

Livestock Environment Design and Management in the Next 100 Years: *What's Achievable in 30?*

Brent Auvermann
Texas A&M University System
Amarillo, TX

“Sustainability” Defined

mi·rage [mi-rahzh] *-noun, plural -rages*. Something illusory, without substance or reality. Modern Language Association (MLA): "chimera." Dictionary.com Unabridged (v 1.1). Random House, Inc. 1 Jun. 2007. <Dictionary.com <http://dictionary.reference.com/browse/chimera>>.

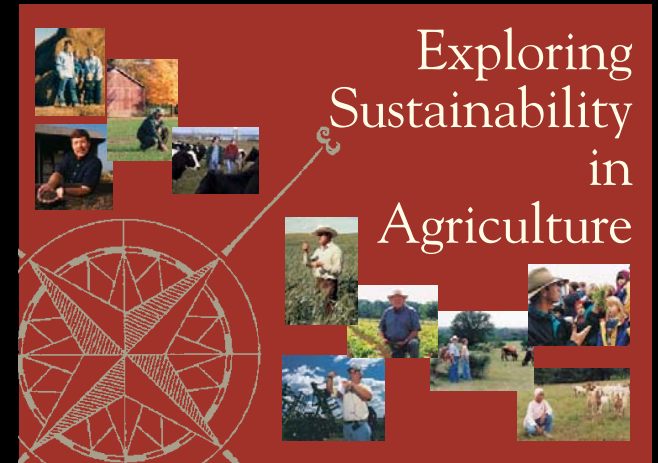
chi·me·ra [ki-meer-uh, kahy-] *-noun, plural -ras*. A horrible or unreal creature of the imagination; a vain or idle fancy. Modern Language Association (MLA): "mirage." Dictionary.com Unabridged (v 1.1). Random House, Inc. 1 Jun. 2007. <Dictionary.com <http://dictionary.reference.com/browse/mirage>>.

Sustainability: The Public Message

Name	Cert. Organic?	Acreage	Livestock /yr
Fernholz	Y	410	2.44 hogs/ac
Forgues	Y	220	0.36 dairy cows/ac
Carter	N	400	0
Sills	Y	3,000	0
Gunthorp	N	130	1,000 pasture hogs; 8,000 poultry
Muth	N (will be Y)	51	0
Shareef	N*	10	20 goats; 1,200 chickens; sheep
Quinn	Y	4,000	0
Thompson	N**	140	0
Sechrist	Y	n/a	50 beeves; 12,000 chickens
Mean/Median	50% (will be 60%)	930/220	50%

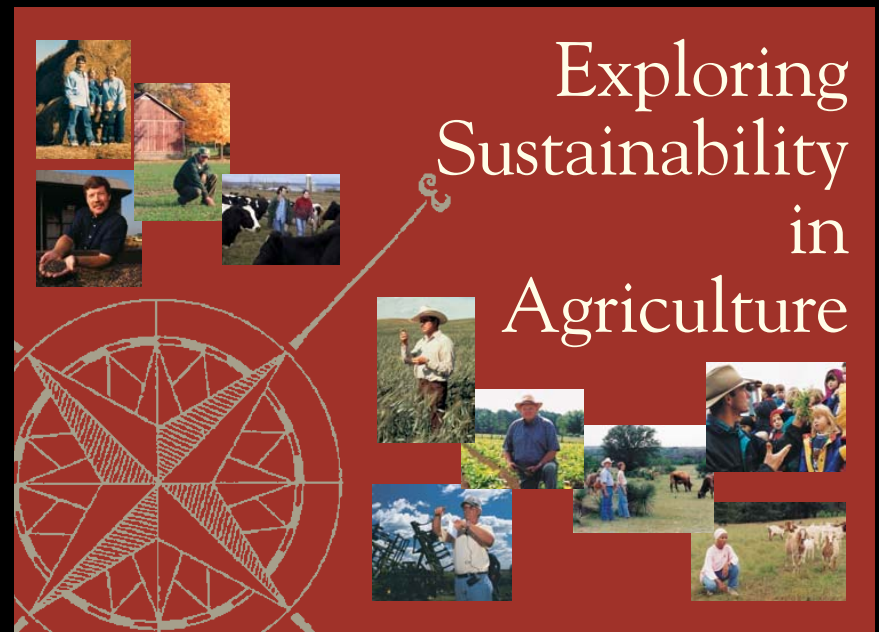
* Livestock generates ~10% of household income

**** Pick-your-own; direct sales to public**



Distilling the Public Message

- ✓ Consumer preferences expressed vigorously and consistently will move the livestock industry
- * Pick-your-own farms, roadside stands, “organic” products, farmers’ markets, food co-ops and pasture-raised meats are central to sustainable agriculture



We Need To...

