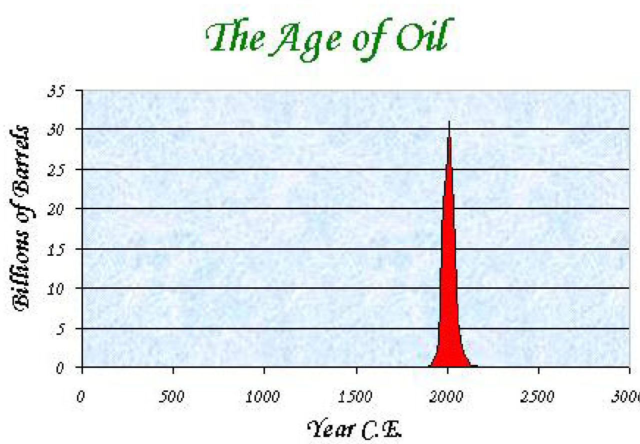
Can The Methow Feed Itself? An Inquiry Into Local Sustainable Agriculture

by Dana Visalli, Anaka Mines, & Hans Smith

A pictorial representation of the 15 acre crop rotation system described in this study that grows a complete human diet while increasing soil fertility.

How many people can the agricultural land base in the Methow Valley in northcentral Washington support, with limited "inputs" from outside the valley (including limited gasoline and diesel), in a manner that is sustainable for generations?

That's a big question, and the first thing that the reader might want to know is, why would we ask such a thing? The answer is that modern agriculture is increasingly viewed as being unsustainable over the long term. There are a number of reasons for this, but a primary one is that agriculture today is dependent upon very large amounts of petroleum, and petroleum is a resource that is finite in supply and that is depleting rapidly (the world consumes 84 million barrels of petroleum every day). The graph to the right abundantly illustrates this point; the red spike is the "Age of Oil" seen over a time span of 3000 years. From this perspective fossil fuels are clearly a temporary phenomenon, lasting 200 years at most. So while oil production may not peak globally this year (it did peak in the U.S. in 1970 and has been declining here ever since), it assuredly will do so in the near future. In fact there was a peak in global production in November of 2008 which has not been exceeded in the four months following. Meanwhile, the current human population of 6.8 billion (which is growing by 70 million a year) has become increasingly dependent on fossil-fueled agriculture.

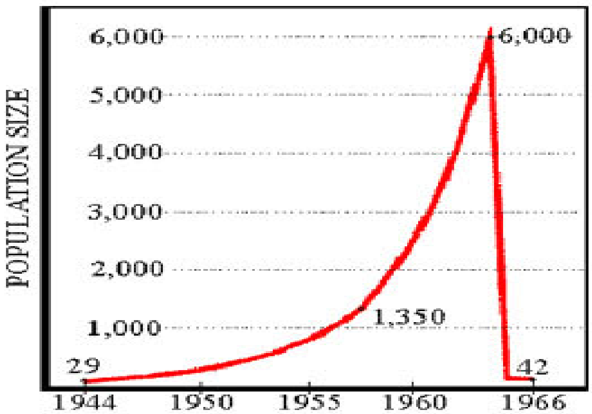


The Age of Oil, seen from the perspective of a 3000 year time span, is very brief.

Modern industrial agriculture also employs a plethora of chemicals, some of which are hazardous to health, it diminishes soil quality and quantity over time, and it pumps large amounts of carbon into the atmosphere. For all these reasons, people all over the country and around the world are attempting to recreate local food production systems.

In order to calculate how many people the Methow can support, we need to understand the concept of carrying capacity. Carrying capacity is defined as "the maximum number of any species that can be supported by an ecosystem indefinitely, without damage to that ecosystem."

The classic example of carrying capacity in the textbooks is the story of the caribou of St. Matthew's Island, which is off the coast of Alaska. 29 caribou were introduced on the island in 1944 as a meat source for soldiers stationed there. The soldiers left the next year, but the caribou stayed and prospered. With no predators on the island, their population exploded to 6000 animals by 1965.



29 caribou were introduced on St. Matthew's Island in 1944. By 1965 the population reached 6000 animals.

