

The Future Agrarian

- Plant taxonomy
- Climate change
- Human economies
- Fossil fuels and agriculture
- Peak oil and food
- New taboos
- Future of farming
- Willits Economic LocaLization
- Ag potential of Willits
- Need for demo projects

Jason Bradford

Little Lake Grange

Sept. 8, 2005

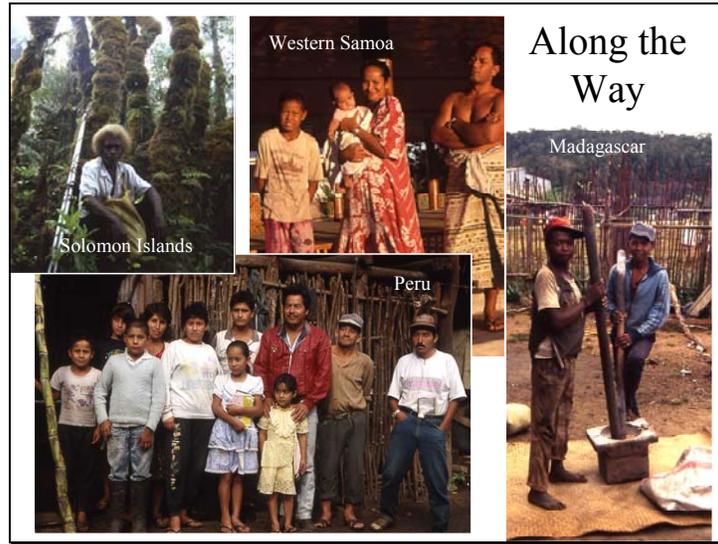


Slide 2



I love plants. I am especially drawn to trees. I end up liking a particular group of trees and shrubs and decide to study it for my doctoral thesis.

Slide 3



My education is multifaceted.

I meet, work and live with people from totally different cultures.

5 out of 6 billion people live in what are typically considered “poor” countries. I develop some understanding about how most people of the world live.

Slide 4

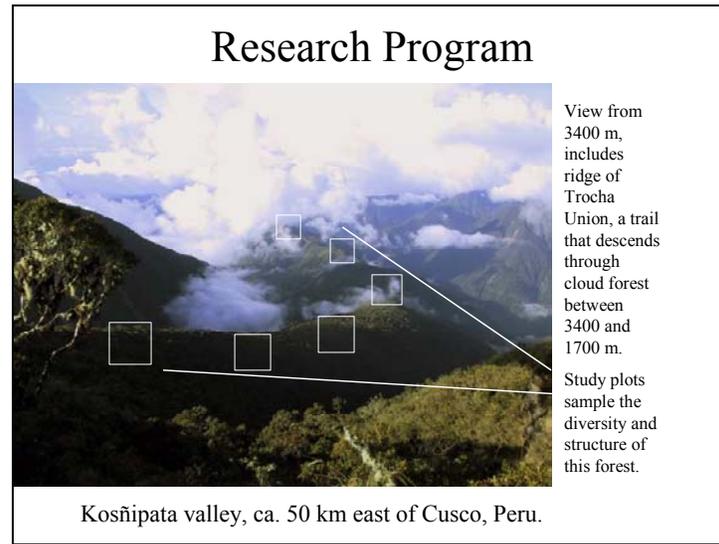


Towards the end of my doctoral research, I become aware that the plants I have been studying may be in serious danger due to climate change.

The tropical cloud forests they inhabit are identified as particularly sensitive to climate change.

I am emotionally bonded with these wonderful plants. This scares me.

Slide 5



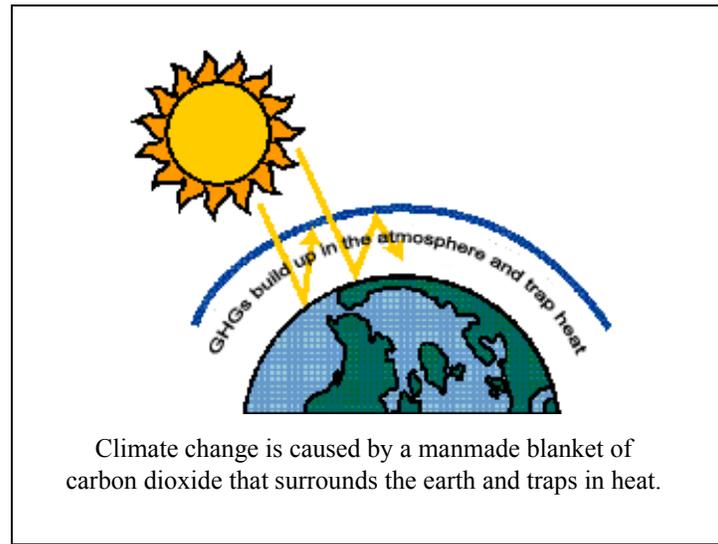
I bring together many scientists to study how climate change impacts species in tropical cloud forests.

Here's our primary study site in Peru. We are researching both the forest and the climate, particularly the formation and movement of clouds. In each of our sample plots (see the boxes) we find a very distinct set of species, but with some overlap.

Depending upon the severity of climate change, species from these forests may have to migrate upwards the equivalent of 1, 2 or 3 or more "boxes" and do so very quickly. The more the climate changes, the more likely species will go extinct during this change.