- ...know what we mean by “sustainability” vis-a-vis animal production
- ...find a way to quantify it in as few dimensions as possible
- ...develop simulation models that we trust, that don’t yield absurdities and that explicitly convey uncertainty
- ...challenge presuppositions that function as straitjackets
 - Political: “We don’t have the necessary policy structures in place”
 - Economic: “Those options are simply not affordable”
 - Cultural: “Large/small is better than small/large”
- ...be willing to entertain & test provocative ideas & possibilities

Certain states produce much more pollution than others

By SETH BORENSTEIN
THE ASSOCIATED PRESS

WASHINGTON — America may spew more greenhouse gases than any other country, but some states are astonishingly more prolific polluters than others — and it's not always the ones you might expect.

The Associated Press analyzed state-by-state emissions of carbon dioxide from 2003, the latest U.S. Energy Department numbers available. The review shows startling differences in states' contributions to climate change.

The biggest reason? The burning of high-carbon coal to produce cheap electricity.

■ Wyoming's coal-fired power plants produce more carbon dioxide in just eight hours than the power generators of more populous Vermont do in a year.

■ Texas, the leader in spilling greenhouse gas, cranks out more than the next two biggest producers combined, California and Pennsylvania, which together have twice Texas' population.

■ In sparsely populated Alaska, the carbon dioxide produced per person by all the flying and driving is six times the per capita amount generated by travelers in New York state.

■ "There's no question that some states have made choices to be greener than others," said former top Energy Department official Joseph Romm, author of the new book "Hell and High Water" and executive director of a nonprofit energy conservation group.

■ The disparity in carbon dioxide emissions is one of the reasons there is no strong national effort to reduce global warming gases, some experts say. National emissions dipped ever so slightly last year, but that was mostly because of mild weather, according to the Energy Department.

■ "Some states are benefiting from both cheap electricity while

Wyoming has most carbon emissions

States relying on cheaper methods of generating power contribute far more carbon dioxide emissions per person than other states.

Carbon dioxide emissions per capita in metric tons, 2003



NOTE: One metric ton equals 2,204.6 pounds.

Carbon dioxide emissions from transportation per capita



SOURCES: Census Bureau, Energy Information Administration

WANT MORE INFO?

For state-by-state energy and emissions profiles, visit this U.S. Energy Information Administration Web site:
■ <http://onto.eia.doe.gov/state/>

most economical, least expensive way to produce power almost anywhere in the world," he said. He argued that outlawing such plants would have little overall impact globally; however, the U.S. has long been the leading global source of carbon emissions.

Emissions from generating electricity account for the largest chunk of U.S. greenhouse gases, nearly 40 percent. Transportation emissions are close behind, contributing about one-third of U.S. production of carbon dioxide. States with mass transit and cities, such as New York, with wide expanses that rely heavily on cars, trucks and planes, like Alaska.

For people who want to reduce their household emissions, or their "carbon footprint," the state where they live really does matter.

After seeing Al Gore's documentary, "An Inconvenient Truth," University of Wyoming professor Gregg Cawley used one of the many calculators available online to determine his "carbon footprint." Cawley lives in a small one-bedroom apartment and drives a moderately efficient Subaru, so he figured he contributes less to pollution than the average American.

But the calculations showed otherwise. And even if he reduced his energy consumption, the numbers would hardly budge.

Then he changed his home state in the equation. He took out Wyoming and plugged in Washington state. This simple change cut his personal emissions by nearly three tons of carbon dioxide a year.

