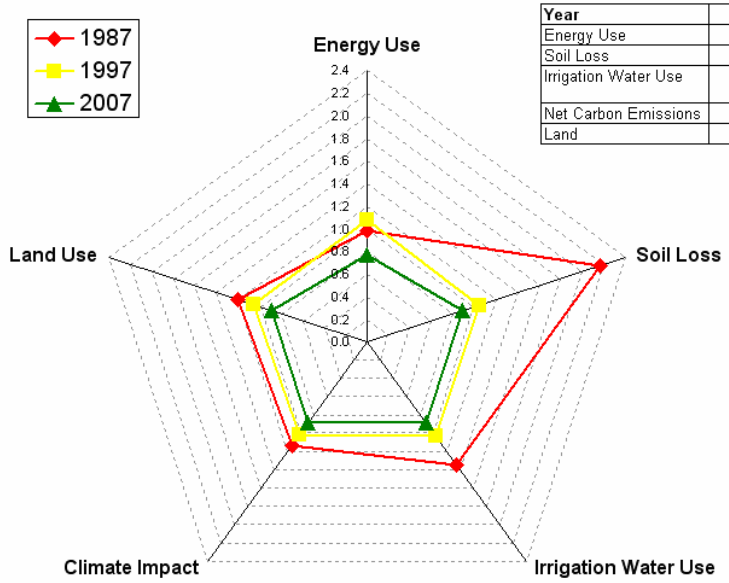
Environmental Indicator Report
Corn: Summary of Results

Over the study period (1987-2007),

- **Productivity** (Y/A) increased 41%
- **Land use** increased 21%
  Land use/bushel decreased 37%
- **Soil loss** above T has decreased 43% / acre and 69% / bushel.
- **Irrigation water use**/acre decreased 4% Water use/bushel variable, with an average 27% decrease
- **Energy use**/acre increased 3%. Energy use/bushel decreased 37%
- **Greenhouse gas emissions** / acre increased 8%. Emissions per bushel decreased 30%

Corn Efficiency Indicators (Per Unit of Output, Index 2000 = 1)



Year	2000	Unit
Energy Use	0.057	Million Btu/bushel
Soil Loss	28.7	Pounds soil/bushel
Irrigation Water Use	5.6	Thousand gallons/Incrementa bushel due to irrigation
Net Carbon Emissions	3.0	Pounds Carbon/bushel
Land	0.013	Acres/bushel

(Values are expressed as 5-year centered averages.)

Keystone Initiative's definition of Sustainable Agriculture

1. Meeting the needs of the present while enhancing the ability of future generations to meet their needs
2. Increasing productivity to meet future food demands
3. Decreasing impacts on the environment
4. Improving human health
5. Improving the social and economic well-being of agricultural communities

"Feeding 9.25 billion people without one hectare more of land or one drop more of water"

ANSI Standard for Sustainable Agriculture

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THE SUSTAINABILITY EXPERTS®

- Began with the Organic Standards in September, 2007
  - Leonardo Academy and Scientific Certification Systems
  - USDA appealed Leonardo Academy's involvement to ANSI
  - ANSI rejected USDA appeal, USDA is not obligated to accept this standard
- Technical Committee recently recommended:

1. Standard should end at farm gate
2. Standard should initially be limited to crop production
3. Standard should be performance-oriented

Performance standards rely on measurable data to demonstrate the positive and negative effects of specific production practices, encourage producers to monitor their practices over time.

