Valuing Sustainable Practices

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Introduction

You want to be a good steward of your land, and you want the people who come after you – family members or not – to practice good stewardship, too. What will it take to really make that kind of legacy happen? The following sections detail 10 common sustainable agriculture and conservation practices. We discuss some scientific background and reasons for the practices, estimated costs and benefits of each one, some of the barriers that new farmers may face in implementing them, and suggestions for rent, lease, or sale terms that can facilitate these practices. Each section includes a worksheet that allows you, a decision-maker for a piece of agricultural property, to calculate expected costs and benefits of the practice. This analysis will help you decide whether to take steps in your farm transition plan to ensure that the practice will happen on your land in the future.

It is important to recognize that the numbers presented in this publication are broad estimates that are calculated from national or regional averages over many farms. The numbers shown in the worksheets in each section are a starting point to illustrate possibilities, but they will not apply to every farm. You should collect as much information as you can about your own land and adjust the numbers to reflect your particular situation.

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Crop Rotation

Crop rotation means changing the crop planted in a field from year to year. In the U.S. Midwest, it is common for grain growers to practice a two-year crop rotation by alternating between corn and soybeans in a given field each year.

2-year, 3-year, and 4-year crop rotations

Research at Iowa State University's Marsden Research Farm compared two-, three-, and four-year rotations: corn/soybeans (CS); corn/soybeans/oats (CSO); and corn/soybeans/oats+alfalfa/alfalfa (CSOA).

Fossil fuel use in diesel fuel equivalents:

- Two-year CS: 25 gallons/acre
- Three-year CSO: 10 gallons/acre
- Four-year CSOA: 11 gallons/acre

Corn yield comparison:

- Two-year CS: 194 bushels/acre
- Three-year CSO: 199 bushels/acre
- Four-year CSOA: 202 bushels/acre

Soybean yield comparison:

- Two-year CS: 50 bushels/acre
- Three-year CSO: 55 bushels/acre
- Four-year CSOA: 57 bushels/acre

Profitability, as % of net return to management for the two-year CS system:

- Two-year CS: 100%
- Three-year CSO: 103%
- Four-year CSOA: 91%

Reference:

Energy and Economic Returns by Crop Rotation. September 2012. Ann M. Johanns, Craig Chase, and Matt Liebmann. Iowa State University Extension. www.extension.iastate.edu/agdm/crops/html/a1-90.html (accessed 8/12/13).

In order to gain maximum benefits from crop rotation, you need a rotation sequence that is longer than two years. Multi-year rotations break up weed cycles as well as insect life cycles and certain disease cycles, reducing the damage these cause to crops. Including legumes in the rotation can create the conditions that lead to improved soil structure and fertility, which over the long term leads to increased crop yields with fewer purchased inputs. Growing a more diverse array of crops spreads out financial risk because a single crop failure will not be so disastrous (1). These benefits are seen by organic farmers who are required to use multi-year crop rotations, but the same benefits also happen on non-organic farms that use long crop rotations.

In spite of the fact that longer rotations can have net returns per acre as high or even higher than two-year rotations, the vast majority of agricultural acres in the Midwest are in a two-year rotation. Part of the reason is

that in two-year rotations, fossil fuel inputs substitute for the higher labor inputs required for the three- and four-year rotations (2). Lots of farmers choose the two-year rotation and accept the relatively small reduction in net return per acre in order to operate many more acres with less labor.

How can a landowner make it possible for the future land owners or operators to use a three- or four-year crop rotation? Beyond the higher labor requirement, there are costs in the form of background management and machinery ownership to deal with a complex multi-crop system *(see Complexity Costs text box)*. Retiring farmers or landowners could consider giving the future farm operator a credit for all or part of the higher management costs he or she will have from using a long rotation. The choice to include a longer rotation partly comes down to the determination of the landowner and farm operator. Long rotations that reduce fertilizer and pesticide expenses are an easier decision to make in years when grain prices are low. It takes a stronger commitment to stick to it in years when grain prices are high, when it's really tempting to let go of the long rotation in favor of a large profit from planting all acres to corn *(see Corn & Soybean Profitability text box)*.

If the future operator will not own the land, you should consider a long-term lease arrangement to ensure that the farm operator can maintain a three- to four-year crop rotation system. You can specify

Complexity Costs

Calculations of costs of operating an organic farming system show an estimated $117/acre higher cost for background management + dealing with system complexity + machinery ownership + other factors, as compared to a conventional corn and soybean system *(see Organic Costs text box in the Organic Certification section)*. We'll call this total cost the "complexity" cost.

Some of that complexity cost has to do with management time and labor spent in dealing with organic certification requirements, but a portion of the complexity cost has to do with managing a larger variety of crops and owning or hiring the different types of machinery to deal with those crops (Delbridge et al.). Those costs for crop rotation management and machinery ownership would also apply to a conventional farm with a rotation longer than two years.

If we estimate that 50% of the total complexity cost for an organic system would apply to a non-organic four-year rotation:

$117/acre total complexity cost /2 = $58.50/acre in complexity cost for non-organic four-year rotation.

(Round to $59/acre)

Reference:

A whole-farm profitability analysis of organic and conventional cropping. 2013. Timothy A. Delbridge, Carmen Fernholz, Robert P. King, William Lazarus. *Agricultural Systems*. http://dx.doi.org/10.1016/j.agsy.2013.07.007

multi-year rotations in the terms of a lease. Use land rental rates that are in line with typical rates in your area, that reflect the crop production potential of your soil, and that give the farmer sufficient profit potential so that she or he will be able to stick to the longer rotation in good years and bad years. Your local NRCS office can help you find those appropriate rates. If the future operator will also be the owner, you can use deed restrictions or covenants to ensure that the land will be treated the way you want. See Conservation Financing for more details about these tools for farm transitions.