"That's the problem," he said. "I live in the wrong damn state."

absurdities

After seeing Al Gore's documentary, "An Inconvenient Truth," University of Wyoming professor Gregg Cawley used one of the many calculators available online to determine his "carbon footprint." Cawley lives in a small one-bedroom apartment and drives a moderately efficient Subaru, so he figured he contributes less to pollution than the average American.

But the calculations showed otherwise. And even if he reduced his energy consumption, the numbers would hardly budge.

Then he changed his home state in the equation. He took out Wyoming and plugged in Washington state. This simple change cut his personal emissions by nearly three tons of carbon dioxide a year.

"That's the problem," he said. "I live in the wrong damn state."

Opposing Views

- Victor Davis Hanson: Sustainability requires a significant population of “agrarians”
- Jared Diamond: “Sustainable agriculture” is an oxymoron; agriculture is the “worst mistake in human history”

To Concentrate, or Not to
Concentrate?

The Philosophical Questions of Sustainable Animal Production

- What is the optimal distribution of concentrated vs. dispersed animal production? *Objective Function: Social Robustness*
- What policy structures will favor a smooth transition to that optimal distribution of concentrated vs. dispersed animal production?
- What cultural norms will enable those policy structures to ascend, and how might we go about establishing them as such?
- What body of knowledge will support the implementation of those norms and structures?

The Practical Questions of Sustainable Animal Production

- What is the optimal distribution of concentrated vs. dispersed animal production? *Objective Function: Ecosystem Resilience*
- What market structures will favor a smooth transition to that optimal distribution of concentrated vs. dispersed animal production?
- What cultural imperatives will enable those market structures to ascend, and how might we go about establishing them as such?
- What body of scientific knowledge will support the implementation of those imperatives and structures?

What is Achievable in 20-30 Years?

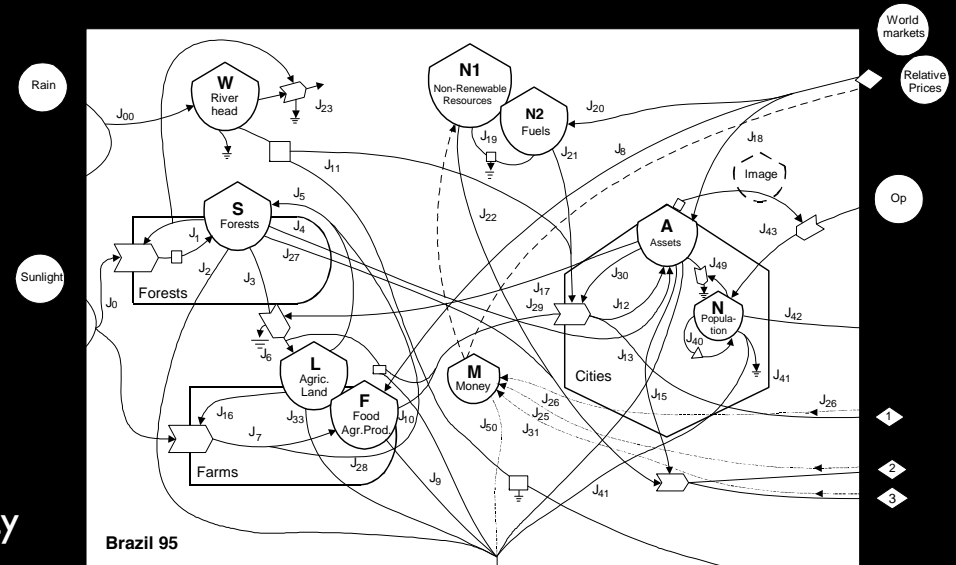
1. Formulate and adopt practical, meaningful measures of sustainability that accommodate the full continuum of AFO species, scales and configurations
2. Formalize an open-source, modular modeling framework to predict sustainability measures at arbitrary ecosystem scales
3. Assemble a rich library of First-Law-compliant, unit-operation modules representing nutrient and energy flows through AFOs and their constituent processes
4. Assemble and validate models of AFO-intensive ecosystems using historical census, inventory and environmental-monitoring data

What is Achievable in 20-30 Years?

