

Ecological Livestock Raising  
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*Slide 1*

Title page

*Slide 2*

What do you see in this picture? Two women and a cow walking quietly toward a barn. The grass is green and lush, and the early morning sun bathes the scene in a luminous aura of light. The names of the women are Elizabeth (that's my wife, on the left), and Katy (one of our interns). The cow's name is Loveday, one of our two Jerseys, and she is on her way to be milked. It's around 6:30 in the morning, in May.

What I see here is the very image of ecological cattle raising. Basically, what we do on our farm is harvest the sunlight. The energy of the sun makes the grass grow which feeds Loveday who gives us about 4 gals of milk that we drink or process into butter and cheese. Milk from a grass-fed cow is much sweeter than milk from a grain-fed cow, because it contains high levels of natural sugars. Loveday's milk also feeds the chickens and the pigs. The energy of the sun shines on the skin of the cow and thereby is converted into vitamin D. We consume the milk, butter and cheese *raw*, which means that all of these products are alive with *enzymes* which are the catalysts without which we cannot metabolize our food (by contrast, pasteurized milk is dead in the sense that the enzymes have been killed by heat). And we also do not homogenize the milk because homogenization interferes with the absorption of the milk calcium into the blood stream.

The only feed this and any of our two dozen cows get is green forage in summer, and hay in winter. Cattle, like sheep, are ruminants, which means that they can produce all the required proteins and other nutrients from grass in their four stomachs, through the process of gradual mastication. They are fed no grain and so they don't produce the deadly E-coli strain 0157:H7; nor do they require any other supplement, medications, antibiotics or wormers.

***I would like to talk to you about five related topics:***

- 1. What livestock do we raise on S&S Homestead Farm?***
- 2. What are the methods we use?***
- 3. What are our markets?***

**4. What are the economics of small-scale and self-sufficient livestock raising?**

**5. What is ecological livestock raising (is there a difference between organic livestock production and ecological livestock raising)**

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**1. On S&S Homestead Farm, we raise beef and dairy cattle, sheep, pigs, and chickens.**

Here are some pictures of each.

*Slide 3*

Dairy and beef cattle:

We have two milk cows, Loveday and Lilly. Both of them are purebred Jerseys. They are gentle animals that respond well to personal attention and are easily manageable. Each produces between 1-4 gallons of milk per day, depending on the season and how recently they have calved. We cross breed them with a Simmental-Angus bull, by the name of Faulker, whom you see here. The cross-bred calves could potentially be milked as their udders are typically large, but we find that their beef genetics make them less tractable and less willing to be touched, milked, groomed, than the purebred Jerseys. So usually the calves are slaughtered for beef when they 3 years old, or become replacement heifers.

Besides the Angus-Simmental bull, we also have five beef cows that are 50% crosses between Angus, Hereford, Jersey, Scottish Highland and 50% Simmental. The reason we have bred the entire herd to 50% Simmental is that the Simmentals, an Alpine breed, are particularly efficient in converting cellulose to high quality protein, without the need for supplementation with grain or other feed concentrates. The only mineral we supply is selenium which is deficient in Western Washington and, if not supplied, causes white muscle disease (essentially the animal dies from heart failure). We administer selenium in the form of a salt block.

The Simmental is a large-framed animal that reaches its phenotypical maturity at about three years of age. So we slaughter when the beeves are about 30-36 months old, usually at the end of the spring flush, after the animals have a chance to finish on lush spring grass and are in prime condition.

So typically, our annual cattle herd consists of 2 dairy plus 5 beef cows, the bull, and half a dozen each of newborn calves, yearlings, and two-year old slaughter animals. We do not segregate the bull from the main herd which means that we

do not control when the calves are born. However, we find that the calves usually are born in time for weaning to take place just at the time when the grass starts growing in March. Because the bull is always with the herd, he is very mellow, does not challenge our fences, and fertility is invariably 100%.

*Slide 4*

Here is another picture of some of the yearlings in late winter.

*Slide 5*

Sheep:

Normally, our annual sheep flock consists of 5 ewes, 1 ram, and 2 lambs per ewe, born in late winter or early spring. As with the cattle, we do not segregate the ram from the flock and find that birthing matches the seasonal rhythm. When we started building our flock in 1994, we began with purebred Suffolks which are specialized to produce high quality meat carcasses, but found that the ewes often were poor mothers and a high percentage of lambs were born with double eyelids, requiring surgical correction to prevent blindness. So we cross-bred the Suffolk ewes first with Romney, then with Polypay and finally with Churro genetics to produce lambs that are vigorous, with no birthing problems, are free of genetic defects, and resistant to internal parasites. The Churro are particularly interesting. The name means sheep in Spanish, and the breed was developed by the Navajo from stock brought to the new world during the Spanish conquest of America during the 16th century. Churro are hardy animals, very fertile, and sport multicolored coats. However, they are also relatively small and flighty, and not nearly as trusting as British-descended sheep, which makes them more difficult to manage. For these reasons, in the coming season we will reintroduce a Romney ram into our flock. We raise sheep mostly for the meat, but also love the beautiful sheep skins for which, unfortunately, there is only a limited market.