I really want to get this right. I want the best information, I want to understand this system properly because I believe that understanding may help both the biodiversity and the local people fare better. So I start learning a lot about our economic system.

Slide 6



Let me make sure everyone knows about the primary cause of climate change.

When fossil fuels are burned they release what are called “greenhouse gases” that build up in the atmosphere. This causes changes analogous to the heat trapping that happens in greenhouses. However, these changes are not benign. The rate of climate change now happening is extreme relative to historic records going back hundreds of thousands to millions of years. These changes can lead to the flooding of coastal cities, cause droughts and crop failure, promote forest fires, and many other bad outcomes.

While anything smacking of “alarmism” is dismissed by many Americans, I believe those of us in the U.S. are extremely naïve and isolated. Having traveled around the world, I have seen how many people live in marginal situations. Already, climate change and rising energy prices are leading to misery and famines in poorer parts of the world. Without the energy input of fossil fuels, our society would face similar outcomes unless we reorganize rapidly and before actual fuel shortfalls occur.

Slide 7

Fossil Fuels and Agriculture



- Industrial fertilizer plants use **natural gas**
- Tractors, pesticides, water pumps, food processing, transportation, food storage—all rely on **fossil fuels**
- The “**Green Revolution**” is based on unsustainable farming practices

“Modern agriculture is the use of land to convert petroleum into food.” Albert Bartlett

Now I will get into agriculture and how it relates to the issues discussed so far.

As just one example, fertilizer factories have doubled global the supply of nitrogen available to plants (mostly crops) and animals (mostly humans). This has provided an essential nutrient to agriculture that otherwise imposes a limit on the amount of food we can grow. In addition to artificial fixation of nitrogen, there’s the mining of phosphate rocks and limestone using heavy equipment, and the shipment of these fertilizers around the planet.

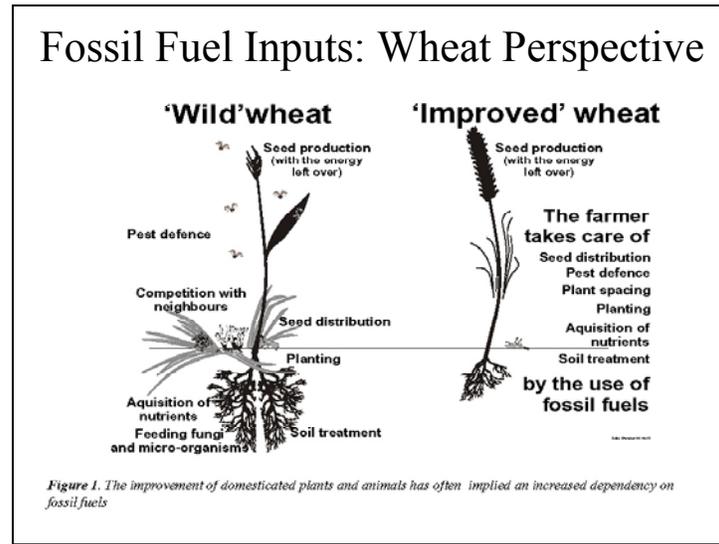
In fact, for each food calorie produced in a “modern” farm, several fossil fuel calories are burned.

Quote from Albert Bartlett, Professor Emeritus, Physics Department, University of Colorado, Boulder, CO

See also:

Why Our Food is So Dependent on Oil by Norman Church

April 2nd, 2005 <http://www.321energy.com/editorials/church/church040205.html>

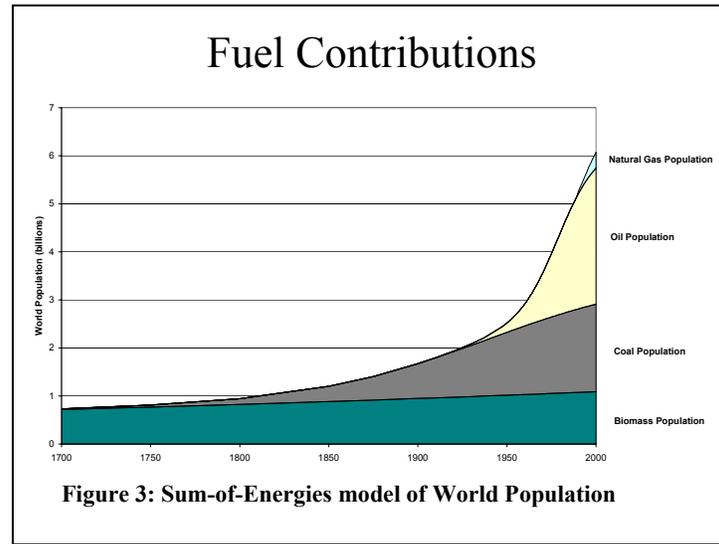


I am a biologist, so I understand that plants can only give us what they can produce in excess. This gets back to tradeoffs again. Our farming system has achieved high yields only by using fossil fuel energy to replace the work usually done by the plant.