The island ecosystem might have been able to sustain a small herd indefinitely, but 6000 animals created a condition of "overshoot;" the caribou overshot the carrying capacity of the island. They consumed all food sources faster than the plants and lichen could grow back, and then most of the herd starved to death.

An important element of overshoot is that it actually damages the ecosystem, such that the carrying capacity is reduced from what it would have been if the population had remained within ecological limits. The corollary for humans is that we are in danger of doing enough damage to natural and agricultural lands that we could reduce the long-term carrying capacity of individual ecosystems or of the entire planet.

So the question becomes, how can we create a sustainable system of agriculture that support the current population of the valley without diminishing the carrying capacity for our children and for future generations?

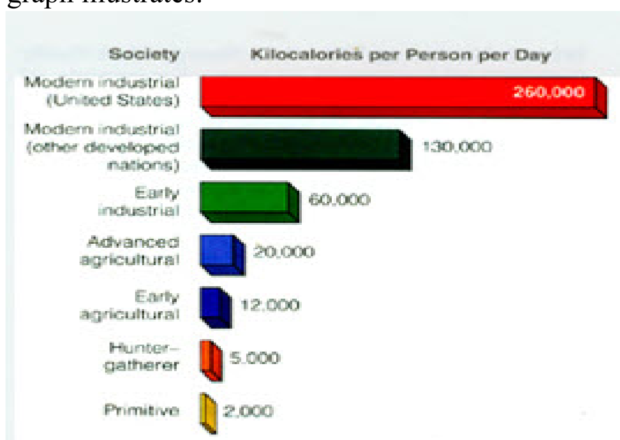
Current Conditions

What is the current population of the Methow, and how much of the food and other necessities of life are imported from outside the watershed and/or are dependent upon depleting global resources?

The most recent U.S. census information informs us that there are approximately 5200 people living full-time in the Methow Valley, which is a population density of 30 people per square mile of private land. 95% of the food consumed here is imported, much of it from California and Mexico, both over 1000 miles away and dependent on large inputs of fossil fuels to grow and transport.

In addition, most of the energy consumed in the valley is imported. Every year we consume:
2 million gallons of gasoline and diesel,
60,000,000 KWH (kilowatt hours) of electricity,
250,000 gallons of propane.
The only local source of energy (other than the sun) is the 5000 cords of wood burned here each year.

Modern culture has grown accustomed to cheap, easy access to large amounts of energy, as the follow graph illustrates:



Human energy use through history, with primitives using 2000 calories a day, moderns using 250,000 calories.

The human body needs about 2000 calories of energy a day in the form of food to survive. Over the course of human history, increasing amounts of external energy have been added to daily consumption--first through the use of fire, then draft animals, then fossil-fueled machinery, so that today everyone in industrial society has access to at least 125 times more energy than the base caloric level. For example, the energy content of just one gallon of gasoline is the equivalent of 500 hours of human labor. If you doubt this, try driving your car in one direction until you have burned one gallon of gas, and then push it back to the starting point using only your own labor.

The primary concern here is that modern agriculture is dependent upon these very large energy throughputs, from energy sources that will be completely depleted within 50 years. The time to build a local, energy-efficient agricultural system is now.

Diet For a Small Valley

In order to calculate how many people the Methow could feed sustainably, we needed to design a healthy diet that can be grown locally, calculate how much irrigated land it would take to grow that diet for one or for a number of people while maintaining and improving soil quality "forever," and then determine how much high-quality agricultural land exists in the valley.

Adults need a minimum of 2000 calories a day to sustain their bodies. We designed our locally grown diet based on 2800 calories per day to allow for the innumerable variables of food production and processing. Our model is just one of many diets that could be contrived, although we are constrained by water, weather, and climate in what crops we can grow successfully here. The chart to the right lists the food types in the diet, followed by the amount of each item consumed per person annually, which is then compared to current national average. The differences between our design and the national averages stem from the limitations imposed by local growing conditions, and by the striking difference in resource inputs required by different food types. For example, it takes seven times as much water and energy to produce a pound of meat as it does to produce a pound of grain, so in our study we we obliged to minimize meat consumption.