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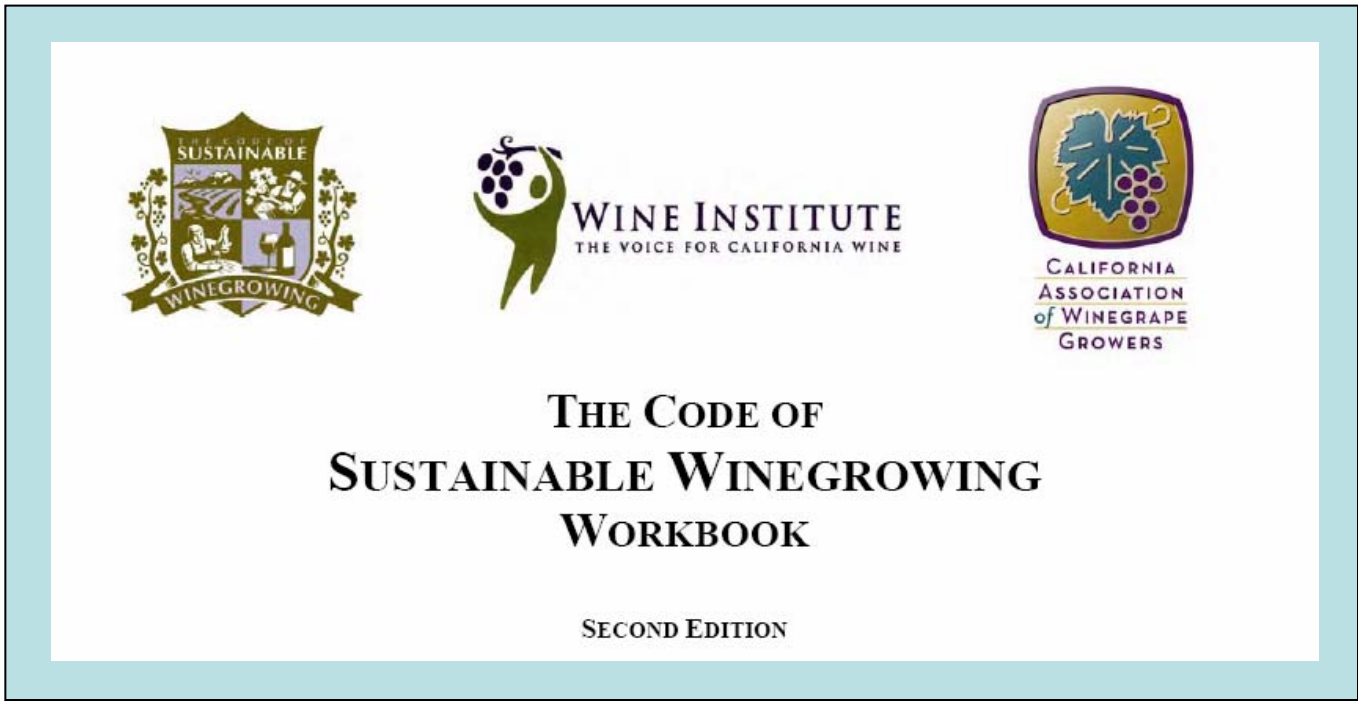
Stewardship Index for Specialty Crops

- Multi-stakeholder initiative to develop a system for measuring sustainable performance through the specialty crop supply chain
- The project will offer a suite of outcomes-based metrics to enable operators at any point to benchmark, compare, and communicate their performance
- The Stewardship Index will not seek to provide standards, but will instead provide a yardstick for measuring outcomes
- May also provide tools and resources to help specialty crop companies advance sustainability goals

What does an Agricultural Sustainability Standard Look Like?

- Four categories of certification
- Requires external verification and audits
- Addresses one crop in one region
- More than 500 pages long



Other groups: Sustainable Agriculture Initiative Platform

- SAI is a non-profit organization dedicated to supporting the development of sustainable global agriculture practices involving all stakeholders of the food supply chain
- Includes corporate 23 members, with estimated sales of $340 billion

Sustainable Food Lab

- Consortium of 70 businesses and social organizations from four continents
- Mission: deepen and accelerate the shift of sustainable food from niche to mainstream
- Three grant-funded clusters of supply chain projects aim at measuring and monetizing climate impacts, improving livelihoods in developing countries, and developing metrics to measure progress along all three dimensions of sustainability.

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We needed new vocabulary and new tools

- *Ecological Services* are those things we derive from ecosystems directly or indirectly

- *Life Cycle Analysis* provides a comprehensive accounting of materials needed for a process and its outputs both desired and ancillary

- *definitions of production practices*
- Room for discussions of *values*

A tool: Life Cycle Analysis

- LCA is a tool that integrates and aggregates a full picture of the process or product in question
- Requires comparable metrics that span sectors, industries and geographies
- Metrics grounded in scientific methodologies, specifically Life Cycle Assessment
- LCA data should be transparent, validated, widely available, inexpensive
- The same LCA data and models should be used by producers, retailers, policymakers, NGOs and consumers