- Formulate and adopt practical, meaningful measures of sustainability that accommodate the full continuum of AFO species, scales and configurations
 - Provide a basis for inter-media valuation of ecological stresses and services
 - Derived from life-cycle analysis (LCA) or other whole-system accounting procedures
 - Short-term: Nutrients (imports vs. managed exports) and natural-resource depletion
 - Intermediate-term: Energy (fossil vs. solar-derived)
 - Long-term: Aggregated nutrients, energy and natural-resource depletion

What is Achievable in 20-30 Years?

- Formalize an open-source, modular modeling framework to predict sustainability measures at arbitrary ecosystem scales
- Establish standards for module publication to unit-operations library (units, input flows, modulating inputs, outputs, documentation, validation, parameter uncertainty, transparency, assumptions)
- Use dynamic systems-modeling languages (feedback pathways, parameter sweep, sensitivity analysis, uncertainty propagation)
- Compute sustainability measures



What is Achievable in 20-30 Years?

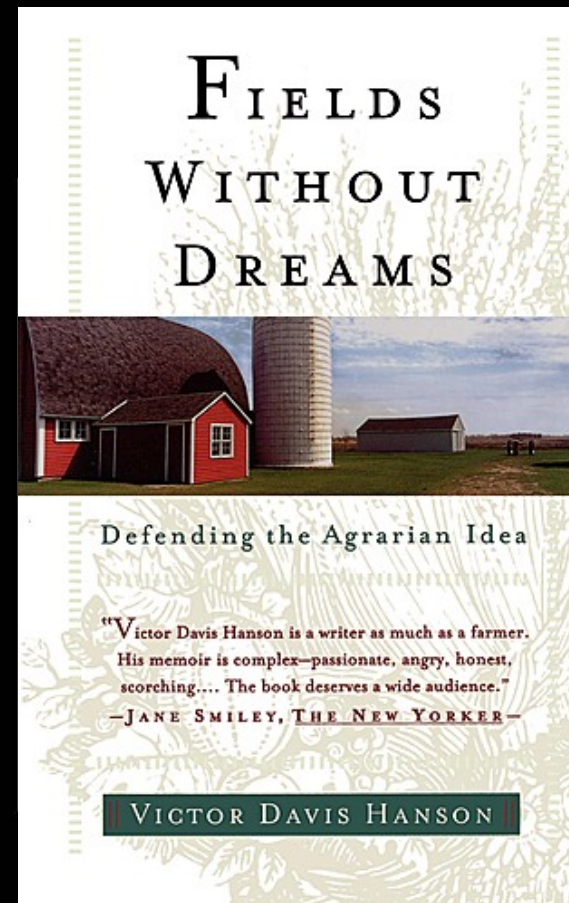
- Assemble a rich library of First-Law-compliant, unit-operation modules representing nutrient and energy flows through AFOs and their constituent processes
- First-Law compliance is non-negotiable at all process scales
- Start with mass flows; build credibility and confidence; refine successive versions
- Animals, feed/manure/wastewater handling, storage, advanced technologies, air emissions, housing
- Add energy flows as data-availability permits

What is Achievable in 20-30 Years?

- Assemble and validate models of AFO-intensive ecosystems using historical census, inventory and environmental-monitoring data
 - Establish species working groups
 - Begin with “model farms” - as many as needed to account for variability within a given species
 - Recruit industrial cooperators to validate at AFO scale

Hanson's *Modestly Provocative Ideas*

- Eliminate the USDA “root and branch, without hesitation,” along with her cash grants, tax credits and other market distortions.
- Regulate commodity brokerage, and eliminate vertical integration through antitrust legislation.
- Discourage absentee ownership and reduce farm size by (a) rewriting federal reclamation laws and (b) indexing taxes by parcel size and residence.



It's Over

They [critics of modern agriculture] rightly point out that the loss of crop diversity and farm decentralization will eventually make these complex food systems - that is, of all of us as well - as vulnerable to sudden collapse as the palatial agricultural economies of the pre-*polis* past...

...But I am more worried, as Aristotle and Jefferson were, about the human cost of the empty countryside and the effect it has had on American society and our democratic institutions.

Victor Davis Hanson
Fields Without Dreams, p. 283