*Slide 6*

Here are some of the lambs in early summer.

*Slide 7*

And here is a picture of one of our interns nursing a lamb whose mother was too old to do the job herself.

*Slide 8*

Pigs:

We usually raise no more than 3 or 4 pigs at the most per year, for the simple reason that we cannot produce enough feed to produce more pork. This is regrettable because farm-raised pork raised on our own barley, raw milk,

vegetables and fruit tastes entirely different from commercial pork produced on feed concentrates. The meat is sweet and succulent, and absolutely delicious. A smoked ham from one of pigs, for instance, does not require any glazing. Just pop it in the oven at 325 degrees and bake for about 20 minutes/pound. You wouldn't want to insult the delicate flavor of the ham with mustard or any other condiment. These pigs are Hampshire crosses. Because of the limited number we can raise, we do not breed the pigs on the farm, but buy them as weaner pigs at about six weeks of age, from a neighbor.

### *Slide 9*

Chickens:

We breed Speckled Sussex chickens on the farm. They are one of the oldest American breeds, good layers and excellent brooders. The white chickens are Leghorns, and we don't breed them for the simple reason that the instinct to sit on a clutch of eggs for some three weeks has been bred out of these birds in order to increase their productivity as egg layers. So every time we have to replace them (when they are 2-3 years old), we have to buy the chicks from a hatchery. We time purchasing chicks until one or several of the Speckled Sussex have just hatched their chicks, and then place the Leghorn chicks under the mother hen who usually accepts and raises them just fine. We feed our chickens a homemade mash of cooked potatoes and vegetables and ground barley. In the winter, when there are few bugs or worms to be had, we supplement the feed with organ meats, such as cooked beef or pork hearts or liver. The chickens are in their run in the morning when they lay their eggs, then are let out to run free over the entire farm, where they perform important duties, for instance, eating slug eggs which is why we have almost no slugs in our garden, or no ants in the house. We scrape the floor of the chicken house every day and pile the bedding under the roost. That way the chicken house stays clean and sweet smelling, and we do not need to treat the birds with antibiotics or dust them to keep them healthy.

### *Slide 10*

#### **2. What are the methods we use?**

In the previous section, I showed what kind of livestock we raise, and I have told that we feed them forages, hay, grain, potatoes, vegetables, fruit, and organ meats, depending on the animal species and the season. In this section, I want to tell you something more about the methods we use in raising our livestock, and how we raise the feeds. In this connection, I want to touch on 4 related topics:

a. Animal and vegetative health

- b. Rotational grazing and haying
- c. Soil fertility
- d. Water cycling

Of course, all these topics are related. Everything that happens on the farm, affects everything else. The health of the soil, vegetables, and forages affects the health of the animals, and vice-versa. The fundamental principle by which we operate is that the farm is an integrated, self-organizing and self-correcting system that is open to and powered by the sun, but is closed to outside inputs as much as possible. For example, we don't bring in feeds or fertilizers from the outside. Instead, the farm eco-system relies on its own resources, which is not only economically advantageous, but more importantly, the vegetation and animal life on the farm are in balance and develop place-specific immunities. As a result, we are in no need of antibiotics or other medications for animals, or pesticides or herbicides in fields or gardens.

The most important requirement for an integrated system is cleanliness. For instance, this is a picture of the stall and stanchion, where we milk the cows. Every time we milk (twice a day), we wash the concrete floor and gates to make sure that there is no debris, manure, or smells that can affect the wholesomeness and flavor of the milk.

*Slide 11*

In this picture, you see one of our trainees wash the stainless steel milking buckets with hot water and soap. Notice the steam from the hot water. We use soap, but no chemical cleanser or sterilizers.

*Slide 12*

The first thing Elizabeth does to get ready for milking is that she washes the cow's udder with hot water and soap. Notice that the tail has been tied to keep it from hitting her face (we know of a woman who lost an eye because of an errant cow's tail!)

*Slide 13*

Sometimes one of us milks, and sometimes we do it together.

*Slide 14*

During the milking, Loveday's calf waits quite patiently in the stall next door. When we have harvested the milk we want, the calf is brought in and she takes

the rest of the milk. It is important that the udder is stripped out completely, and the calf does that very efficiently. Once the calf is weaned at three months of age, we have to strip out the udder to make sure that no milk is left behind, which could cause the cow to develop mastitis. (In all the years we have milked cows, we have never had mastitis or any other milk-related disease.

*Slide 15*

After the milking is done, we groom the cow. It keeps her clean, and she likes it, which means that she likes us and doesn't hesitate to come when we call her into the barn.

*Slide 16*

When we are done milking, we bring the yearling heifers into the neighboring stall, where they get their daily ration of hay. There are several reasons for doing this. One is that we don't want the heifers to breed and certainly not with our bull, who is their sire. So we keep the heifers together with the two milk cows in a separate field above the milking barn, and we feed them separately from the herd. The other reasons are: we find that feeding cows in a stall like this, they don't waste much if any of the feed (as they tend to do in the field when you simply put the hay down on the ground, and the animals trample the feed).