The Diet

Food Class	Pounds/ Person/Yr	Current U.S. Average	Calories/ Person/Day
Grain	230	200	1008
Dry Beans	50	2	219
Eggs	20	28	36
Oil	40	65	428
Sugar (honey)	30	150	113
Seeds	10	7	70
Vegetables	485	425	160
Potatoes	180	150	173
Fruit	300	279	197
Nuts	10	10	77
Dairy	310	593	204
Meat	50	65	134
Total Calories/Day			2819

A complete diet that can be grown and/or raised in the Methow

The food categories include:

Grains: Wheat, oats, rye, barley and corn all do well in the Methow when irrigated.

Beans: Dry beans are an exceptional crop; they produce well in our climate, are very nutritious, they produce their own nitrogen (through a symbiotic relationship with root and soil bacteria), and they are easy to store for long periods of time..

Oil: Sunflower and canola are the best sources of vegetable oil in the Methow; we also include animal fat as 25% of this category.

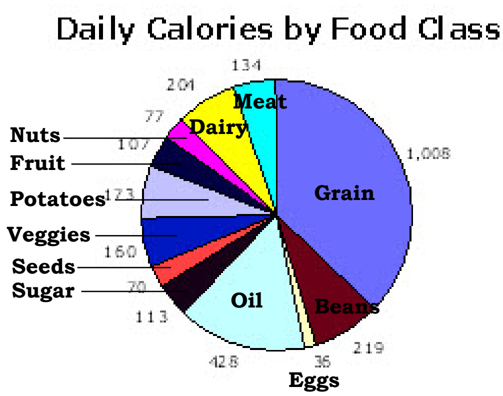
Sugar: In our diet all sugar comes from honey. Keeping bees over-winter has become more challenging in recent years due to parasites on the bees.

Seeds & Nuts: Sunflowers produce abundantly in the Methow, hazelnuts are productive here, walnuts are marginal but will produce nuts in appropriate microclimates.

Vegetables & Fruits: Most foods in this category are low in calories but provide essential vitamins and other nutrients. Potatoes are in a class of their own because they are energy-rich and are very productive in the Methow We will need a gourmet potato cookbook!

Dairy: Calculations are based on 1.6 cups of milk per person per day, which includes all milk products.

Meat: The 50 pounds of meat per year is one third the current U.S. average. We are conservative with this food source because as mentioned above it requires heavy resource inputs. It is possible to increase this amount when the dryland pastures of the uplands are included in the agricultural land base, although animals would still need hay from irrigated fields to overwinter.



This diet is simply one possible model of a food regimen that is both healthy and is composed of foods that can be grown in the Methow. Many others could be formulated.

While the original Native Americans that inhabited the Methow lived off the naturally-occurring food resources of the watershed, we did not include wild foods in our design because the current population of the valley far exceeds the number of Methow natives that once lived here. Attempting to live off the native food resources of the watershed would quickly deplete those assets.

Land to Grow the Diet for a Small Valley

How much land is needed to grow a complete "Methow diet" for one person? This is a difficult number to pin down, as there are many variables, including soil quality, water and energy availability, and the vicissitudes of the weather. In our model we utilized the best agricultural land in the valley, that currently irrigated land which is graded as Class I and Class II by the Natural Resources Conservation Service. Because the selected land base is already irrigated we can assume there is adequate water, except in the driest of years. The crops chosen for the diet are those that do well in the Methow's hot summer/cold winter climate. Because it is a known fact that petroleum will be less available in the future than it is today, we assume a low energy-input agricultural system, with most of the physical work conducted by horses and by humans.

Land Area Required Per Person

Food Class	Pounds/ Person/Yr	Yield/ Pounds/Acre	Acres/Crop Person
Grain	230	1500	0.15
Dry Beans	50	1500	0.03
Eggs	20	220	0.10
Oil	25	750	0.03
Sugar (honey)	30	NA	0.0
Seeds	10	1000	0.01
Vegetables	485	10,000	0.05
Potatoes	180	10,000	0.01
Fruit	300	10,000	0.03
Nuts	10	1000	0.01
Dairy	310	1600	0.19
Meat	50	250	0.21
Total Acreage/Person/Year			**0.82**

The amount of land needed for all the components of a healthy diet for one person for a full year.