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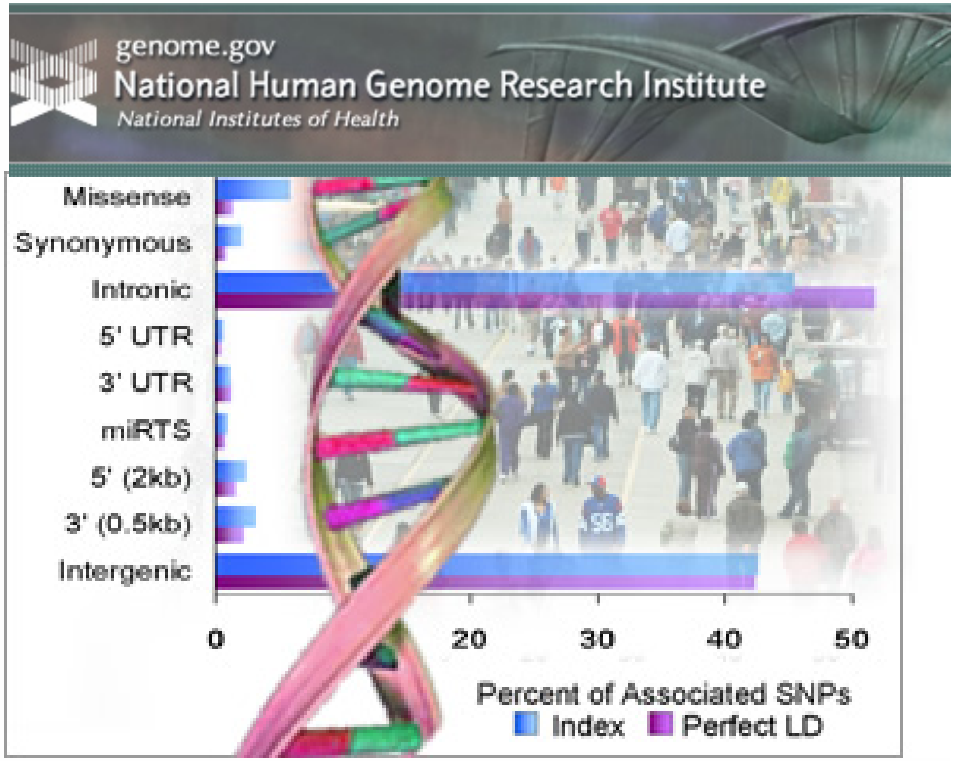
Open source databases for LCA
A critical role for the public sector, both government and universities

Human Genome Project as a Model

The Human Genome Project and its planners emphasized that in order to reap its maximum benefit, new DNA sequence should be freely available in the public domain.

Thus, all sequence information generated by the Human Genome Project was immediately deposited into databases accessed freely via the World Wide Web.



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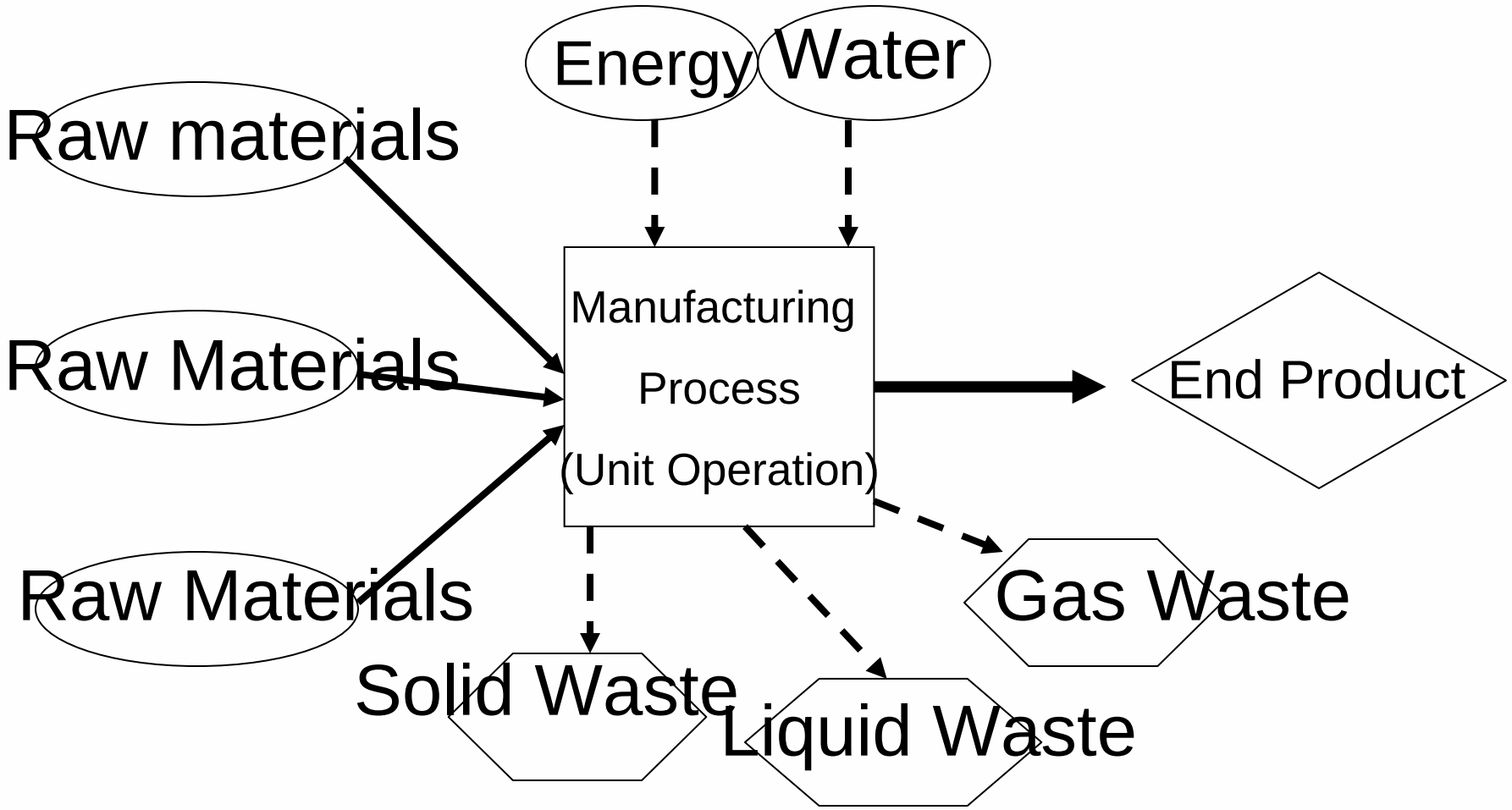
Life Cycle Analysis Process