Furthermore, holding the heifers in the stall for a few hours every day, allows us to collect their manure. A cow excretes over 90% of the nutrients she takes in in the form of hay and converts into the proteins and vitamins she needs to sustain her. The manure they excrete is full of enzymes and bacteria, which, if collected and piled in a heap, turn the feed into a potent source of soil fertility.

*Slide 17*

On the other sides of the cow stalls, we feed hay to the sheep. Since we don't milk the sheep, we let the bedding and manure accumulate in a deep litter, which is then piled and composted in spring.

*Slide 18*

This compost pile measuring about 5x6x8 feet has been collected in the two stalls since November, when we started feeding the heifers in the barn.

*Slide 19*

At temperature levels between 120-160 degrees Fahrenheit, pathogens in the manure are killed, but beneficial bacteria and fungi flourish. The metabolic activity of the microorganisms also serves to fix the NPK in the fecal matter so that they can neither leach out in water nor volatilize into the air.

### *Slide 20*

By the middle of March, when the grass in the pastures is about 6 inches tall, and the heifers no longer need to be fed hay, I move the accumulated, heating manure pile out on to open ground. I cover it with plastic to keep the chickens from scratching it apart, and to keep the summer sun from drying out the pile. The internal heating stops, the pile cools, and now the earthworms move in. I usually leave the pile alone for several months, by which time the entire pile has been digested by worms, leaving behind worm castings, in other words the organic matter in the fecal matter has been totally mineralized, producing a high-quality fertilizer that is perfectly balanced. This picture shows what's left over from last year and, because of the winter rains, the compost is wet. Normally, by the time the compost is put on vegetable beds in spring, it is crumbly and moist, but no longer wet.

### *Slide 21*

While we are talking about vermicompost and worm castings, I want to show you this picture. These are castings left behind by night crawlers (*lumbricus terrestris*), which, as their name implies, come out at night to feed on animal droppings. I calculate that between the cows and sheep, the ruminant animals on the farm produce about 90,000 lbs. of dry matter (DM) in the form of manures per year. Only a small portion of that is captured in the feeding areas, the rest stays behind on the ground and is metabolized into the soil first by macro-organisms such as earthworms and beetles, and then by microscopic soil organisms, of which there are as many 1 billion in each teaspoon of a healthy soil that is well supplied with organic matter and free of synthetic toxins, such as chemical fertilizers, pesticides, or herbicides. Some bacteria and fungi are decomposers that break down the organic residue pulled into the soil by the worms. Other bacteria and fungi immobilize Nitrogen (N<sub>2</sub>) by storing it in their bodies; others, again, live in mycorrhizal associations with roots and deliver nutrients (such as potassium) and water to the plant. Some protozoa and nematodes feed on the bacteria and fungi, releasing plant-available nitrogen (NH<sub>4</sub><sup>+</sup>). Other bacteria, fungi, nematodes and microarthropods are parasitic and pathogenic, which means, for example, that they feed on roots and other plant parts and potentially cause disease; but, again, a healthy soil organism is fundamentally in balance, and the forces of growth and decay, life and death support each other in the food web below our feet.

This takes me to the next topic in this section on **methods**, which has to do with **rotational grazing and haying**:

### *Slide 22*

Here is a picture of my German shepherd, Ursa, and me feeding the cattle hay in early winter. Rotational grazing, of course, refers to a system of doling out

portions of green forage in a growing pasture, i.e. it is a system that applies only to the growing season in spring, summer and fall, but not in winter when the cattle don't graze green forage but are fed hay. But the principle of controlling animal movement by a rotating fencing system is the same, and the underlying goal is the same. Whether feeding forage or hay, the farmer uses a movable electric fence to control animal movement, stocking rate and density.

For example, in the months from late March through the end of November (or so), we move two dozen cattle across ten acres of pasture by dividing the pasture in 8 strips across the breadth of the field. We set up three tape fences electrified to a voltage between 5-10 Kv pulsing through the wire every 20 seconds. If the animal touches the wire, the impulse travels through its body to the ground and back to the charger. The animal recoils from the shock and the circuit is broken until another animal touches the wire, and only then is electricity actually consumed (leaves the system). The system is therefore very inexpensive to run, no more than a couple of dollars in energy costs per month for the entire farm (50 acres). The herd is introduced to a strip when the grass is about 6 inches high, and moved to the next strip when the forage has been grazed down to an average of 2 inches. Because of stocking rate and density (24 animals/1 ¼ acres), the herd tends to stay in place instead of moving around and wasting forage by trampling. Also, being confined in a smaller area, the animals tend to consume everything instead of selecting, for example, the sweeter legumes instead of the tougher grasses such as tall fescue, which have an important role to play as roughage in the ruminant diet. If the herd had access to the entire ten acres at the same time, the animals would repeatedly return to the more delectable forage species, keep grazing them down, with the result that the plants never have a chance to replenish their nutrient stores through photosynthesis and instead would have to draw on the nutrient reserves stored in the roots until they are exhausted, and the plants die. This explains why it is that it is easier to overgraze a larger pasture than a smaller one, provided the smaller pasture is allowed to rest between grazing intervals. So we move our herd across the ten acres eight times in the course of the summer, which means that each strip is grazed for about a week (more or less, depending on weather and re-growth rates), and then rests for 8 weeks before the herd returns to it. During the week the herd spends in each strip, most of the forage is consumed, and what is left behind is a fairly dense layer of manure. By the time the herd comes back, the grass will have regrown to about 6 inches or so, AND night crawling worms and beetles will have metabolized most of the cow pies into the soil, leaving no habitat for parasites to invade the digestive system of the grazing animal.