Crop Rotation

	- Column	+ Column	
Qualitative Benefits of the Practice	**Cost of Implementation and Potential Income Loss**	**Potential Income Gain and Reduced/Avoided Costs**	**Your Judgment: Value Per Acre of This Practice on Your Land**
Lowers risk of disease, insect, and weed problems Improves soil structure and fertility Increases species diversity Spreads out workload Spreads out financial risk Reduces purchased synthetic fertilizer inputs **The numbers in this table are broad estimates, and you should adjust them for your farm's conditions.**	Cost of dealing with the complexity of a long crop rotation system: $59/acre *(See Complexity Cost text box in this section)*	$6/acre/year average greater net return for 3-year rotation than for 2-year rotation (1) Plow-down value of alfalfa in providing nitrogen to the next cash crop: $96/acre of alfalfa that will be followed by corn *(See Alfalfa Nitrogen Credit text box in Perennial Forage section)* Plow-down value of alfalfa in providing nitrogen to the second-year cash crop: $30/acre of corn or small grain in second year following alfalfa *(See Alfalfa Nitrogen Credit text box in Perennial Forage section)* $8.60/acre/year gain in fertilizer value of soil by saving 4.1 tons/acre/year from soil erosion; cumulative over years *(See Value of Saving Soil text box in this section)* Benefit to society: approximately $20/acre/year gain in water quality value of soil by saving 4.1 tons/acre/year of soil from erosion *(See Value of Saving Soil text box in this section)*	Potential income gain and costs avoided: + Potential income loss and costs to pay: - Your judgment on value to your farm of qualitative benefits: + Value to society or environment: + Add up the total net value per acre per year: Multiply by a time frame (5 years? 10 years?) Total value over time:

References:

(1) **Rotation.** In *Organic Risk Management: Tools for Managing Pest and Environmental Risks to Organic Crops in the Upper Midwest*. 2010. Editors: Kristine M. Moncada and Craig C. Sheaffer. www.organicriskmanagement.umn.edu/ (accessed 8/27/13)

(2) **Energy and Economic Returns by Crop Rotation.** September 2012. Ann M. Johanns, Craig Chase, and Matt Liebmann. Iowa State University Extension. www.extension.iastate.edu/agdm/crops/html/a1-90.html (accessed 8/12/13).

Further Resources:

Ag Decision Maker, Whole Farm Decision Tools. Iowa State University Extension and Outreach. www.extension.iastate.edu/agdm/decisionaids.html
This online toolbox, created by Iowa State Extension, helps farmers answer hundreds of "what if" questions about their operations and about possible new enterprises. Worksheets are available to evaluate production decisions, marketing decisions, machinery questions, etc.

Value of Saving Soil

Soil lost due to erosion in the Corn Belt of the U.S. Midwest (2007 average numbers):

Water erosion = 3.9 tons/acre/year (1)
Wind erosion = 0.2 tons/acre/year (2)
Total erosion = 4.1 tons/acre/year

The loss rate on your land may be lower or higher, depending on how steep the slopes of the fields are, the cropping system, soil type, and various other factors. To find out the expected rate of soil erosion on your land, contact your local Natural Resources Conservation Service (NRCS) office to ask them for an estimate. Find your local NRCS office: http://offices.sc.egov.usda.gov/locator/app?agency=nrcs

Plant nutrient value of saving soil:

The value of the plant nutrients nitrogen (N), phosphorus (P), and potassium (K) provided by one ton of soil is equal to about $2.10 of purchased fertilizers, in 2012 dollars (3).

If good soil conservation practices are followed:
4.1 tons/acre/year of soil saved x $2.10/ton = about $8.60/acre/year in plant nutrients.

A couple of things to note:
- This is a cumulative savings over years because those tons of soil provide those nutrients *every* year. As minerals and organic matter in the soil gradually break down, the nutrients contained in them become available to plants.
- This calculation only accounts for major nutrients: nitrogen, phosphorus, and potassium. Soil also provides minor, but important, nutrients like sulfur, magnesium, calcium, boron, and others.

Water quality improvement value of saving soil:

The Natural Resources Conservation Service estimates that compliance with conservation standards results in $4.96 in off-farm water quality benefits for every ton of soil saved, in 2007 dollars (4).

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Value of Saving Soil, continued: (pg. 2)

If good soil conservation practices are followed:
$4.96/ton in benefits x 4.1 tons/acre/year saved = $20.34/acre/year in water quality benefits (Round to $20/acre/year)

References

(1) **Water Erosion on Cropland, by Region and Year.** NRCS. In *2007 National Resources Inventory, Soil Erosion.* www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/technical/nra/nri/?cid=nrcs143_013656

(2) **Wind Erosion on Cropland, by Region and Year.** NRCS. In *2007 National Resources Inventory, Soil Erosion.* www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/technical/nra/nri/?cid=nrcs143_013655

(3) **Value of Soil Erosion to the Land Owner.** August, 2012. Mike Duffy, Iowa State University Extension. www.extension.iastate.edu/agdm/crops/html/a1-75.html (accessed 6/11/13)

(4) **Interim Final Benefit-Cost Analysis for the Environmental Quality Incentives Program (EQIP)**. January 2009. USDA Natural Resources Conservation Service. www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_007977.pdf

Corn & Soybean Profitability

When making decisions about future land use, it's important to get the full picture of what the costs and the benefits of those decisions will be. One important number to estimate is the potential loss of net income per acre from a cash grain crop if something other than cash grain will be grown.

There are many tools available to help estimate what cash crop values might be. Grain prices change over time, so you can't know future prices for sure; but you can use past averages to make your estimate. Because corn, soybean, and other grains are handled as commodities in the stock market, the prices of these tend to be similar all over the country at any given time. Production costs and typical yields change a lot from place to place, though, so profitability is not the same all over. The Economic Research Service (ERS), part of the USDA, is a good source of average data on costs of production and profits from crops (1,2).

If you want a quick and easy estimate of profit per acre from a grain crop, open the ERS report for your crop (1); find the column for your region of the country (2); and use the "Value of production less total costs listed" number. That's the average amount of profit per acre from that crop after production costs, labor, and farm overhead costs are subtracted from the total value of the grain. You should look at more than one year, because crop yields and prices can change greatly from year to year.

- ERS estimated 2011 profit from Heartland CORN: $247.50/acre/year
- ERS estimated 2012 profit from Heartland CORN: $146.87/acre/year
- Average of 2011 and 2012 CORN: $197.20/acre/year

- ERS estimated 2011 profit from Heartland SOYBEAN: $206.12/acre/year
- ERS estimated 2012 profit from Heartland SOYBEAN: $216.75/acre/year
- Average of 2011 and 2012 SOYBEAN: $211.44 /acre/year

You can calculate a specific estimate of crop prices, production costs, and profits for your own land. A retiring farmer will most likely know what current grain prices are, the long-term average yields for any field, and may have a fairly good estimate of production costs per acre. If those numbers are not known, though, here are some places to look up average numbers:

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Corn & Soybean Profitability, continued (pg 2)

Yields:

National Agricultural Statistics Service, Statisics by State: www.nass.usda.gov/Statistics_by_State/ (3)

Click on your state. On your state's page, click on "County Estimates." Then choose a crop report. You will get a table of information on that crop's acreage and yield by county.

It can be easy to get lost in the NASS web site, though. If you have trouble, contact your local Natural Resources Conservation Service (NRCS) office to ask about average crop yields for your county. Find your local NRCS office: http://offices.sc.egov.usda.gov/locator/app?agency=nrcs

Grain Prices:

The Department of Agricultural and Applied Economics at the University of Wisconsin-Madison has a nice, accessible web page that lets you find prices for a variety of crop and livestock products, by month and by year (4). You may want to use an average of several years, since prices change a lot from year-to-year.