Every unit operation has inputs and outputs



A huge opportunity and (perfect storm?) for land grant colleges of agriculture

Existing activities → Diminished capacity → Existing activities PLUS new needs and opportunities

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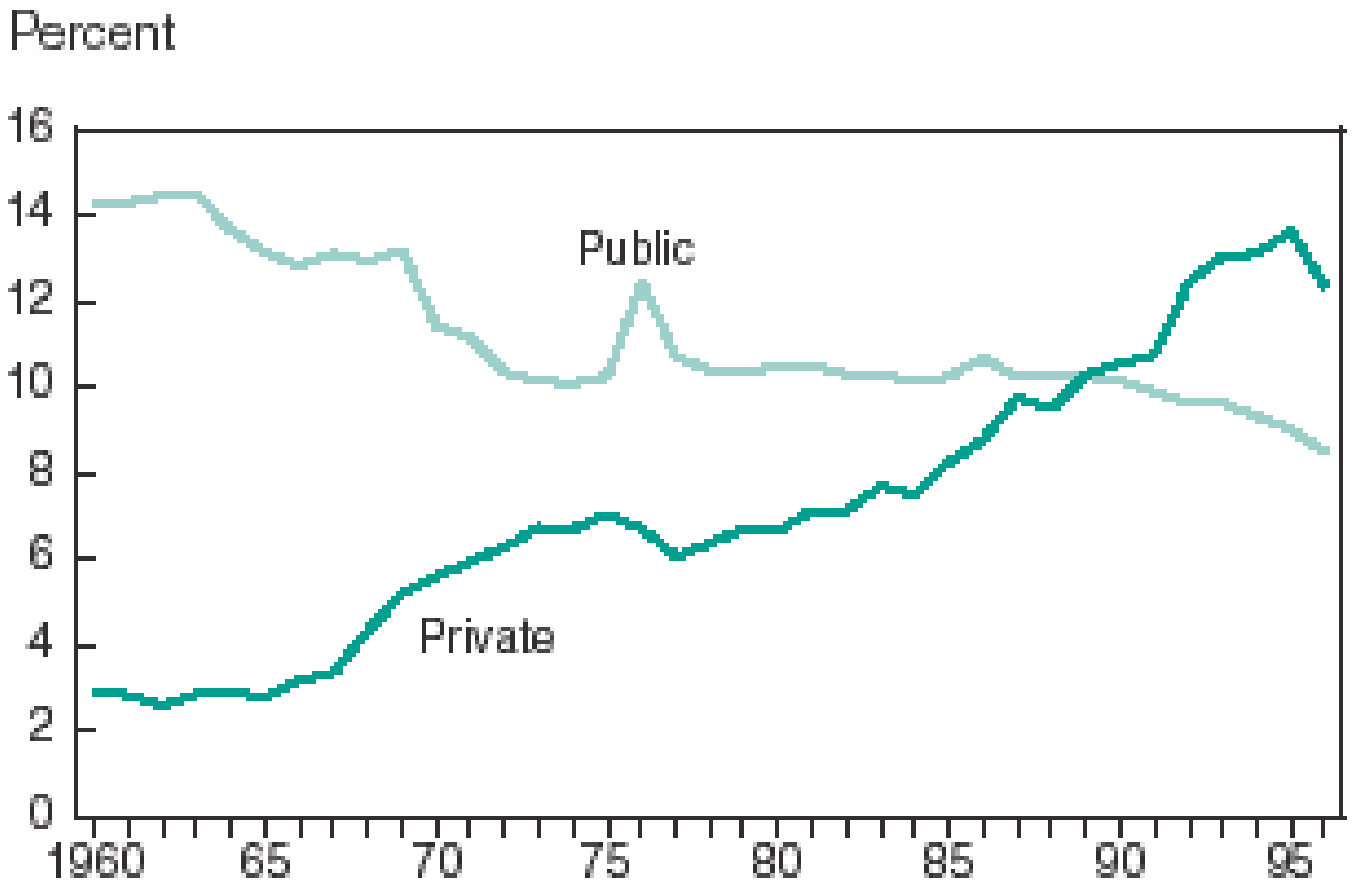
The case of plant breeding