Source of graphic:

<http://www.holon.se/folke/written/stuff/ines/INES.pdf>

Slide 9

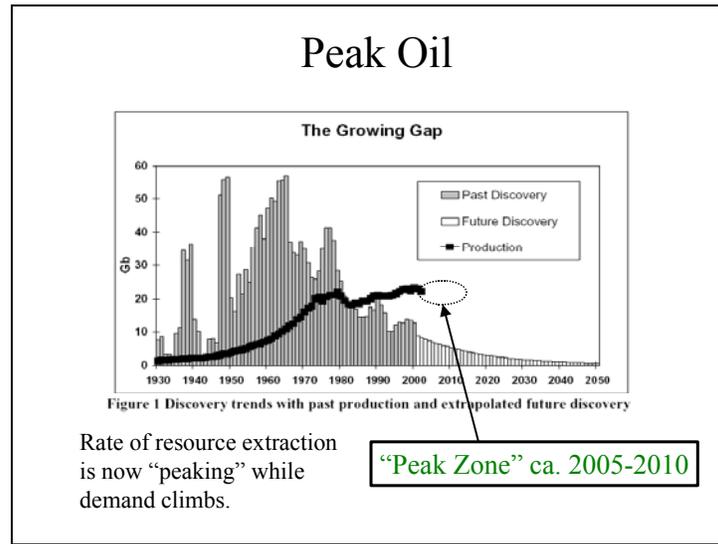


Fossil-fueled energy has enabled humans to raise food production and out compete other animals and take over more and more of the productive capacity of the Earth, so in a sense we are “eating fossil fuels.” The contribution of different sources of fossil fuel towards human population increase has even been calculated over time.

See the following articles: Richard Manning, "'The Oil We Eat' Following the Food Chain back to Iraq." Harper's Magazine. Feb 1, 2004, archived at www.energybulletin.net/30.html; Bill McKibben, "The Cuba Diet: What will you be eating when the revolution comes?" Harper's Magazine. Apr. 9, 2005, archived at www.energybulletin.net/5225.html; Dale Allen Pfeiffer, "Cuba-A Hope" From the Wilderness. Dec. 1, 2003, archived at www.energybulletin.net/1342.html; Dale Allen Pfeiffer, "Eating Fossil Fuels" From the Wilderness. Oct 3, 2003, archived at <http://www.energybulletin.net/281.html>; Norman Church, "Why Our Food is So Dependent on Oil" Powerswitch UK. Apr. 2, 2005, archived at www.energybulletin.net/5045.html; James Brooke, "North Korea, Facing Food Shortages, Mobilizes Millions From the Cities to Help Rice Farmers" New York Times. June 1, 2005, archived at www.energybulletin.net/6486.html

Graphic from:
<http://dieoff.org/page199.htm>

A published paper related to this url is:
Campbell, Colin J., "Petroleum and People," *Population and Environment* 24(2), November 2002, pp.193–208.



A concrete example of living on capital instead of interest is the problem of the peak in oil production. Oil literally embodies the energy of ancient sunlight. It is produced very slowly over geological time. We burn in one day what took hundreds of thousands of years to produce. A resource that is so non-renewable must be managed very carefully. Much of its use should go towards sorting out what will replace it when it’s gone!

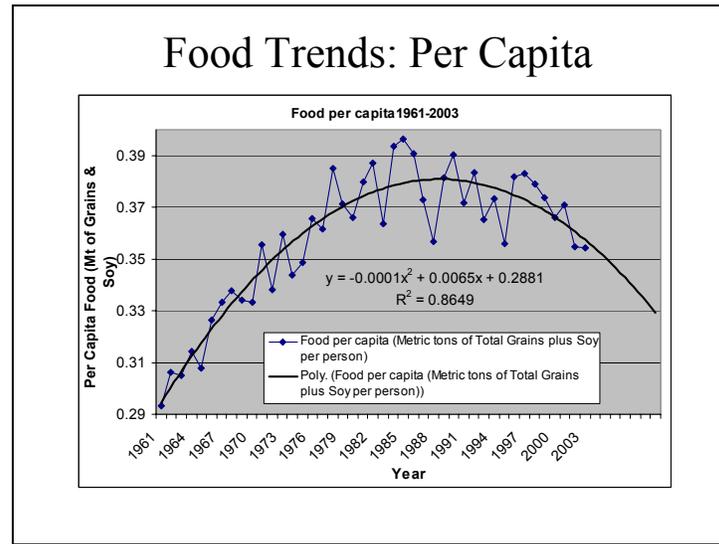
Graphic from:

“Oil Depletion—The Heart of the Matter” by C.J. Campbell
<http://www.oilcrisis.com/campbell/TheHeartOfTheMatter.pdf>

See also:

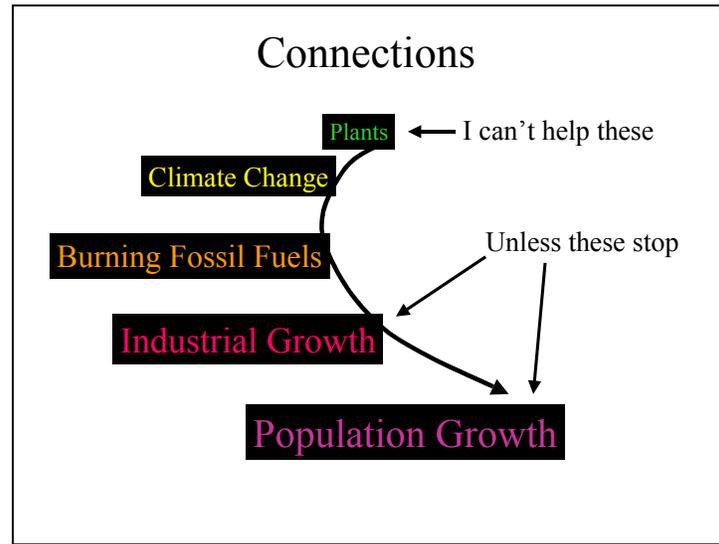
<http://www.peakoil.net>

<http://www.energybulletin.net>



Even with fuel supplies still abundant, the destructive activities of modern agriculture and showing diminishing returns. Global per capita food availability, measured as total grains (wheat, rice, corn, barley, oats, sorghum) plus soy, peaked in 1984 and is on a steady declining trend with 2003 levels at a 27 year low (data from: http://www.fao.org/waicent/portal/statistics_en.asp). A second order polynomial regression of the data suggests not an increase or near-term stability of food supply but a steep per capita decline. The same data used in this figure show a decline in total (not just per capita) food production since 1999; with grain reserves now considered dangerously low (FAO, 2003). Most likely, fisheries have also peaked in absolute catch levels (Hilborn et al., 2003).

We still have lots of food, plenty to feed everyone and more in fact, but are now likely entering a decline. Trying to overcome this by deepening our dependence on modern agriculture would be the worst response. The best response would be to: 1) transition to sustainable agricultural systems and moderate the decline rate, 2) improve food distribution efficiency to avoid social instability due to rising food costs, and 3) focus on reducing fertility rates so that total human population declines no slower than the decline in food supply. If we falter, population will eventually decline due to higher mortality rates, a more painful “solution.”



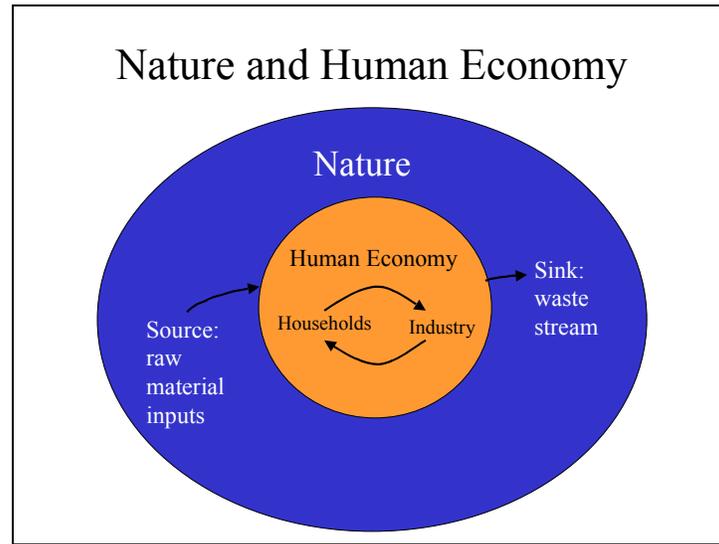
So my path goes from an interest in plants, to an interest in climate change because it threatens these plants. Well, the main proximate cause of climate change is the burning of fossil fuels. So I learn about them, and about the history of industrialization made possible by their use. And I realize that the great surge in human population has been made possible by these fuels and the infrastructure they have powered.

In short, it is very clear that we have an overpopulation and over-consumption problem of enormous magnitude. I know it may be taboo to talk much about population issues. But we have to get over this taboo because it doesn't make any sense and ignoring a problem won't make it go away. I'd like to replace this population taboo with some new ones instead.

Proposed New Taboos

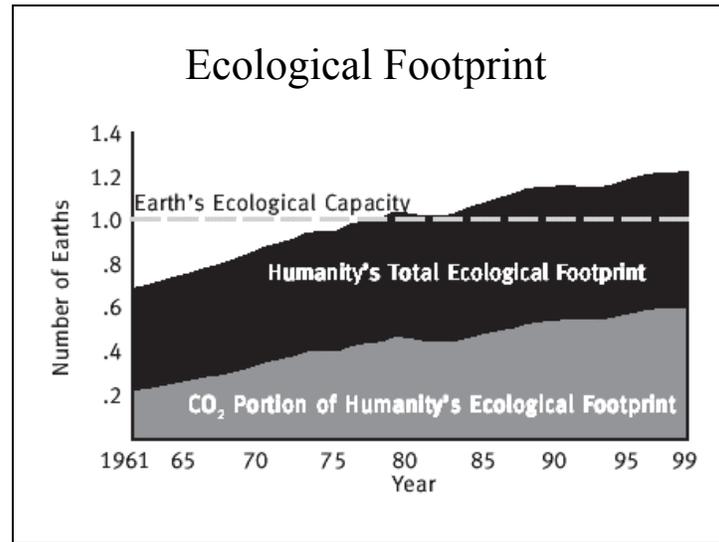
1. Do not rely on non-renewable resources for survival (e.g., aquifer and fossil fuel depletion).
2. When disposing of wastes, make sure they don't build up in the environment and damage ecosystem or human health (e.g., build up of heavy metals and greenhouse gases).