Production costs:

Use the "Total Costs Listed" number for the crop from the same ERS tables mentioned above (1).

Example Corn & Soybean Profit Calculations:

Note: The following corn and soybean calculation examples use 2011 numbers for Chickasaw County, Iowa (3). The grain prices in 2011 were significantly higher than the average prices of the previous 5 years, and yields were good in 2011, so profits from corn were very high. You would not expect to see this same level of profit every year, but it's an example of why farmers can be very tempted to break away from a longer rotation in favor of growing corn.

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Corn & Soybean Profitability, continued (pg 3)

Example of profit per acre calculation for corn:

- 2011 corn yield: 188.8 bushels/acre (3)
- December 2011 corn price: $5.86 / bushel (4)
- Production Costs in 2011 for Heartland corn: $636.39 /acre (1)
- Calculate: (Yield x Price) – Production Cost = Profit
- 188.8 bu./ac. X $5.86/bu. = $1,106.87 /acre gross income
- $1,106.87/ac. Income - $636.39/ac. Production Cost = $469.98/acre profit

Example of profit per acre calculation for soybean:

- 2011 soybean yield: 51.4 bushels/acre (3)
- December 2011 soybean price: $11.50 / bushel (4)
- Production costs in 2011 for Heartland soybeans: $409.81 / acre (1)
- Calculate: (Yield x Price) – Production Cost = Profit
- 51.4 bu./ac. X $11.50/bu. = $591.10/acre gross income
- $591.10/ac. Income - $409.81/acre Production Cost = $181.29/acre profit

Again, remember, this example reflects 2011 yields and prices which were both high. This level of profit will not be seen every year.

Throughout the remainder of this publication we'll be using corn and soybean profit per acre figures from the University of Minnesota (5). These figures include government payments for corn and soybean production and are averages for the years 2008-2012:

- CORN profit = $310.47/acre/year
- SOYBEAN profit = $149.70/acre/year
- Average profit = $230.09 (Rounded to $230/acre/year)

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Corn & Soybean Profitability, continued (pg 4)

References

(1) **Commodity Costs and Returns**. June 2013. USDA Economic Research Service. www.ers.usda.gov/data-products/commodity-costs-and-returns.aspx#.UfvbrY3U98E (accessed 8/30/13).

(2) **Agricultural Resource Management Survey (ARMS): Resource Regions**. September 2010. USDA Economic Research Service. http://webarchives.cdlib.org/sw1wp9v27r/http://ers.usda.gov/briefing/arms/resourceregions/resourceregions.htm (accessed 8/30/13).

(3) **Statisics by State**. USDA National Agricultural Statistics Service (NASS). www.nass.usda.gov/Statistics_by_State/. (accessed 8/30/13).

(4) **Prices of Grains, Livestock Products, and Hay**. Brian Gould. In Understanding Dairy Markets: Your Source for Market Information and Price Risk Management Principles. University of Wisconsin, Madison – Department of Agricultural and Applied Economics. http://future.aae.wisc.edu/tab/feed.html#65 (accessed 8/30/13).

(5) **What does it take to earn a living on the farm?** April, 2013. Gary Hachfeld, University of Minnesota Extension. http://swroc.cfans.umn.edu/prod/groups/cfans/@pub/@cfans/@swroc/documents/asset/cfans_asset_440374.pdf (accessed 8/06/13)

Soil Fertility Management

Adding livestock manure, either from animals on the farm or purchased nearby, is a common practice on fields in the Midwest. Eventually, that organic material breaks down and becomes stable soil organic matter (SOM). Good SOM levels allow less use of purchased fertilizer and other purchased soil amendments. Good SOM levels also help drought-proof the soil. SOM is like a sponge: it absorbs up to six times its weight in water (1). Increasing SOM helps the soil retain and hold water that can be used by crops.

It does make a difference whether manure or synthetic fertilizers are used to manage soil fertility. According to the Leopold Center for Sustainable Agriculture at Iowa State University, "Manure is a biologically active substance; synthetic fertilizers are not. Since soil is a living system itself, with millions of living organisms in each spoonful, it will react better to manure than to synthetic fertilizers (2)." Synthetic fertilizers are produced using fossil

Your Living Soil

Healthy soil includes:

Minerals – bits of sand (coarse), silt (finer), and clay (finest)

Organic matter – carbon-based materials that come from the breakdown of plant, animal, and microbial matter.

Humus – Organic matter that has been thoroughly broken down and changed by passing through microbes or by chemical reactions in the soil. Humus is how soils store carbon.

Roots – The healthiest soils are those that have living plants on them all the time. (Including winter! Dormant plants are still alive!) Living roots wind through spaces between soil particles and larger soil clumps called "aggregates," and help bind those clumps together.

Living organisms – Healthy soil is home to an entire unseen network of:

- Bacteria
- Fungi
- Protozoa (microscopic animals)
- Earthworms and other worms called nematodes
- Arthropods: millipedes, mites, beetles, spiders, ants

The sheer number of organisms in soil is hard to imagine: healthy soil contains 100 million to 1 billion bacteria per teaspoon. The living things in the soil feed on dead plant and animal material, living plant roots, and each other. In the process, they release nutrients that can be taken up by plants.

Reference:

Soil Biology Primer **[online].** Available: http://soils.usda.gov/sqi/concepts/soil_biology/biology.html (accessed 5/21/13)

fuels, so if reducing fossil fuel use is an important part of the vision for the future of your farm, then encouraging use of manure for fertility is an important option to consider. Manure produced by large confined animal feeding operations (CAFOs) and by small farms can become a problem and a pollutant unless it is spread on land as a fertilizer, using good management techniques. Encouraging use of manure as fertilizer is a way to turn a potential pollution problem into a good resource for crop production.

Manure application is something that many cash grain farmers choose not to do because it takes different equipment and requires more labor and management than use of purchased synthetic fertilizer. Synthetic fertilizer has specific, known amounts of each nutrient in it. Manure is more variable, so farmers who use it need to get it tested to learn the nutrient levels and then make calculations of the amount of manure needed. Sometimes synthetic fertilizer may be needed in addition to the manure, to balance the levels of each nutrient needed by the crop that will be grown. That means the farmer may need to run two different sets of equipment across the fields, to apply the manure and the synthetic fertilizer.

Nutrients in Manure

The example manure application rate shown in this table is based on liquid swine manure. Manure used on your land might be a different type (solid instead of liquid), or from a different livestock species. Those things will change the calculations of how much manure should be used and the cost of application. See the references listed below to find information that matches the type of manure your farm will use.