The "diet for a small valley" is shown again in the chart above, this time with estimated yields per acre shown in the middle column, and the amount of land need per person for each crop in the column to the right.

Yields per acre are highly variable and therefore controversial; we tended to be conservative. Industrial agriculture, for example, currently produces 6000 pounds of wheat per acre, but this achieved by pumping large amounts of fossil fuel energy into the crop in the form of nitrogen (produced using natural gas), phosphorus (which is mined thousands of miles from the fields), pesticides, herbicides, and massive equipment. For small grains grown organically, yields are often reduced.

Vegetables and fruits weigh so much in pounds per acre because they are composed largely of water. When these crops are intensively managed on small farms, with attention given to each plant, organic yields are often higher than they are in industrial agriculture.

Meat production is another item that could be discussed until the cows come home. We simplified our calculations by estimating a yearling steer raised in one year to 600 pounds on 4 tons (from one acre) of forage and hay, yielding 40% of it's weight as edible meat.

Sustaining Agriculture

The big problem with not taking care of the soil is, as Will Rogers put it some years ago, "They ain't makin' any more dirt." And in fact fertile soil has almost as many living organisms as there are dirt particles. If we want to pass on to our children a healthy agricultural land base (which is the foundation of human civilization), we will have to become stewards of healthy soil.

In this study we designed a "closed" agricultural ecosystem that will improve soil over time and support a complete diet for humans. Biological systems are never completely closed; both energy in the form of sunlight and water flow through them; but almost all nutrients and organic matter in natural systems are retained and constantly cycled. In our design we simply copy nature.

We chose a size of 15 acres for our complete-diet farm because that is a convenient area for a small group of people to manage working together. Obviously the area could be more or less than 15 acres. And, people will most likely want to specialize in certain crops and trade for others. In this study we examined how to grow a complete human diet on one contiguous plot of land while maintaining and improving soil fertility.

Before we go into which crop goes where, let's briefly visit the need for crop rotation. It is not a good idea to grow the same crop in the same soil year after year. Any one crop will deplete the same nutrients out of the soil year after year, creating deficiencies. At the same time insect pests and pathogens that prey on that plant species will increase. The way to avoid this lop-sided arrangement is to rotate crops on a regular basis to soil that hasn't seen that plant for two to four years.

In addition--and this is a point worth pondering for a moment--plants, interacting with the other kingdoms of life (animals, bacteria, fungi, protists)--have made the soil increasingly fertile over time. As agricultural fields are nothing more than speeded up natural ecosystems, they too can conduct their business in a manner that enriches the soil.

For example, all plants need the element nitrogen to grow; it is essential. But, while the atmosphere is 80% nitrogen, plants cannot utilize it from that source. Fortunately, the Legume Family (which includes our garden peas and beans, alfalfa, clover, and vetch) and a few species in other plant families have evolved a relationship with specific bacteria that have the capacity to take nitrogen out of the atmosphere and "fix" it in to soil, where it is available for plants. So, it is essential that nitrogen fixing plants (plants that host nitrogen-fixing bacteria) be used in the crop rotation, to pump nitrogen into the soil.

Phosphorus and potassium are also essential to plant growth; these elements are not available from the atmosphere. Currently they are mined in a few places on the planet and shipped all over the world. Obviously, this is not how natural ecosystems manage these nutrients.

In non-petroleum driven agriculture, our only options are to 1) recycle almost all these elements that pass from the soil into the plants back into the soil by composting all organic material, and 2) using deep rooted plant species somewhere in the crop rotation to bring up phosphorus and potassium from the subsoil.

Manure from both farm animals and humans sequesters large amounts of the three essential nutrients mentioned above. When added to the soil by grazing animals and after composting, soil fertility is raised beyond what can be achieved by just recycling plants. Thus an optimum rotational system will include nitrogen-fixing plants, grazing animals, and food crops.