During the winter months we apply the same system, but in reverse. This time the goal is to feed the animal on dry ground, leaving behind broken sod well fertilized by the animals excreting behind themselves as they feed beneath the fence in front of them. By moving the fence in ten-foot increments/day, the entire field is covered with nutrients to support whatever succession crop that is planted there once the animals have moved to pasture.

We feed the hay daily in 50-pound bales, i.e. bales that are small and light enough that both my wife and I can easily lift them without a machine. There are both economic and nutritional reasons why we prefer daily feedings of small bales to feeding, e.g. large round bales once a week or so. The production of round bales requires specialized and fairly expensive equipment, including a 50 hp tractor, at least. Our tractor produces only 18 hp at the PTO, but that is enough power to operate the 50-year old sickle bar mower I bought from Barnett Implements in Mt. Vernon for \$700, and restored. I rake the fresh cut hay into wind rows with an equally ancient hay rake. Then my neighbor comes and bales, charging me less than \$400 for 25 tons of hay, i.e. \$16/t, which is our only cash expense for the annual hay crop, besides the price of fuel for haying equipment and the hay truck. By comparison, I recently read in the *Stockman Grass Farmer* that in Colorado hay currently costs \$150/t out of the field, which price would probably double for shipping.

The nutritional reason for feeding daily becomes clear when you break open the bales and inhale the sweet smell of fresh hay that hasn't been leached by rain or sun, and therefore is nutritionally dense and palatable. Furthermore, laying the hay down on the opposite side of the fence means that the cattle waste very little by trampling. Altogether, I estimate that rotational grazing which extends the summer grazing season by at least 6 weeks/year, and daily feedings in winter save perhaps up to 50% of hay in comparison to more mechanized methods intended to save on labor by maximizing machine use.

### *Slide 23*

The crop we plant in the sacrifice area where the cattle have wintered is barley. One of our interns calculated that the total amount of nitrogen deposited by the cows is minimally 128#/acre, while barley requires 60#/acre, less than half of what is available. After the barley has been harvested in the fall, the seeds of forages in the soil re-colonize the field, and the cycle is repeated in winter. The barley, usually about 2 ton, is harvested by a neighbor who owns a small and ancient combine. He charges about as much as the grain is worth on the commodity market. Nevertheless, the procedure is worthwhile both economically and ecologically. The barley provides organic feed for pigs and chickens at the price of non-organic grain. Because it is grown on the farm instead of purchased, the farmer can be sure of the quality and healthfulness of the product, and he avoids importing weed and other invasive plant seeds from another site.

Furthermore, the field yields not only grain but also straw which, at \$7.50 per bale at the local feed store, is worth more than the grain, and is a very valuable farm resource. We use it for bedding, as well as mulching in our vegetable and fruit production. And finally, by returning the excess nutrients from the winter sacrifice area to the rest of the farm in the form of animal feed, we avoid leaching

the nitrogen into the groundwater and poisoning the water we drink and give to our animals.

*Slide 24*

We have discussed achieving **soil fertility** through composts and rotational grazing. What other **methods** do we use to the same end? I should mention two: One is cover cropping. This picture shows winter rye and some fava beans in a bed that will be planted with potatoes next month. Potatoes are an important crop for us, both for domestic use, and as feed for chickens and pigs. This bed has been double dug, which means that it initially was dug three spades deep and plenty of organic matter incorporated in the lowest layer after removing rocks and deep-rooted weeds such as thistle and burdock. What this means is that the O-horizon, which on Lopez Island is typically very shallow (rarely more than 3-4 inches), is now 30 inches deep, rich in organic matter, and in good tilth, i.e. crumbly in texture, with lots of pore space to store water and air. It also means that the bed is well drained, and so I will be able to turn the cover crop in with a spade in a week or so, leave it to decompose in the soil for about two weeks. Then I will lay down a drip tape, and place the seed potatoes right on top of it (without making a furrow) at 1-foot intervals, and covering the whole thing with a 2-foot layer of semi-decomposed hay. The potatoes will be kept cool under the hay and protected from the sun. The expected yield is about 5 pounds per plant.

But before I seed potatoes or anything else in our kitchen garden, or the vegetable fields, we apply another special farm-produced input that requires some explanation. What I am talking about are biodynamic preparations which are a series of 8 different herbs and plant substances (chamomile, nettle, yarrow, dandelion, valerian, oak bark) plus silica crystals and cow manure that are fermented in the soil during the winter and then stirred out in water and either inserted into the compost piles or sprayed directly on the soil at planting time and throughout the year. These fermented substances function in compost and soil very much like homeopathic remedies do in the human body: applied in minute quantities, they regulate and strengthen metabolic processes to enhance energy and nutrient exchanges and generally strengthen the microorganic life in the soil and the health of the plants.