In our example:

- The manure used is liquid manure from finishing swine, which has an estimated average nitrogen content of 58 lbs. per 1,000 gallons of manure (1).
- Corn nitrogen needs per acre range from 130 lbs. to 180 lbs.; we kept to the low side of that at around 140 lbs. of nitrogen per acre (1).
- 80% of the nitrogen applied in liquid swine manure is available to the crop in the first year that the manure is applied, if sweep injection technique is used for manure application(1).

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Nutrients in Manure, continued (pg. 2)

The calculations:

- 3,000 gallons of manure x 58 lbs./1,000 gallons = 174 lbs. of nitrogen applied in manure.
- 80% availability, so 174 x 0.8 = 139.2 lbs. of nitrogen/acre available to corn crop.
- Cost of application: liquid injection method at $11.90/acre(2), so cost for 3,000 gallons/acre = $35.70/acre.

Value of nutrients in liquid manure from finishing swine, per 1,000 gallons of manure; in 2012 dollars.			
	Nitrogen	Phosphate (phosphorus)	Potash (potassium)
$/lb. of commercial fertilizer (3)	$0.60	$0.72	$0.54
Lbs. of nutrient/1,000 gallons of manure (1)	58	44	40
$ value/1,000 gallons of manure	$34.80	$31.68	$21.60
Total value of 1,000 gallons of manure to supply nitrogen, phosphorus, and potassium to a crop: $34.80 + $31.68 + $21.60 = $88.08			

References:

(1) **Manure Management in Minnesota.** 2012. Jose Hernandez and Michael Schmitt. University of Minnesota Extension publication # 03553. www.extension.umn.edu/distribution/cropsystems/DC3553.html.

(2) **2013 Iowa Farm Custom Rate Survey**. March 2013. William Edwards, Ann Johanns, and Andy Chamra. In *Ag Decision Maker*, Iowa State University Extension and Outreach. www.extension.iastate.edu/agdm/crops/pdf/a3-10.pdf

(3) **Fertilizer Use and Price**. Reports from the Economic Research Service, USDA. www.ers.usda.gov/data-products/fertilizer-use-and-price.aspx#26727. (accessed 6/11/13)

How can a landowner make it possible for future landowners or operators to use manure for fertilizer? Using manure is generally cheaper overall than using synthetic fertilizer, so manure use is not likely to be a financial burden for the farmer. In a few cases, the distance to a source of manure may raise transportation costs to the point that its use is not feasible. The main drawback to manure is the time and management effort that the farm operator needs to invest in it. Synthetic fertilizer doesn't take as much time and management.

As with crop rotation, the choice to use manure depends partly on the determination of the landowner and the farm operator to use it. Both farm operator and landowner need to understand the benefits of manure use and agree to use it on the farm. The landowner may consider giving the farm operator a credit for the manure management efforts that contribute to long-term soil health. Specifying manure use can be accomplished through lease terms, and can be done with either an annual cash rental situation or a longer-term lease. See Conservation Financing for more details about lease terms.

Manure Management & Application			
	- Column	**+ Column**	
Qualitative Benefits of the Practice	**Cost of Implementation and Potential Income Loss**	**Potential Income Gain and Reduced/Avoided Costs**	**Your Judgment: Value Per Acre of This Practice on Your Land**
Encourages soil biological activity Provides a useful purpose for livestock manure, which could otherwise become a pollutant Raises soil organic matter levels and increases water-holding capacity of soil Avoids purchase of commercial fertilizers that are produced using fossil fuels **The numbers in this table are broad estimates, and you should adjust them for your farm's conditions.**	Application cost for liquid swine manure, about $36/acre *(See Nutrients in Manure text box)*; possibly higher if long haul distance. Manure testing, $27 for basic nitrogen, phosphorus, & potassium test; 1 or 2 tests/season (3) . Management time to collect and send in samples, calculate crop nutrient needs and manure quantities required: estimate at $20/hour and half an hour per field. Cost of manure purchase: frequently zero; cost is in getting it hauled and spread. Odor; personal value judgment on how offensive the manure odor is when it's being pumped and applied.	$15.70/acre/year of nitrogen, phosphorus, potassium, and sulfur for each 1% of soil organic matter; it takes about a decade of regular manure application to raise the SOM by 1%. (*See Value of Soil Organic Matter textbox)* $88.08 approximate value of the nitrogen, phosphorus, and potassium in 1000 gallons of manure *(See Nutrients in Manure text box)*. This is an avoided cost: you don't buy this amount of commercial fertilizer because you have the nutrients in the manure.	Costs avoided: + Costs to pay: - Your judgment on value to your farm of qualitative benefits: + Value to society or environment: + Add up the total net value per acre per year: Multiply by a time frame (5 years? 10 years?) Total value over time:

References:

(1) **Organic Matter Management**. In The Soil Management Series. Revised 2008. Ann Lewandowski. www.extension.umn.edu/distribution/cropsystems/components/7402_02.html (accessed 6/11/13).

(2) **Frequently Asked Questions about Cropping System Diversity and Profitability.** [online] Leopold Center for Sustainable Agriculture, Iowa State University. www.leopold.iastate.edu/faq-cropping-system-diversity-profitability. Accessed 6/10/13.

(3) **Dairyland Laboratories Manure Packaging & Pricing.** https://www.dairylandlabs.net/pages/m_packaging_pricing.php

Further Resources:

Soil Health, Profits & Resiliency. This Land Stewardship Project web page features ways Midwestern farmers are building soil organic matter and other biological attributes of their soils using cover crop cocktails, managed rotational grazing, perennial plant systems and no-till agriculture.
www.landstewardshipproject.org/stewardshipfood/soilquality

Sustainable Soil Management. 2004. Preston Sullivan. Appropriate Technology Transfer for Rural Areas (ATTRA).
https://attra.ncat.org/attra-pub/summaries/summary.php?pub=183
This publication covers basic soil properties and management steps toward building and maintaining healthy soils. It contains answers to why soil organisms and organic matter are important.

Drought Resistant Soil. 2002. Preston Sullivan. Appropriate Technology Transfer for Rural Areas (ATTRA).
https://attra.ncat.org/attra-pub/summaries/summary.php?pub=118
To minimize the impact of drought, soil needs to capture the rainwater that falls on it, store as much of that water as possible, and allow for plant roots to penetrate and proliferate. These conditions can be achieved through management of organic matter.

Soil Health. 2010. John Lamb, Sheri Huerd, and Kristine Moncada. In *Organic Risk Management*, Editors Kristine Moncada and Craig Sheaffer. University of Minnesota.
www.organicriskmanagement.umn.edu/soil_health.pdf (accessed 8/30/13)
This online manual is intended as a guide for organic and transitioning producers in the Upper Midwest, but it includes a lot of good basic agronomy and soil science information that is useful for non-organic farmers as well.