The design for our 15 acre complete-diet mini-farm is as follows. Keep in mind that each year each acre listed drops down one notch. For example, Acre 5, which grows grain the first year, will shift to Acre 6 and be planted in vegetables the next year, while Acre 6 will shift to Acre 7 and be planted in legumes to recharge the soil with nitrogen. Some acreage remains in pasture for up to 4 years, reducing the work necessary to manage the fields.

Acre 1: Pasture & hay for one multipurpose dairy & meat cow (older cows and male calves become a source of meat).

Acre 2-3: Pasture & hay for sheep, which provide meat and wool.

Acre 4: Pasture for our one farm horse, which will be used for both field work and transport.

Acre 5: One acre of grain (we need 2.5 acres total, but the grain is split into smaller parcels in the interests of crop rotation), for humans.

Acre 6: Vegetables, potatoes, and seeds.

Acre 7: Beans for humans, other legumes for chicken feed.

Acre 8: Grain, for humans.

Acre 9, 10, 11: Alfalfa hay.

Acre 12: Field corn and/or other grain, for feeding chickens and other animals.

Acre 13: Cover crop. This is a nitrogen-fixing crop that will be turned back into the soil when it starts to flower, optimizing nitrogen gain and adding organic matter after the previous crop of corn, which is a "heavy feeder."

Acre 14: Vegetable oil crop: Sunflowers, canola, or other oil crop suitable for our area.

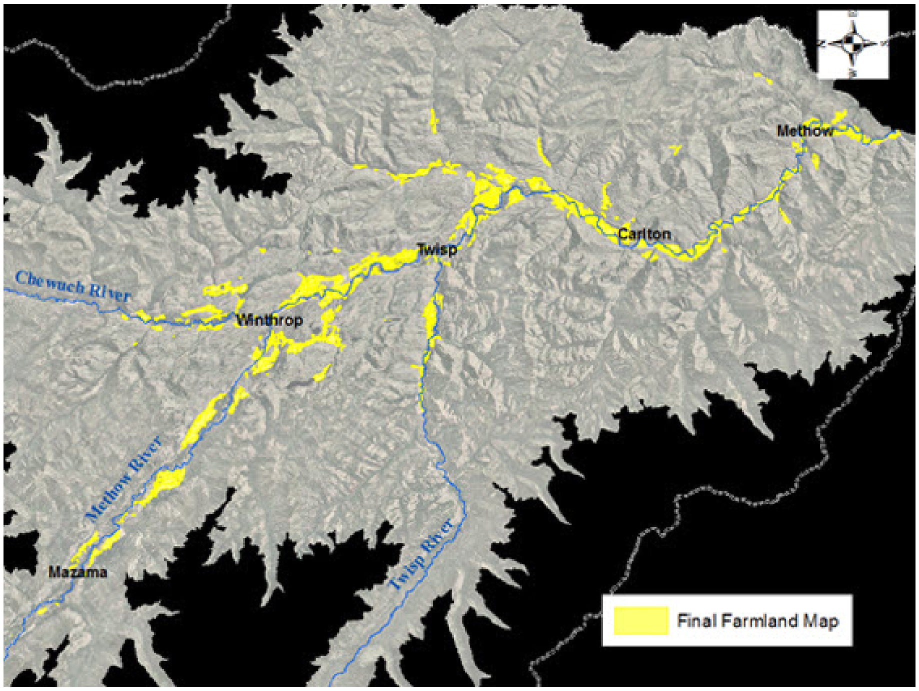
Acre 15: Grain, for humans and animals.

In addition to the 15 acres in a rotational system, this design also includes a half acre that is planted in perennial fruit and nut crops.