Scientists concur: Failure to abide by these taboos is extremely hazardous to one's health or longevity, and to the viability of future generations.



These proposed new taboos derive from an understanding of the dependence of humans on the broader environment and set of supporting resources for human livelihood. In the conceptual framework of Ecological Economics, the human economy is a subset of the Earth system. Nature provides the inputs to the human economy, and the outputs are wastes that nature must deal with. The human economy should not become larger than the ability of nature to support it, either with respect to the generation of raw material resources (Source) or the build-up of waste (Sink). Once this basic principle is understood, questions regarding the appropriate scale of human activities are paramount. If the human economy gets too big, nature can't provide for all our demands indefinitely.

Note that the current form of dominant economic thought, neoclassical economics, tends to restrict itself to the domain of the orange circle. The "circular flow" model between households and industry is not placed within the context of natural resources or effects of pollution on ecosystems.



Data show that our economy has grown larger than the ability of the planet to support for very long. This is called “overshoot.”

How far overshoot are we? A very conservative estimate comes from the Ecological Footprint analysis. In 1999 humans were at least 20% beyond a sustainable economy. The Ecological Footprint is conservative because it does not measure the erosion of topsoil, the influence of pollution on biological productivity, or the dependency of an economy through its built infrastructure on the rapid drawdown of non-renewable resources. It does measure the biological production capacity needed to absorb some of the wastes of economic processes (e.g., acres of forests needed to counter fossil fuel emissions). In reality then, our overshoot is probably much higher than suggested here.

See:

Wackernagel, M., et al. 2002. Tracking the ecological overshoot of the human economy. *Proceedings of the National Academy of Science* 99(14): 9266-9271.
<http://www.pnas.org/cgi/content/abstract/142033699v1>

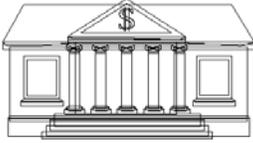
Also:

<http://www.myfootprint.org>

Living on Capital

The humble dirt farmer versus Donald Trump


Living on Interest
\$1,000,000 at 3% interest
→ remove \$30,000 per year of steady income




Living on Capital
\$1,000,000 at 3% interest
→ remove \$100,000 per year until it runs out

How does a population's economy survive if more than one Earth is required to support it? The analogy often used to explain this goes as follows: Imagine you have a bank account with a large endowment. If you withdraw only a modest amount, you can live off the interest accrued. On the other hand, if you spend wildly you can have fun but burn into the capital and then go bankrupt. Many people seem to want the short-term prestige of wealth even at the expense of their long-term security. Maybe it has something to do with so-called sexual selection?

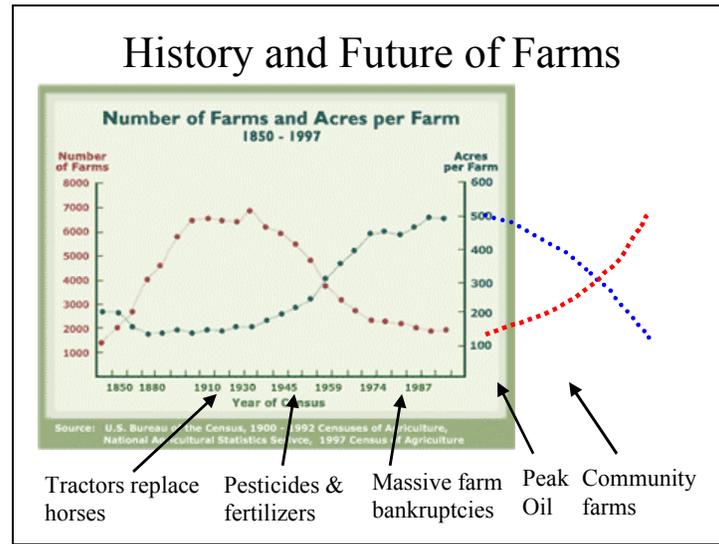
Scientists are telling us that our economy is essentially living irresponsibly off of Nature's Capital instead of drawing from it modestly as an endowment.

See:

Herman E. Daly & Joshua Farley. 2004. Ecological Economics: Principles and Applications. Island Press: Washington, D.C.

<http://www.ecoeco.org/>

<http://www.steadystate.org/>



Now let's look at what this all means for the history and future of farming.

The 20th century saw the adoption of mechanized, chemical agriculture. These techniques permitted very high yields, but only if farmers had access to expensive forms of capital and a constant supply of off-farm inputs. Many small farmers couldn't come up with this capital and were absorbed by those who could. As food output rose, prices dropped, further stressing farmers. The wave of farm bankruptcies in the mid-80's (e.g., Farm Aid concerts) occurred as the amount of food produced per capita was highest in history.

Because this system, and the associated transportation system it relies on for distribution, are only possible with surplus oil and natural gas, post Peak conditions will require a downscaling in farm size and farms will need to be located nearer the people they feed. For example, a thousand acre farm will need to be broken into sections managed by people and animal power. This means more barns and tool sheds closer to where the land is worked. Such changes take new investments. I expect an upsurge in so-called "Community Supported Agriculture."