- Fundamental for improved sustainability by any definition
  - Maximize available natural resources
  - Minimize inputs
  - Improve quality, nutrition
  - Adhere to regulations

Plant breeding as a share of total agricultural R&D expenditures



And what about organic agriculture? It's back to the future: Participatory networks sprung up to meet needs left unmet by universities and companies

- Universities
  Research, Extension
- Farmers
- USDA
- Non-profits
- Seed companies**

Any healthy ag system requires strong healthy seed companies

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Organic Seed Partnerships Outputs

- Dozens of varieties
- Hundreds of farmers

www.organicseedpartnership.org

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Organics in WI ag

- #1 organic dairy
- #1 herb, nursery and greenhouse production
- #2 number of registered organic farms
- Top 5: corn, soybeans, oats, barely, rye, hay
- 147 farmers markets
- 243 handlers and processors
- Home of Organic Valley
- Organics and Milwaukee
- Kellogg Local Food movement
- WI Farm Bureau Board includes a young grazer

WISCONSIN ORGANIC Advisory Council

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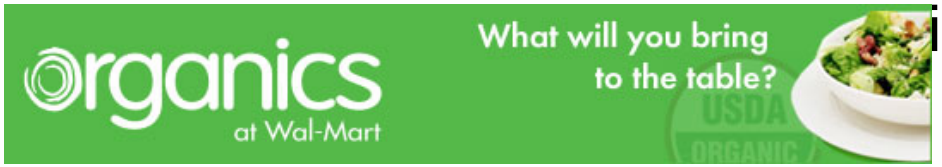
Changing faces of Agriculture

- Organics growing as an industry $5.07B in US

  (1.1% drop from '08 after growth from 12-23% since '03)

  Increasing tension between growth and values
- Value-driven organizations grow powerful e.g., Organic Valley
- Traditional businesses attracted to organics US/Canada trade opens 7/1/09
- Metrics becoming very important



Summary: Intellectual trends

On the science side, *landscape views required*, not soil, water, air, plant--major challenge to century old university depts and 1990 era corporate structures

Not just multi-, now trans-disciplinary approaches, including social sciences and common vocabulary, good quality data on global scale, clear goals essential for success (and often not yet available)

Vertically integrated multi-sector coalitions for research including for-profit, NGOs, universities and government, crucial roles for public sector players

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Sustainability curricula

- Sustainability Science
  - Joint venture with College of Engineering
  - Focused on measures and accounting, on the integration of disciplines and approaches in biology and ag, engineering,
- Sustainability Studies
  - Supports humanities, social sciences and arts research in this area

Areas of consensus

- Almost everyone recognizes and supports improvements in agriculture that mitigate environmental damage and improve food quality and safety
- Almost everyone supports the use of science and social science-based metrics in the determination of which choices lead to best outcomes
- Almost everyone recognizes that the human relationship to food is profound and complex

Areas of controversy

- What imperatives do we accept to ensure all our kind is properly fed now and in the future?
- Are defined and undefined environmental and social risks in the future more or less important than food security in the present?
- Processes to prioritize known and predictable risks
- Processes to prioritize known and predictable benefits
- Methodologies used to evaluate practices
- Communicating with markets