An important source of soil fertility in this small, closed agricultural ecosystem will be human manure, often called humanure. Humanure contains up to 7% nitrogen and 5% phosphorus by dry weight, the nutrient equivalent of a gold mine. We currently ship in nitrogen and phosphorus from factories and mines around the world, but this will be impossible in a post-petroleum world. We will have to do as nature does and recycle everything. Humanure is easily composted and turned into pathogen-free, soil-like

A schematic representation of our 15 acre rotation system:

1-Pasture- Legume & Grass	**2-Pasture- Legume & Grass**	**3-Pasture- Legume & Grass**	**4-Pasture- Legume & Grass**	**5- Grain**
10- Alfalfa hay	**9- Alfalfa hay**	**8- Grain Sow alfalfa in fall**	**7- Dry beans for people 0.6 ac + legumes for chicken feed 0.4 ac**	**6- Annual vegetables 0.5 ac + Potatoes 0.26 ac + Seeds 0.24 ac**
11- Alfalfa hay	**12- Field corn for chickens & pigs**	**13- Cover crop to turn under, pasture for chickens/pigs**	**14- Oil crop 0.9 ac + seeds for planting 0.1 ac**	**15- Grain Sow to pasture in fall**



A computer-generated map of the Methow Valley, showing the currently irrigated class I and II farmland, which totals 11,887 acres.

humus; there are a number of good books on the process for doing so.

Putting our Agricultural Model on the Ground

How much usable, quality agricultural land exists in the Methow to support this model? Cross-referencing maps from both Okanogan County records and the Natural Resources Conservation Service, and omitting lands not currently irrigated or too far uphill from a gravity water source to irrigate in a low-energy manner, our GIS (Geographic Information Systems, a computer-based mapping technique) data yields a total of 11,887 acres of land available to utilize in our model.

Reviewing some of our important numbers:

There are currently 5193 people living in the Methow watershed.

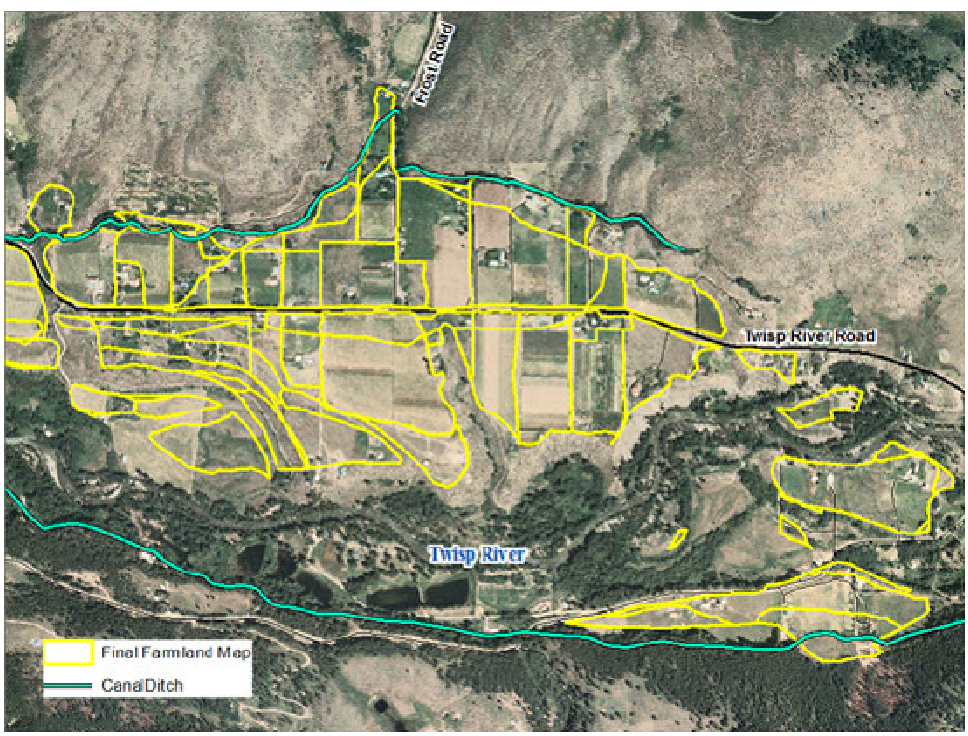
We have approximately 11,887 acres of good quality, irrigated farm land.

An average person requires .82 acres of irrigated farmland in our region to meet their dietary needs and preserve soil fertility for future generations.

So we can provisionally answer our initial question, Can the Methow Feed Itself? The answer is: Yes, it is possible to feed the current population from the existing agricultural land base, while protecting the soil resource base.