Soil Fertility. 2010. John Lamb, Kristine Moncada, and Craig Sheaffer. In Organic Risk Management, Editors Kristine Moncada and Craig Sheaffer. University of Minnesota. www.organicriskmanagement.umn.edu/soil_fertility.pdf (accessed 8/30/13)
This online manual is intended as a guide for organic and transitioning producers in the Upper Midwest, but it includes a lot of good basic agronomy and soil science information that is useful for non-organic farmers as well.

The Cost of Soil Erosion. January 2013. Iowa Learning Farms, Iowa State University Extension and Outreach.
www.extension.iastate.edu/ilf/sites/www.extension.iastate.edu/files/ilf/Cost_of_Eroded_Soil.pdf (accessed 8/30/13).
Erosion costs the landowner because of lost farmland productivity and potentially decreased land sales price. This study is reported by the Iowa Learning Farms, which is a joint project of many of the agricultural organizations in Iowa; including Iowa State University, the Leopold Center for Sustainable Agriculture, and the Iowa Department of Agriculture and Land Stewardship.

Value of Soil Organic Matter

Increasing the Soil Organic Matter (SOM) in a typical acre by 1% can increase that acre's worth due to the nutrients stored in that organic matter. Soil organic matter releases nitrogen, phosphorus, potassium, sulfur, and carbon as it gradually breaks down, so every year, every 1% of SOM is a source of approximately $15-worth of nutrients that are available to plants.

It does take time to increase SOM. It takes about 10 pounds of added organic material to eventually break down and become one pound of soil organic matter. You would need 200,000 pounds of manure per acre, applied at smaller annual rates over a period of at least 10 years, to raise the SOM level of a typical soil by 1%.

This increase in SOM could happen faster if the crop residues were incorporated back into the soil, but even then, it would require a number of years. Building SOM depends on the living creatures in the soil, and it is a gradual process. You can't force it to happen faster by adding excessive manure at one time -- that just puts all of the nutrient levels out of balance and kills off the life in the soil that is needed to break down the manure. Over-application of manure could also be a pollution hazard.

Calculating the value of SOM:

Soil organic matter decomposes and releases nutrients at different rates depending on the texture of the soil, temperature, moisture, tillage, and other factors. Using an estimate from Minnesota of 3% SOM in the soil and a 2% annual decomposition rate (1), along with SOM nutrient level estimates from The Ohio State University Extension (2), the following table shows nutrients contained in the SOM and nutrients that become available to plants each year from the SOM.

Nutrient	Total amount per acre contained in 3% SOM*	Total amount available per acre per year with 2% annual decomposition of SOM
Nitrogen (N)	3,000 lbs.	60 lbs.
Phosphorus (P)	300 lbs.	6 lbs.
Potassium (K)	300 lbs.	6 lbs.
Sulfur (S)	300 lbs.	6 lbs.
*An acre of soil, 6 inches deep, weighs an average of 2,000,000 lbs. At 3%, the total SOM would be 60,000 lbs. This is assumed to be 50% carbon, and SOM typically has a 10:1 ratio of carbon to nitrogen, so nitrogen would be 5% of the total SOM. (1,2)		

Value of Soil Organic Matter -- continued (pg 2)

Using fertilizer prices from 2012 (3,4), the SOM-supplied nutrients would have the following value per acre per year:

Nutrient	Lbs. supplied by SOM, per acre per year	Value/lb. in 2012 dollars (3,4)	Total value from SOM per acre per year
Nitrogen (N)	60	$0.60 (applied as urea)	$36
Phosphorus (P)	6	$0.72	$4.32
Potassium (K)	6	$0.54	$3.24
Sulfur (S)	6	$0.59	$3.54
TOTAL value of plant nutrients from 3% SOM, per acre per year:			$47.10

The SOM releases approximately these levels of nutrients every year, so over a 10-year period the value of 3% SOM is about $470 per acre.

Increasing SOM percentage in the soil will increase the amount of nutrients available from SOM. Based on the numbers in the tables above, a 1% increase in SOM would deliver:

$47.10/acre/year for 3% SOM, divided by 3 = $15.70/acre/year for each 1% SOM

References:

(1) **Organic Matter Management**. In *The Soil Management Series*. Revised 2008. Ann Lewandowski. www.extension.umn.edu/distribution/cropsystems/components/7402_02.html (accessed 6/11/13).

(2) **Understanding Soil Microbes and Nutrient Recycling**. 2010. James J. Hoover and Rafiq Islam. The Ohio State University Extension. www.northcentralsare.org/Educational-Resources/Project-Products/Understanding-Soil-Microbes-and-Nutrient-Recycling (accessed 6/11/13)

(3) **Fertilizer Use and Price**. Reports from the Economic Research Service, USDA. www.ers.usda.gov/data-products/fertilizer-use-and-price.aspx#26727. (accessed 6/11/13)

(4) **2012 Sulfur Fertilizer Price Comparison for Alfalfa**. April 2012. Carrie Labowski, University of Wisconsin. http://ipcm.wisc.edu/blog/2012/04/2012-sulfur-fertilizer-price-comparison-for-alfalfa/. (accessed 6/11/13)

Cover Crops

Ninety percent of grain growers use crop rotations (most of those are two-year rotations), but fewer than 7% use cover crops in their rotations and only about 1% of all cropland acres were in cover crops in 2010 (1). Most cover crops planted by Midwestern farmers are not harvested and sold. Rather, they are planted and then chopped, mowed, or plowed down.

Cover crops help build soil organic matter by scavenging nitrogen and other nutrients left in the soil and using it for growth, tying it up in the plant material of the growing cover crop. Once the cover crop is chopped, mowed, plowed, etc.; the billions of bacteria and fungi that live in the soil break down that plant material gradually. Cover cropping has multiple benefits on the farm and off the farm, many of which are difficult to represent in dollars. Cover crops keep living roots in the ground when there is no cash crop growing, which keeps soil anchored in place and reduces soil erosion. This in turn contributes to improved water quality. Cover crops help to break weed, pest and

Cover Crop Nitrogen

The amount of nitrogen available to the next crop from a plowed-down cover crop depends on timing of plow-down, type of cover crop, amount of ground cover and maturity of the cover crop, weather and soil conditions while the plowed-down crop is breaking down, and other factors.

This example is based on a hairy vetch cover crop that produces 60 lbs./acre of nitrogen (1).