Graphic from:
<http://nationalatlas.gov/agriculture.html>

Study and Replicate Local Models

WILLITS ECONOMIC LOCALIZATION PRESENTS:

CREATING LOCAL COMMUNITY BASED AGRICULTURE:
TOOLS, APPROACHES, EXAMPLES



SPEAKERS: STEPHEN & GLORIA DECATUR OF LIVEPOWER FARM



WELL

- A family farm in Covelo
- Uses real horsepower
- Community Supported Agriculture
- April 11th at the Community Center

Find the local leaders who inspire and can help us sort out the details we'll need. WELL is sponsoring presentations by such experts. John Jeavons spoke about sustainable agriculture, and the Decaters provide an experienced example.

<http://www.growbiointensive.org>

http://www.covelo.net/agriculture/farm/pages/farms_lpf.shtml

For an interview with Steve Decater see:

<http://www.globalpublicmedia.com/interviews/364>

What is a “Community Farm?”

- Serves needs of the local population...food doesn't go to the broader commodities market where prices can fluctuate wildly.
- Land usually owned by a community trust and given a long-term lease that guarantees it will be farmed...not subject to speculative development for other uses.
- Usually adheres to best stewardship practices to ensure healthy food, farmers, and environment.
- Often involves other institutions, such as schools, to reconnect the next generation to the land.



WELL Speaker Series

1. Richard Heinberg. 17 Feb 2005. "Peak Oil and the Post-petroleum Economy."
2. Ann Hancock. 14 Mar 2005. "The Ecological Footprint: Time to Lighten-up?"
3. John Jeavons. 21 Mar 2005. "Principles and Visions of Sustainable Agriculture."
4. Stephen and Gloria Decater. 11 Apr 2005. "Community Supported Agriculture: Market and Non-market Approaches to Starting a Local CSA Farm."
5. Julian Darley. 2 May 2005. "Relocalize Now: Community Responses to Climate Change and Peak Oil."
6. Don Dame. 20 June 2005. "Public Power: Community and Local Alternatives to PG&E."
7. Larry Desmond. 25 July 2005. "Rural Water Development."

WELL's Mission

“To foster the creation of a sustainable local economy based on the principles of sufficiency, responsibility, and life promoting actions.”

How?

By creating social networks that educate and empower our community to change, via:

meetings at the Community Center, educational speakers, hands-on workshops, media outreach, research reports, projects, etc.

Why Economic Localization?

1. Dependency on imported goods is highly polluting and reduces carrying capacity in the long-term (**Responsibility**)
2. We do have abundant local resources and the ability to live sustainably with these (**Ingenuity**)
3. The production and long-distance transport of basic goods is not, or will not be, reliable (**Security**)
4. This is an opportunity to get to know each other and develop a variety of economic niches to meet individual and group needs (**Community**)

I offer four basic reasons why economic localization is the logical response to overshoot.

Note that point 2 may not apply everywhere. People often ask me, “What about the cities?” Sorry, but I don’t have an answer for that. Most cities in America can’t be made sustainable. Their infrastructure is too energy dependent. Skyscrapers and modern office buildings with sealed envelopes don’t function without power. They demand too much food from areas too far from where they are. The surrounding “countryside” has been paved over by suburbia. They are resource sinks and pollution sources.

But for a while, cities may fare better than rural areas. Much of rural America has lost its productive base as the global economy has sent local farmers into bankruptcy. These areas are now dependent upon imported food and energy too, but they are not part of the distribution hubs. Shortages will hit the import-dependent, country town before it hits the major port city.

Shared Values



Responsibility
Ingenuity
Security
Community

↑
Cross political,
ethnic, religious,
economic, gender,
generational... lines

The image shows two children, a girl in a red hat and a boy in a white hat, standing in a garden. They are holding baskets of colorful Easter eggs. To the right of the photo is a list of four values: Responsibility, Ingenuity, Security, and Community. Each value is underlined. A green box highlights the word 'Community'. Below the box is an upward-pointing arrow and the text 'Cross political, ethnic, religious, economic, gender, generational... lines'.

Individual change and Community Building begins by recognizing and promoting what unites us, our shared values.

Life has risks. We manage these by acting responsibly, solving problems through ingenuity, thinking about long-term security, and by seeking mutual support through community.

If people with different worldviews and ideas can at least agree on this shared set of values, community can build through shared experiences even when visions of the future may differ.

I suggest four common values (RISC): Responsibility, Ingenuity, Security and Community that should have broad appeal.

Whenever difficulties arise, remind each other about what you share.

Groups will go through phases of honeymoon, chaos, and renegotiation. The shared values will be the glue that helps groups move into productive stages. Only after struggle, will true communities emerge.

See:

http://www.fce-community.org/community_building.php

| Food Group Inventory | | | | |
|---------------------------------|---------------|--|--|--------------------|
| Market | Customers/Day | Delivery Frequency and Daily Turnover | # Days Supply in Stock | County Products |
| Mariposa Market (natural foods) | 200-300 | Fruits and vegetables: 3 deliveries/week Meat and dairy: 2 deliveries/week Groceries: 2 deliveries/week Frozen Foods: 2 deliveries/week | 2-7 days 7 days 7 days 7 days | 1% (10% in summer) |
| Ray's Sentry Market | 1,200 | Fruits and vegetables: 6 deliveries/week Meat and dairy: 3 deliveries/week Groceries: 2 deliveries/week Frozen Foods: 2 deliveries/week | 1 day 3 days 3 days 3 days | 15-20% |
| Safeway | 1,900 | Daily delivery of all items | 1-2 days | 2% |

Let's look at these values in light of what the WELL Food Group has discovered about our food system in Willits.