*Slide 25*

Here local high school students are harvesting nettles to place in a ceramic tile in which it will be buried in the soil for one year, at the end of which the plant matter will have fermented into an earthy smelling compound.

*Slide 26*

We stir out the preparations in this 50-gallon wine barrel

*Slide 27*

Less than a handful of fermented preparation is stirred for an hour to create a deep vortices moving alternately right and left.

*Slide 28*

Spraying valerian juice stirred into rain water on the compost pile.

*Slide 29*

The next topic I want to talk about in the context of **Methods**, has to do with water cycling. This pond is about 150 feet across, 15 feet deep, and it holds about 750,000 gallons of water. Most of the water comes from the roofs of our two barns.

*Slide 30*

The system starts here: during the rainy season (November through April), the water runs down gutters into cattle tanks in which there is an overflow pipe that funnels the water into a cistern. When the cistern is full, it overflows into open swales which carries the water by gravity into the pond about a thousand feet away. During the drought season (July through September), the water is pumped back up hill to the cistern, where a shallow well pump pressurizes the water (40psi) for use in irrigation.

*Slide 31*

This picture shows the photovoltaic panels that drive the pump that moves the water uphill into the cistern.

*Slide 32*

Here are the pump and filters.

*Slide 33*

A small computer regulates the flow of the water to three remote sites: the cistern, the orchard, and a two-acre vegetable field.

The solar-driven catchment system has several benefits. One is that it now supplies more than half the water needs of the entire farm operation and the private household of the farmer. This is important because our hand-dug produces only 2 gals/minute, and we share the water with 18 neighboring households. The other is that the water irrigating the vegetable and fruit production is now soft rainwater instead of much harder groundwater. Rainwater is more easily transported in the plant capillaries and therefore benefits plant

productivity and health. The animals, on the other hand, benefit from the added minerals, and therefore we give them groundwater to drink.

*Slide 34*

Here are some of the row crops using the solar-driven drip irrigation system: corn to the left, followed by potatoes, sugar beets (mangels) for dairy cow feed, bush beans, and summer squash.

*Slide 35*

I want now to turn to our 3. Topic:

**3. What are our markets?**

When we first started out producing food on this farm more than 37 years ago, our primary interest was to supply our own family with high quality, nutrient-dense, fresh and flavorful vegetables and fruit and, to some degree, meat and eggs. My wife and I were both employed as fulltime teachers and we did our farming on the side, on the weekends and during summers and vacations. On less than ¼ acre we grew all kinds of vegetables and potatoes, planted an orchard of stone fruit and berries. During the summer we also had chickens for eggs and we raised rabbits in cages. In addition, I ran a single cow and her calf as part of a neighbor's herd in exchange for helping him bring in the hay. Then, when my youngest son turned 18 and graduated from high school, we felt the time had come when we could become fulltime farmers, except that my wife took a part-time position teaching English and Spanish at Lopez Island High School. This was in 1994, and we have been farming on an expanded scale ever since. We soon found that we produced more than we could consume by ourselves and started selling the surplus to our island neighbors.

Over the years, we have experimented with a number of ways to market our products and learned some lessons along the way. For instance, when we grew our first barley crop we sold it at the Cargill grain elevator on Highway 20; and when we raised more animals we tried to sell them at the Marysville auction, and when we started milking our cows, we thought about making a contract with Dairygold. These are all examples of producing for the commodity market. For a small producer commodity markets are problematic, however; the producer has little or no control over prices, the profit margins are discouragingly small (most of the profit goes to the middle man or processor who, on top of everything else, tries to tell you what to produce and how).

An alternative often recommended to small producers is local niche markets. For instance, in San Juan County, you can use the USDA-approved mobile slaughter unit (a project spearheaded by this farm and developed by the Lopez Community

Land Trust) and either butcher on a custom basis, or have your animals processed by the butcher and sell your meat and sausage out of your farm freezer or at local food stores.

At S&S Homestead Farm, over the years we have tried a number of these approaches, from commodity to niche marketing and have come to the conclusion that what works best for us is *not* to concentrate on a particular commodity or niche, but to produce a lot of different things to meet our own food needs first, and sell the rest to our immediate community. This choice has turned out to be economically rewarding, as well as deeply satisfying to contribute to the growth of a local food system and local food security.

*Slide 36*

A bumper crop of summer cabbage, broccoli, Romaine lettuce and turnips

*Slide 37*

In winter we grow mostly greens such as kale, corn salad, lettuce, spinach, and root crops, including carrots, turnips, beets, rutabaga and leeks.

*Slide 38*

We have deliberately restricted our vegetable CSA to no more 12 families for two 20-week seasons per year (a CSA is an arrangement by which customers pay a lump sum to the farmer at the beginning of the season in exchange for a weekly basket of produce).