- Assuming that the hairy vetch is plowed down and incorporated into the soil, about half of that nitrogen becomes available to the following corn crop (2).
- 60 lbs/acre / 2 = 30 lbs./acre
- Based on 2012 fertilizer prices, the value of that nitrogen is:
  30 lbs./acre x $0.60/lb (3) = $18/acre

References:

(1) **Winter Cover Crops.** 2010. Kristine Moncada and Craig Sheaffer. In *Organic Risk Management.* Eds. Kristine Moncada and Craig Sheaffer. University of Minnesota. www.organicriskmanagement.umn.edu/winter_cover13.html (accessed 9/03/13).

(2) **Managing Cover Crops Profitably.** 2007. Sustainable Agriculture Research and Education (SARE), USDA. www.northcentralsare.org/Educational-Resources/Books/Managing-Cover-Crops-Profitably-3rd-Edition (accessed 9/03/13).

(3) **Fertilizer Use and Price**. Reports from the Economic Research Service, USDA. www.ers.usda.gov/data-products/fertilizer-use-and-price.aspx#26727. (accessed 6/11/13)

disease cycles, which results in lower crop damage and avoided costs from lower use of herbicides and pesticides. Cover crops, especially legumes, can contribute nitrogen to the next cash crop, reducing the need for purchased fertilizer (2,3). Each one of these effects may be fairly subtle and might not be seen every year; depending on weather conditions, the cover crop used, and how the cover crop is managed. Overall, especially over time, the impact of consistent cover cropping on the whole farm's system can be very positive (3).

An interesting feature of cover crops is that they are frequently aerial-seeded into a standing crop. "Flying" the seed onto the field with a small plane avoids any damage to the cash crop caused by running seeding equipment on the ground. Cover crop seeding is often done in the middle of the growing season, once the crops are already beginning to mature. As the cash crop matures, it drops leaves or leaves dry up, letting more light through the crop canopy to allow the cover crop to grow (4). The cover crop is then established at the time of cash crop harvest and may continue to grow after harvest, depending on weather conditions. Besides use with corn and soybeans, cover crops can also be effectively used with many other cash crops such as wheat, other small grains, sunflowers or other oilseeds, or vegetable crops.

If cover cropping is a practice that you want to encourage in your farm transition plan, then it is important to recognize the long-term investment nature of cover cropping in the way that you structure a rental, lease, or sale agreement. There are costs to planting and then plowing down a cover crop, and a time cost of managing a complex system. There are multiple benefits to cover cropping, but they build up over time and it may take several years to see the benefits.

Some things to consider:

- Converting all or part of a farm operation to cover cropping is a situation in which it might make sense to use a "stepped rent" together with a long-term lease, with payments lower in the first few years than in subsequent years. If the land will be sold, structuring the payments to be lower in the first few years would help encourage cover cropping.
- As the long-term benefits of cover cropping become more clear, conservation programs (public and private) are stepping in to offer incentive payments for cover cropping. Program payments can be part of the financing for a farm that uses cover cropping.
- Landowners might consider giving the farm operator a credit for the extra management work that leads to long-term improvement of the soil.
- Retiring farmers and landowners who want to see cover cropping happen on their land will also need to clearly specify this requirement in the terms of any agreement, because it isn't the easiest choice for a farmer to make when it comes to labor and management costs. See Conservation Financing for more information about options for rent or lease terms.

Cover Crop Yield Gain

Cover crops may be especially beneficial for the subsequent cash crop yields in a drought year. Survey results in the Corn Belt in late 2012, a year of widespread drought, showed that farmers who had used cover crops in the previous season had an average of 9.6% greater corn yields and 11.6% greater soybean yields than farmers who had not used cover crops (1).

In the worst drought-affected areas, the yield increases were even higher with cover crops: 11% for corn, and 14.3% for soybean. This may have been due to greater water-holding capacity of soils in a cover-cropping system, and shading and cooling of the soil by the cover crop. Yield differences may be less dramatic or nonexistent in years with enough rainfall throughout the entire growing season. Not every year is a drought year, but many years have dry soil conditions for part of the growing season. Cover crops are good insurance against the risk of unpredictable weather.

This estimate of yield increases due to cover crops uses the Cover Crop Survey data (1), with some assumptions:

- Yield increase of 6% for corn and 11% for soybean when cover crops are used, based on survey data from farmers with less than three years of experience in cover crop use.
- One in three years might have weather conditions such that cover crop use could provide a yield boost. (On some soils and in some areas, that might be every year.)
- Five-year average corn and soybean yields and prices are from an Iowa study (2).

Example yield boost from cover crops:

- 194 bu/acre of corn x 1.06 = 206 bu/acre; 12 bu/acre gain
- 12 bu/acre x $4.35/bu = $52.20/acre gain from corn yield increase
- 50 bu/acre of soybean x 1.11 = 55.5 bu/acre; 5.5 bu/acre gain
- 5.5 bu/acre x $9.95/bu = $54.73/acre gain from soybean yield increases
- Average $ gain from corn and soybean crops: ($52.20 + $54.73)/2 = $53.46/acre
- Divide by three, for the one-year-in-three yield gain assumption: = $17.82/acre

Rounded figure: $18/acre/year estimated gain from a corn and soybean rotation when cover crops are used.

Continued on next page …

Cover Crop Yield Gains, pg. 2

References:

(1) **2012-2013 Cover Crop Survey**. June 2013. Steve Werblow and Chad Watts. Conservation Technology Information Center (CTIC) and North Central Region SARE. www.ctic.org/media/pdf/Cover%20Crops/SARE-CTIC%20Cover%20Crop%20Survey%202013.pdf (accessed 8/9/13)

(2) **Energy and Economic Returns by Crop Rotation.** September 2012. Ann M. Johanns, Craig Chase, and Matt Liebmann. Iowa State University Extension. www.extension.iastate.edu/agdm/crops/html/a1-90.html (accessed 8/12/13).