Our answer is provisional because, food is only one of the factors that limit a population. Another obvious one is water, the examination of which is beyond the scope of this study. Because we are interested in a sustainable agricultural system that works as well for future generations as it does for us, we will be unwilling to degrade the larger watershed ecosystem by “dewatering” streams or over-allocating water for human use.

Other limiting factors could include: 1) Fuel and other energy needs. While we are assuming very limited access to petroleum in our model, in our climate



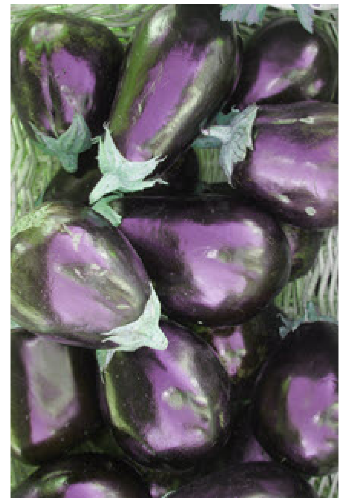
A close-up of Twisp River flats, showing details of mapping of irrigated land.

Methow-grown fruit

we will still need some source of fuel for heat and cooking. If wood is the primary fuel source, at what point does it become a limiting factor? The list of potential limiting factors in a post-petroleum world cound be extensive, for example, we will need adequate clothing, shelther, medicine, metal for tools, even a simple staple such as salt could be challenging as there is no local source for the substance.

But, even after considering all things, let us not lose sight of the bottom line of this report: we do have the land necessary right here to feed ourselves. As the world changes, we don't have to panic, we can simply adjust to reality. The changes in the realms of energy and finance that confront us are not just an opportunity to become more locally sustainable, but they are also an opportunity to become more connected to our community, to the source of our nourishment, and to the other living things that share our valley.

The ecological approach to agriculture that we have described in this report, modeling our agricultural fields after natural ecosystems, is nothing new. Many careful observers of biology have designed similar systems throughout the ages. In 1910, British agronomist Sir Albert Howard, after witnessing the damage being done to soils even then by industrial agriculture, noted that "Mother Earth never attempts to farm without livestock; she always raises mixed crops; great pains are taken to preserve the soil and prevent erosion; the mixed vegetable and animal wastes are converted into humus; there is no waste; the processes of growth and the processes of decay balance one another; ample provision is made to maintain large reserves of fertility; the greatest care is taken to store the rainfall; both plant, and animals are left to protect themselves against disease."



Methow-grown vegetables

Sustainable agriculture is simply a manner of adapting the ecological rules of natural systems (energy comes from the sun, nothing is wasted) to our farms and fields.

Resources:

Our study was inspired by a similar one done by Jason Bradford in Willits, California titled, *Can Our County Feed Itself?* His essay, well worth reading, is published in four parts, can be found individually at www.energyfarms.net/node/ 1489 (and 1490, 1491, 1492). 20 pages.

Richard Heinberg and Michael Bomford, working with the Post Carbon Institute, recently published a 40-page guide to making the transition to post-petroleum agriculture. *The Food and Farming Transition: Toward a Post-carbon Food System* is available at http://postcarbon.org/files/PCI-food-and-farming-transition.pdf or at the Methow Naturalist home page.

The Post Carbon Institute itself publishes a monthly newsletter sent via email that contains excellent material on energy, climate change, and pathways to a sustainable future. www.postcarbon.org

A series of gardening guides tailored for conditions in northcentral Washington are available for download through the Methow Naturalist homepage, www.methownaturalist.com Subjects include *Composting, Humanure & Soil, Winter Gardening & Winter Food Storage, Garden Planting Guide & Seed Saving Chart,* and *Cover Crops: An Overview and Species Guide.*

An excellent web site for daily information on energy, ecology and organic agriculture is the Energy Bulletin, www.energybulletin.net

There has been an email group listserve in the Methow called *Yipdoggies* since a 2002 energy conference in Twisp, posting articles on sustainability and discussing issues. Some strong medicine is served up there; for example, we cannot both pay for the U.S. war machine and build a sustainable culture; it's one or the other; you are free to choose which you will support. To join Yipdoggies send an email to dana@methownnet.com