Following the same model, we also supply families with beef, pork and lamb from 5-7 beef, 3 pigs, and half a dozen lambs. The customers pay us a fixed amount per pound of meat (hanging weight), and they pay the processing fees charged by the butcher.

Until last year, we also supplied 21 families with varying quantities of unpasteurized milk per week on a cow-share model, where shareholders lease part of the dairy animal for the season and pay for that share commensurate with the amount of milk they want. As you probably know, the state has made cow-share arrangements illegal and now requires that all producers who want to sell or barter milk to become licensed as grade A dairy producers and processors. Unfortunately the infrastructure costs required to qualify for a dairy license are simply too high for very small producers like ourselves, and so we have been forced to stop providing this clean, healthful and safe product to our neighbors. Instead we are now training individual families in how to keep their own family cow and thereby secure the superior food they want and cannot find in commercial outlets on the island.

### *Slide 39*

Before I leave the topic of markets and marketing, I want to mention another enterprise which has developed on the farm, which is education. Since 1994 we have trained more than 30 college-level and graduate student interns. We also teach public school classes K-12 in ecological food production, and we have started a pilot project providing a stream of farm-grown vegetables for the school cafeteria. In addition we welcome farm tours for individuals, organizations, conservation districts, and we carry out on-farm research in collaboration with university faculty and researchers. My wife and I also lecture off the farm in various settings. For many years this work was done on a volunteer basis, without compensation. However, as our educational program developed and became more and more time-consuming and demanding, we decided to shift more energy into our teaching efforts, but also ask for at least modest pay. Today, income from educational outreach provides just about half of the total economic return of the farm.

### *Slide 41*

#### **4. What, then, are the economics of small-scale and self-sufficient livestock raising?**

As you can see in the upper pie chart, the total economic production of the farm is here expressed in percentages. 58% of production (beef, pork, lamb and sheep skins, dairy, chicken and eggs) is sold to the island community, 42% is consumed at home. Some products (hay, grain, fertilizers) are not sold at all, but are consumed entirely in raising the livestock on the farm.

The lower pie chart illustrates the relationship of costs to profits: Fixed production costs (buildings, machinery, fencing, water system) comprise 25% of costs; variable production costs for the various production centers (beef, pork, lamb, chickens, eggs, dairy, grain, hay, vegetables), and including supplies, greenhouse management, machine hire, utilities, taxes, life, health and liability insurance, accounting, and continuing education for the farmers, comprise 24% of returns; costs for our educational outreach programs and internships (farm produced and purchased foods, housing, tools and books) comprise another 27% of production returns. The margin of retained profits over costs comes to 24% of returns.

You will no doubt notice that there are three major cost items not included here: labor costs, set-asides for retirement, and the cost of the land. The reason they are not included here is that they do not represent farm expenses in the form of current cash or mortgage payments.

The simple reason for not including the cost of labor is that there isn't any cash cost to the farm. My wife and I do not see any reason to pay ourselves a salary,

and we agree with agricultural writer, Gene Logdson, who makes the point that any farm production value for which you do not have to pay (in this case the value of what we produce with our labor), should be listed in the profit column. Conventional economists do not see it that way, of course: their thinking is that if the farm does not produce enough profit that can be extracted and spent in the market place, then it is simply not profitable.

The second cost item not included here is set-asides for retirement, clearly a very important issue for most working folk. In my instance, I earned retirement funds during the 30 years I worked in the university system, and my wife who is still teaching in the public schools, will receive a pension from the Washington Retirement System at age 65. I am 70 years of age now and have received Social Security since I 1994 when I left the university. But I have not taken any pension disbursements yet, because so far the farm has provided for all my daily needs, including food, shelter, meaningful and challenging work, and recreation.

The third cost item excluded from the analysis is that of the land. I bought the original 10 acres in 1970 for \$10,000, another 5 acres in 1994 for \$35,000. In both instances we paid cash, which means that we have no current mortgage expense. (The remaining 35 acres we farm are leased at no cost from 2 neighbors: the benefit to the land owners is that our use improves the land and that it lowers their property tax to agricultural value rather than market value, a tax saving of about 60%).

Now I am quite aware that mainstream economists argue that unless the farm produces enough return to cover what is called the “opportunity cost” of capital investment, the overall enterprise is considered unprofitable. “Opportunity cost” is calculated by multiplying capital investment x the Prime Rate (currently 8.25%) x 2. So given the current market value of the (owned) land, plus farm buildings, machines and other infrastructure (for a total of at least \$600,000), the farm would have to return \$99,000 per year to be considered profitable. Clearly, the farm returns less than that and, in fact, none of the profits are extracted but are reinvested as working capital and for improvements.

What these examples show is that the question of farm profitability has to be answered in the context of the particular needs of the farmers and other, larger contexts. The so-called bottom line is never quite what it seems.

The next slide will illustrate this:

#### *Slide 42*

What you see here is just a fraction of the bounty the farm produces: meats, milk, potatoes, bread, fruits, fresh and fermented vegetables, juices, jams, garlic.