Just about all our food is trucked in from distribution centers in the Bay Area and sold in large outlets. Furthermore, most people must drive between store and home. Most food is stored and prepared in the home using fossil fuel dependent equipment.

If the road between here and the Bay Area were cut off for long, e.g., a major landslide or earthquake, in less than a week Willits would be out of food. Therefore, localized food is a major security issue. The responsible thing to do is reduce our vulnerability. To do this, we will have to apply all our local ingenuity and develop stronger community bonds.

The Peak Oil issue is analogous to this emergency cut off scenario. It may play out over a longer time frame, and it may initially involve price hikes that hurt the most economically vulnerable, with only intermittent real scarcity.

Relocalizing Food

How many people can be supported here by a diverse agricultural system that is non-fossil-fuel dependent?

Two data sets:

Historic records from pre-industrial agriculture

Contemporary practitioners

How important were draft animals? Where were different crops grown?

Can these small-scale examples be used to extrapolate to larger scales?

Historic Records

| crop | yields per acre, bushels | | | | | 1934 average bushel | average in pounds | calories per acre avg. | people fed per acre ^a | |
|----------|--------------------------|------|------|------|------|---------------------|-------------------|------------------------|----------------------------------|-----|
| | 1899 | 1909 | 1919 | 1924 | 1929 | | | | | |
| barley | 30 | 23 | 27 | 22 | 28 | 27 | 26.2 | 1,256.0 | 1,988,248 | 2.2 |
| corn | 31 | 27 | 20 | 16 | 28 | 23 | 24.2 | 1,353.3 | 2,136,913 | 2.3 |
| oats | 31 | 27 | 26 | 31 | 34 | 28 | 29.5 | 944.0 | 1,689,936 | 1.8 |
| wheat | 20 | 15 | 15 | 15 | 21 | 17 | 17.2 | 1,030.0 | 1,541,910 | 1.7 |
| potatoes | 105 | 128 | 88 | 104 | 115 | 93 | 106.5 | 6,330.0 | 8,678,430 | 9.5 |

Grains can feed about 2 people per acre

Potatoes about 9.5 people per acre

Should sow about 5 time greater area of grains than potatoes, or risk blight and soil depletion

Overall, then about 3.3 people can be fed per acre

13,500 people/3.3 =
4091 acres

“Statistical Information on Mendocino County Agriculture 1899-1936.” J.M. Thompson, Extension Specialist in Agricultural Economics. University of California College of Agriculture and United States Department of Agriculture. January, 1938. (Made available via County of Mendocino Department of Agriculture, 2005).

Current Growers

Ecology Action yields with irrigation: 13,500 people/7 people per acre = **1929 acres**

Ecology Action without irrigation: 13,500 people/4.5 people per acre = **3000 acres**

Live Power Farm reports similar yields to Ecology Action, but they use horses

So if animal feed is included, their actual yields per acre may be lower

10 tons yield

10 acres of grain

2 horses fed

10 acres of pasture

10 tons/10 acres
= 1 ton per acre

or

10 tons/20 acres
= 0.5 ton per acre

| | |
|--|--|
| <h2>How Much Do We Have?</h2> <p>70,000 acres of prime ag land in Mendocino county</p> <p>Little Lake Valley:</p> <ul style="list-style-type: none">About 4000 acres classified as prime if irrigated and drainage enhancedPredominantly Cole clay and Gielow sandy loams <p>Bottom Line: theoretically enough land to meet basic needs</p> |  |
|--|--|

The main area of Little Lake Valley is about 2.5 miles wide and 5 miles long, with extensions on either side of Hilltop as well. The total area of valley fill is about 18 square miles, or ca. 12,000 acres. I estimate about a quarter of this area is wetland habitat, mostly in the northern section, another quarter is housing and roads, mostly to the west, and another couple thousand acres is forested, riparian zone, or non-prime ag land due to soil texture. This gives about 4000 acres of potential prime ag land. However, irrigation water may be rate-limited in the southern portion of the valley, and water availability and quality may limit irrigation along the valley margins where boron, arsenic and other minerals reach high concentration. Dry-land farming methods need to be studied, but it is safe to assume that non-irrigated land would have significantly lower productivity, perhaps only half of irrigated areas.

See the following publications for detailed information:

Farrar, C.D. 1986. Ground-water resources in Mendocino county, California. U.S. Geological Survey Water-Resources Investigations Report 85-4258

Howard, Richard F. and Roy H. Bowman. 1991. Soil Survey of Mendocino County, Eastern Part, and Trinity County, Southwestern Part, California. United States Department of Agriculture, Soil Conservation Service.