Cover Cropping			
	- Column	**+ Column**	
Qualitative Benefits of the Practice	**Cost of Implementation and Potential Income Loss**	**Potential Income Gain and Reduced/Avoided Costs**	**Your Judgment: Value Per Acre of This Practice on Your Land**
Conserves soil moisture Adds valuable organic material to the soil Scavenges and holds nutrients that might otherwise be lost from the soil Protects water quality by holding soil and nutrients in place Increases diversity of plant species on the farm and may improve wildlife habitat Helps reduce weeds May allow reduced herbicide application on the cash crop Helps break pest and disease cycles **The numbers in this table are broad estimates, and you should adjust them for your farm's conditions.**	Cost of cover crop seed blend: $20 to $35 per acre, depending on cover crop types chosen (4) Cost of aerial seeding into standing corn or soybean crop: $15 per acre (4) Cost of killing the cover crop prior to planting the cash crop: $16/acre for tillage method, $7/acre for ground spraying, $10/acre for aerial spraying (6) Management cost for dealing with a more-complex system than corn & soybean: estimate at ¼ of crop rotation "Complexity Cost," so $15/acre *(see Complexity Cost text box in Crop Rotation section)*	Corn and soybean income gain from yield gains per acre following cover crop; $18/acre *(see Cover Crop Yield Gain textbox)* Avoided cost of nitrogen fertilizer because of nitrogen supplied by a legume cover crop: $18/acre *(see Cover Crop Nitrogen text box)* $8.60/acre/year gain in fertilizer value of soil by saving 4.1 tons/acre/year from soil erosion; cumulative over years *(see Value of Saving Soil text box in Crop Rotation section)* Benefit to society: approximately $20/acre/year gain in water quality value of soil by saving 4.1 tons/acre/year of soil from erosion *(see Value of Saving Soil text box in Crop Rotation section)*	Potential income gain and costs avoided: + Potential income loss and costs to pay: - Your judgment on value to your farm of qualitative benefits: + Value to society or environment: + Add up the total net value per acre per year: Multiply by a time frame (5 years? 10 years?) Total value over time:

References:

(1) **While Crop Rotations are Common, Cover Crops Remain Rare:** USDA/ERS www.ers.usda.gov/amber-waves/2013-march/while-crop-rotations-are-common,-cover-crops-remain-rare.aspx

(2) **Winter Cover Crops.** 2010. Kristine Moncada and Craig Sheaffer. In *Organic Risk Management.* Eds. Kristine Moncada and Craig Sheaffer. University of Minnesota. www.organicriskmanagement.umn.edu/winter_cover13.html (accessed 9/03/13).

(3) **Managing Cover Crops Profitably.** 2007. Sustainable Agriculture Research and Education (SARE), USDA. www.northcentralsare.org/Educational-Resources/Books/Managing-Cover-Crops-Profitably-3rd-Edition (accessed 9/03/13).

(4) **Aerial Seeding Cover Crops**. 2012. Allamakee Soil & Water Conservation District. http://allamakeeswcd.org/aerial-seeding-cover-crops/

(5) **2012-2013 Cover Crop Survey**. June 2013. Steve Werblow and Chad Watts. Conservation Technology Information Center (CTIC) and North Central Region SARE. www.ctic.org/media/pdf/Cover%20Crops/SARE-CTIC%20Cover%20Crop%20Survey%202013.pdf (accessed 8/9/13)

(6) **2013 Iowa Farm Custom Rate Survey**. March 2013. William Edwards, Ann Johanns, and Andy Chamra. In *Ag Decision Maker*, Iowa State University Extension and Outreach. www.extension.iastate.edu/agdm/crops/pdf/a3-10.pdf

Further Resources:

Cover Crop Chart: An intuitive educational resource for extension professionals. 2013. Liebig, M.A., H.A. Johnson, D.W. Archer, J.R. Hendrickson, K.A. Nichols, M.R. Schmer, and D.L. Tanaka. Journal of Extension [Online], 51(3) Article 3TOT7. Available at www.joe.org/joe/2013june/tt7.php. (accessed 9/03/13).
Visually similar to the periodic table, the CCC includes information on 46 cover crop species and provides information regarding the suitability of these crops for addressing different production and natural resource goals.

Cover Crop Decision Tools. Midwest Cover Crops Council. www.mccc.msu.edu/selectorINTRO.html (accessed 9/03/13).

This online resource has cover crop information specific to seven states and the province of Ontario, and allows you to enter your farm's information to build a plan specific to your farm.

Using Cover Crops to Improve Soil and Water Quality. 2009. James Hoorman. The Ohio State University Extension. http://mercer.osu.edu/topics/agriculture-and-natural-resources/Using%20Cover%20crops%20SAG%2008%2009.pdf (accessed 9/03/13).
The four-page publication summarizes of all the ways cover crops help farmers improve their soil and water quality with cover crops. It presents advantages and disadvantages of cover crops and lists the different effects of cover cropping on soil and water quality.

Winter Cover Crops. 2010. Kristine Moncada and Craig Sheaffer. In *Organic Risk Management.* Eds. Kristine Moncada and Craig Sheaffer. University of Minnesota. www.organicriskmanagement.umn.edu/winter_cover13.html (accessed 9/03/13).
This online manual is intended as a guide for organic and transitioning producers in the Upper Midwest, but includes a lot of good basic agronomic and soil science information that is useful to non-organic farmers as well.

Soil Health. Burleigh County, North Dakota Soil and Water Conservation District. www.bcscd.com/?id=23 (accessed 6/11/13)
This county-based program offers a number of useful resources on soil management and cover crops.

Special Report on Burleigh County's Soil Health Team.
www.landstewardshipproject.org/repository/1/676/soil_health_lsl_package_final.pdf
The Land Stewardship Project has developed a series of articles on what farmers, conservationists and scientists are doing in one North Dakota Soil Conservation District to build healthy soils using cover crop cocktails and other methods.

Agroforestry

Agroforestry means growing woody species – trees and shrubs – together with crops, livestock, or both in a farming system. The woody plants can help maintain air, water and soil quality; diversify income sources; conserve energy; improve wildlife habitats; and improve total productivity of the farm.

Energy Savings from Windbreaks

How much can you save on energy bills by having windbreaks or shelterbelts around your home? Research in Canada indicated a 27% fuel savings from having good shelter around a mobile home. Anecdotal evidence suggests the savings over time may be as high as 40%. The USDA-NRCS estimates a 10% to 25% energy savings from having a good windbreak around your house (1). Exact energy savings depend on the size and density of the windbreak, the insulation in the home, and the fuel source.

The majority of homes in Minnesota (68%), Iowa (67%), and Wisconsin (66%) use natural gas as their heating fuel (2), and average residential gas usage for the northern Midwest is around 100 mCF (mCF = 1,000 Cubic Feet)(3). Cost of natural gas for residential use in 2012 averaged $10.66 per mCF (4).

Assuming a 20% fuel savings from having a good windbreak, use of natural gas as the fuel, and an average home:

- $10.66/mCF x 100 mCF = $1,066 winter heating cost.
- $1,066 x 0.20 = $213 annual household fuel savings

References:

(1) **Conservation Practices that Save: Windbreaks and Shelterbelts**. November 2006. USDA Natural Resources Conservation Service. www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_023631.pdf (accessed 8/12/13).
(2) **Clean Energy in My State**. United States Department of Energy; Energy Efficiency and Renewable Energy. http://apps1.eere.energy.gov/states/ (accessed 8/12/13).
(3) **Trends in U.S. Residential Natural Gas Consumption**. June 2010. U.S. Energy Information Administration, Office of Oil and Gas. www.eia.gov/ftproot/features/ngtrendsresidcon.pdf
(4) **Short-Term Energy Outlook**. August 6, 2013. U.S. Energy Information Administration. www.eia.gov/forecasts/steo/report/natgas.cfm

The National Agroforestry Laboratory calls agroforestry plantings “working trees” and defines them as “The right trees planted in the right places for the right reasons. (1)” Some types of agroforestry systems (1,2) :

- Silvopasture: This is a system of growing trees for various purposes, and managing the space between the tree trunks for grazing by livestock. One example is fruit or nut orchards where cattle or sheep graze between the trees. It also applies to woodlots or other types of forests where cattle graze.