This is the kind of food my family and I, and our interns and trainees, eat every day. It is nutrient-dense, additive-free, GMO-free, chemical-free, enzyme-rich and

very flavorful food not available in commercial stores or restaurants. It represents what my wife, Elizabeth, calls eating “FLOSS:” fresh, local, organic, seasonal, and sustainably grown food (handout).

This food not only tastes great, but because we have been eating it for decades our health is optimal. We have no need for dietary supplements or medications of any kind, and we don't get sick—haven't even had a cold in years. What is it worth not having to deal with obesity, cardiovascular disease, diabetes, autism, ADD, depression, autoimmune deficiencies, chronic fatigue syndrome, to name just a few? Clearly it is of economic value that we don't have to pay for any of these, do not need drugs, cures, surgeries or therapies; but how do we express these personal savings on the bottom line of our farm enterprise? Let me note that the average American today spends more on health care than on food (but is in poorer health than was the case some 30-50 years ago when food expenses in this country were higher, but health care costs proportionately lower).

Similarly, because we work at home and love being where we work, we have less need for personal travel: in fact, our transportation budget is less than 1/7th of that of the average American. How does that figure in the bottom line of our enterprise? Aren't those saved fuel dollars earned by the farm enterprise?

Also, because of our work and life style, our entertainment budget is 1/10th of that of the average citizen. How does that figure into the earnings of the farm?

In sum, experience has taught me that farm profitability cannot be gauged in terms of short-term (annual) profits alone, without due consideration of long-range effects on personal health and self-fulfillment, as well on society and the environment.

All of these considerations (profitability, health, social and environmental impacts) are part of what is considered ecological agriculture. So I want to use whatever time I have left to explore whether there is a difference between organic livestock production and ecological livestock raising?

## **5. What is ecological livestock raising (and is there a difference between organic livestock production and ecological livestock raising)?**

Let us begin with a comparison of two farms described in Michael Pollan's recent best-seller, *The Omnivore's Dilemma*.

Slide 43

These two farms are comparable in size (both of them about 500 acres) and in the livestock they raise, but they are very different in production methods and ecological impact. The Naylor Farm in Iowa produces cattle, pigs and chickens

on corn and beans, while Polyface Farm in Virginia raises the same livestock but does it mostly on grass. The Naylor Farm annually imports calves, weaner pigs, and chicks which they raise in CAFOs (Confined Animal Feeding Operations) on feed grown monoculturally (meaning that a single species, such as beans or corn, is cultivated in each field), while Polyface breeds perennial livestock and feeds them polyculturally on highly diversified, perennial stands of grasses, forbs, legumes and wild flowers. The Naylor Farm methods are mechanical and involve heavy machinery running on fossil energy; The Polyface Farm methods are biological and are fueled mostly by solar energy harvested through forages and the animals. Naylor Farm relies on the global market to supply them with fuels, synthetic fertilizers, as well as the distribution of their products. Polyface Farm only purchases chicken feed from a neighbor nearby, and they market all their products locally.

The Naylor Farm represents the prototype of the conventional industrial farm based on the concept of food and fiber production as a manufacturing process. It functions like a machine converting purchased inputs of seeds, animals, fossil fuels and petrochemicals into outputs of carbohydrates and protein. The inputs are brought from faraway factories and refineries, and the outputs are distributed worldwide through the global food system. Put more abstractly, the industrial farm has a fundamental economic orientation, reducing product unit cost through mechanization to minimize labor, specialization, disproportionate development of enterprises. Typically self-sufficiency is not an objective of the industrial farm: feeds, energy and fertilizers are imported, and farm programs are dictated by market demands.

Inadvertently, the industrial farm also produces waste streams conventionally disregarded when calculating the bottom line: manure, nitrogen and pesticide run-off that pollute the groundwater, streams and oceans; heat and exhaust from heavy machinery dissipated into the atmosphere in the form of lost energy and greenhouse gases; and, indirectly, chemical pollution, for instance, from mercury, a by-product of man-made substances such as polyvinyl chloride (PVC). There is growing evidence that modern, highly mechanized systems of food production can degrade soil, water and genetic resources to such a degree that when access to non-renewable resources becomes increasingly limited, the prospect of attaining even the modest yields of pre-industrial agriculture may be dim.

By contrast, Polyface Farm represents the prototype of the ecological farm based on the concept of food and fiber production as a biological and social process that is self-organizing, self-correcting, self-sufficient and self-capitalizing. Polyface Farm depends mostly on solar energy harvested through diversified, perennial forages that feed the livestock born, bred and slaughtered on the farm, and distributed to nearby markets. Because production relies on biological rather than chemical or mechanical processes, thermal energy losses and carbon dioxide pollution are minimized, and manures and animal offals are recycled as local fertility. On ecological farms, economic stability is achieved by efficient labor

input, balanced combination of enterprises, diversification, and best possible self-sufficiency regarding fertility, feed, and energy.

It is important to note that organic rather than chemical production does not necessarily make a farm ecological rather than industrial. As defined by the USDA Organic Standards, organic production simply means that inputs are non-synthetic, and free of genetically modified organisms (presumably including cloned animals), and free of radiation. However, to the degree that food and fiber production is organized as a mechanical manufacturing process, an organically certified farm (or livestock production) would still have to be considered industrial, and its impacts on the physical and social environment would be more or less the same.