Image from:

<http://www.google.com/maps?ll=39.416370,-123.328829&spn=0.129776,0.088062&t=k&hl=en>

Grains We Can Grow Here

| | |
|---|--|
| Winter Grains & Legumes wheat, rye, oats, barley, triticale, fava beans... | <ul style="list-style-type: none">•Require little or no irrigation•Use land outside of flood zones•Stores well•About 300-400 lbs per person/year•Can grow about 1000-1500 lbs/acre |
| Summer Grains & Legumes corn, sorghum, dry beans, quinoa, amaranth, buckwheat... | <ul style="list-style-type: none">•May be dry land farmed in flood zones•Stores well•Beans balance protein, sorghum sweetener |

The bulk of our diet in North America is based on grains and dried beans, whether directly as bread and pasta, or indirectly as animal feed and corn syrup. Grains and dry legumes are advantageous because they are easily stored and transported. They also pack a lot of nutrition per weight of food and provide a balanced source of protein.

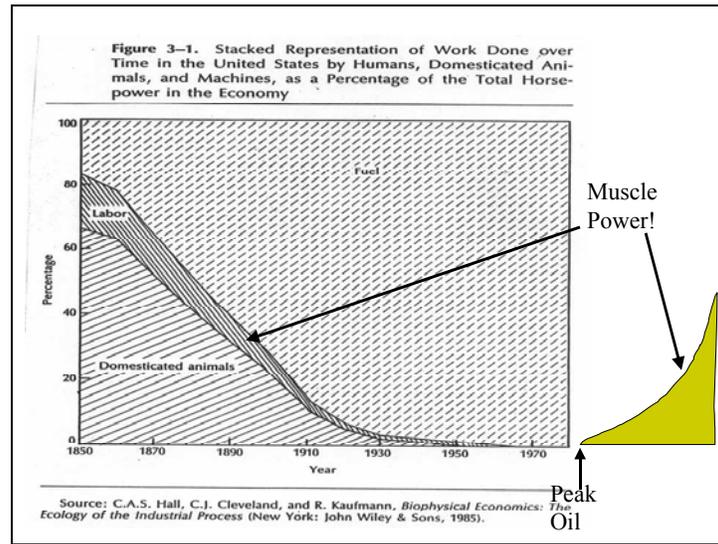
However, most people can't feed themselves on land they own in town because of the large area needed to grow grains. Individual households may be able to make a dent in their need for potatoes and vegetables but only a small portion of grain needs are likely to be met by household scale cultivation.

What Else?

| | |
|--|---|
| Root Crops potatoes, parsnips, beets, onions, shallots, garlic, turnips, celeriac, Jerusalem artichokes, carrots, turnips, horseradish, leeks, radishes... | Greens lettuce, chard, collards, spinach, beet tops, onion tops, amaranth leaves, kale, cabbage... |
| Fruits and Nuts apples, pears, peaches, cherries, pluots, plums, grapes, persimmons, raspberries, blackberries, blueberries, olives, walnuts, filberts... | Other Veggies tomatoes, peppers, summer and winter squash, cucumbers, eggplants, peas, green beans, rhubarb, melons, artichokes, asparagus, broccoli, cauliflower, celery... |

I have grown all but a few of these in my own yard in Willits. Obviously, a varied diet is possible here.

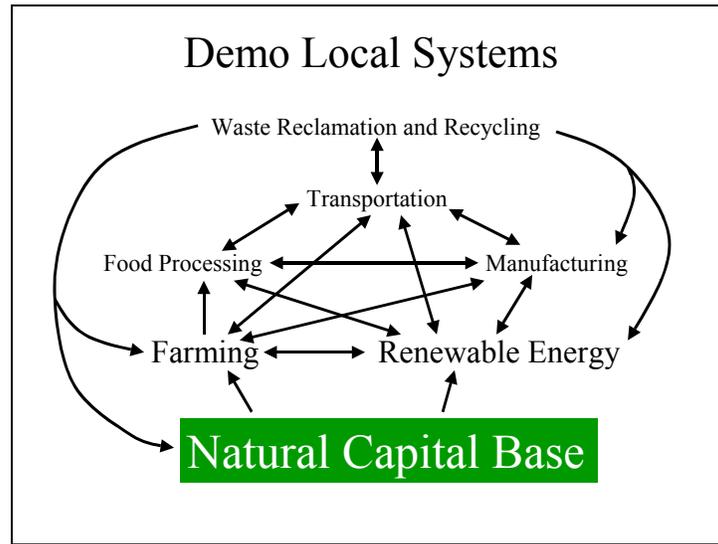
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And who will work on these new farms? As fossil fuels become scarce, to get work done we will use more muscle power. Consider that a gallon of gasoline has the energy potential of 175 hours of human labor (111,000 BTUs per gallon, versus 635 BTUs per hour of human work)! No wonder machines replaced people and animals. We will need a lot of local farms to power our muscles!

This is the sunshine economy.

For a discussion of our economic future and farming see:
“The Long Emergency” by James Howard Kunstler
<http://www.energybulletin.net/4856.html>



Try to understand how food, energy, manufacturing, transportation and waste systems are interwoven, and consider how to form local economic relationships that support each other. For example, if you need a tool, can someone locally make it?

Here's a concept map of how a localized economy might be structured. Getting these systems in place is going to be necessary for an "easier" transition to the local, lean economy. Perhaps start with a farm and figure out how to support that farm using local resources that become new local businesses.