Personally, I have doubts that large-scale farms can ever be fully ecological. Therefore, given the constraints of peaking oil supplies and global climate change, it is becoming increasingly important to consider the ecological opportunities afforded by small-scale, diversified, integrated and self-sufficient food production.

On Lopez Island, where I live, the price of diesel now tops \$3.50/gallon, twice the rate of last year. What this tells me that, if only for economic reasons, I need to redouble my efforts to make the methods of the farm in raising livestock as little dependent on fossil fuels as I possibly can.

At the Eco-Farm conference in California, which I attended last month, one of the keynote speakers made the point emphatically that if America wants to feed itself thirty years from now, we will have to have an additional 40 million farmers who will grow food and fiber on small, integrated and ecologically responsible farms to supply the food needs of their own, local communities.

So let me propose a baker's dozen of suggestions of how to raise your livestock not only organically, but ecologically:

1. Let the sun grow the feeds for you animals instead of buying them. Go solar!
2. Cycle nutrients within the farm to feed the critters in the soil to grow the animal feed you need. Go solar!
3. Catch the rainwater off your roofs and use the power of the sun to move it around the farm. Go solar!
4. Use rotational grazing summer and winter to feed your animals, fertilize and groom your fields and pastures. Go solar!

5. Maximize use of native or naturalized perennial grasses, legumes, forbs, herbs, and flowers, instead of seeding high-input annual forages. Go solar!
6. Save fossil fuels by minimizing farm mechanization and use animal traction instead. Go solar!
7. Eliminate the use of chemicals and synthetics on the farm, using biological systems instead. Go solar!
8. Practice weed control by crop and pasture rotation, soil health management and thermal applications. Go solar!
9. Practice pest control based on homeostasis and inoffensive substances such as Biodynamic preparations. Go solar!
10. Feed and house your livestock for production *to achieve animal health* instead of prioritizing production. Go solar!
11. Maximize opportunities on the farm for your own labor to save money while improving your health, stamina, fitness and joy of life. Go solar!
12. Provide for the food and fiber needs of your family first, and sell the rest to your community, to strengthen the food security, health, and economic viability of all. Go solar!
13. Build a diversified, complex and self-correcting biological system that includes both domesticated and wild plants and animals, and integrates the farm with the surrounding landscape and beyond. Go solar!

I would like to end by reflecting for a moment on the refrain “go solar” in its widest sense, as illustrated by the following slide.

*Slide 43*

When we think about ecology, we tend to focus on our immediate environment, the farm, perhaps our own community and the landscape we live in. When we think globally, we mostly focus on communications, travel and far-away markets that supply us with resources, fuels, raw materials, foods, as well as buy our products.

By contrast, thinking globally from an ecological perspective requires us to think about the interdependence of all life, energies, and human actions, in the whole cosmos. The fact of global warming shows that human actions have consequences far beyond our own farms, communities and landscapes. Man-

made gasses trapping solar heat flows inside the earth's atmosphere change the earth's climate with potentially disastrous consequences for plant, animal and human life. On the other hand, no life on earth is possible without the energies streaming from the sun to the earth. Life in all its myriad forms evolved in response to the light and heat when the earth and the stars and planets first exploded out of the flaming core and gradually settled into the orbits around that great fire ball at the center of our solar system many eons ago.

Ecological farming recognizes that fundamental relationship between the sun and all of life's rhythms on earth, the seasons of summer and winter, the phases of the moon, day and night, life and death. All of life's processes are fueled by solar energies. Heat, light, sound, electricity and chemical energy are all forms of *energy that have their source in the sun*. So when I pour diesel into the tank of my tractor and turn the ignition, the heat of exploding carbon molecules drives the pistons that drive the wheels that pull the plow. Or, when the sun hits the solar panels on my rainwater irrigation pump, excited electrons in the panels and the wires drive the motor that moves the water out of the pond to the field. That's the *energy* of the sun at work in the diesel fuel and the electricity, but in both instances harvesting that solar energy requires ecologically costly, industrial processes of refining crude oil or building the photovoltaic receptors. By contrast, when the sun hits the blades of grass and leaves of clover, solar *energy* is converted directly in the leafy chlorophyll into sugars that nourish the forage plant, the soil organisms living at the plant roots, as well as the dairy cow who ingests the grass and clover and turns the *energy* into delicious milk rich in protein, vitamins and enzymes to nourish her calf and the lucky people who drink her milk. Also, when the sun shines on the cow, her skin converts the solar *energy* into essential vitamin D. In these instances solar *energy* is converted directly to plant, animal and human use through biochemical processes.

The energies supplied by the sun are virtually inexhaustible and non-polluting to the degree that we harvest them as directly and locally as possible, i.e. by maximizing biological processes and minimizing industrial, mechanical processes. In other words, ecological sustainability in any farming system, and particular in systems of raising livestock, requires accessing the live giving power of the sun directly and locally. Go solar!

*Slide 44*

In conclusion, I leave you with the image with which we started. Go solar!