- Alley cropping: An agricultural crop that produces annual income is grown in the alleys between widely spaced rows of trees, while the trees themselves are an investment that will produce revenue over the long term. The trees might be Christmas trees or nut trees or fruit trees; or trees grown to eventually produce lumber or firewood.

- Windbreaks: Planting rows of trees and shrubs strategically to block wind is an agroforestry strategy that can be applied in several useful places on the farm. Along roadways, they act as living snow fences to reduce drifting soil or snow. Around the farm buildings they provide energy savings and around livestock feeding areas they reduce environmental stress on livestock by blocking cold winds in winter and providing shade in summer. Planted in crop fields, windbreaks reduce soil erosion due to wind and protect young crops from wind damage. The trees and shrubs used for windbreaks can include fruit or nut trees or trees with high-value lumber, which generate income for the farm as well as provide the benefits of a windbreak.

- Buffer strips, filter strips, riparian buffers: These types of plantings are given different names depending on where they are placed on the landscape and their specific intention. As a broad group, these types of agroforestry practices are used to achieve soil and water conservation goals. They may not produce a crop that can be harvested or sold, but they have a benefit to the farm system as a whole. Buffer strips and filter strips, or “block” plantings that are wider than strips, can be used between crop fields or livestock areas and surface waters like streams, rivers and lakes to reduce the soil and chemical runoff that reaches the water.

- Forest farming: Tree plantings are managed for lumber or other wood products, and the ground between the trees is planted to a harvestable crop such as ginseng. This is different from alley cropping because the trees are not in rows with annual crops between the rows. The appearance of the area is like a forest and the crops grown are specialty crops that grow in woodlands.

- Agroforestry also includes plantings of woody species that are intended to be the sole crop from those planted acres. Hybrid poplar and hybrid willow plantings, for example, are done with the intent of letting the trees grow for one to several decades, and then harvesting them for industrial uses like biofuel or paper production. These types of plantings are often called “plantations.”

Considerations for Landowners

Agroforestry practices can be very beneficial to the farm as a whole and to the environment, but the up-front costs to establish agroforestry plantings can be high and they do take some land away from row-crop or livestock production. If you want to see agroforestry practices happen on your land in the future, here are some things to consider:

- Correct placement of these practices on the landscape is important to achieve maximum benefits. You may be able to put them on acres that are not the most productive for row crops. Either you or the future farm operator needs to do some research and planning to figure out where to plant the trees, and you may want to enlist help from your local Natural Resources Conservation Service (NRCS) office. Find your local office: http://offices.sc.egov.usda.gov/locator/app?agency=nrcs

- The NRCS encourages agroforestry and has cost-sharing available for establishment and upkeep of many of the practices (2). This is another good reason to work with your local NRCS office.

- Establishment cost-sharing and annual payments may be available from agencies other than NRCS for some agroforestry practices. For instance, Minnesota Department of Transportation (MN-DOT) pays for living snow fence establishment along some roadways affected by blowing snow (3).

- The new farmer on your land can put "sweat equity" into getting these practices established and then maintaining them. Consider valuing that effort as part of the purchase price of the land or finding another way to credit it in a long-term lease.

- Establishment is a major effort that involves site preparation; planting and installation of a weed barrier; and then about three years of fairly intensive mowing, watering, spot spraying, and replanting of dead trees (3).

- Since agroforestry practices do remove land from annual crop production, that loss of potential cash-crop income needs to be figured into the overall lease or sale price of the land. The benefits of the agroforestry practices go to the farm operator, the landowner, and to society; so your plan for determining the sale or lease price should similarly divide the cost of the practice. As mentioned above, cost-sharing from the NRCS can help with establishment and upkeep costs.

- Some agroforestry practices have the potential to generate income for several years to several decades, and there should be a plan for who will profit from that in the future. If establishment costs and risks and upkeep costs are shared between landowner and farm operator, then the income rewards should also be shared.

Agroforestry			
	- Column	**+ Column**	
Qualitative Benefits of the Practice	**Cost of Implementation and Potential Income Loss**	**Potential Income Gain and Reduced/Avoided Costs**	**Your Judgment: Value Per Acre of This Practice on Your Land**
Helps landowner and farm operator diversify income sources through sales of nuts, wood, fruit, biofuels, etc. Enhance the productivity of crops and livestock by providing shade and protection from harsh winds (4) Reduce soil erosion due to wind Enhance wildlife habitat Trees capture & store carbon dioxide from the air Improve water quality by trapping sediment and other run-off before it reaches surface waters	Establishment costs for living snow fence (also applicable to buffer strips, windbreaks, shelterbelts, including those used in alley cropping): $2,260/acre *(see Establishment & Maintenance Costs textbox)* Range of establishment costs: $1,500 to $3,000 (3); or up to $7,000 for hazelnuts (9) Average yearly costs for first three years of maintenance (establishment phase): $280/acre/year *(see Establishment & Maintenance Costs text box)* Maintenance costs beyond 3rd year: $24/acre/year for spot spraying (3)	Income from black walnut crop, years 11-60: $255/year (6) Income from hazelnut crop, years 5-10: $313/acre/year (261 lbs./acre/year x $1.20/lb.) (7,8) Net gain of $240/year in crop income per acre of windbreak (see *Yield Gain/Loss from Windbreak* text box) $210/year energy savings for home heating due to windbreak around farm house (see *Energy Savings from Windbreaks* text box) Cost-sharing for establishment from state or federal agency (such as NRCS or MN-DOT) may cover up to 90% of cost Annual payment for conservation contract with state or federal agency or private organization (varies)	Potential income gain and costs avoided: + Potential income loss and costs to pay: - Your judgment on value to your farm of qualitative benefits: + Value to society or environment: + Add up the total net value per acre per year: Multiply by number of acres devoted to the practice: Multiply by a time frame (5 years? 10 years?) Total value over time:

The numbers in this table are broad estimates, and you should adjust them for your farm's conditions.	Loss of net income from cash crop on the agroforestry acres: $230/acre/year *(See Corn and Soybean Profitability text box in the Crop Rotation section).* Reduce this number if planting on less-productive acres. $30/acre/year cost for the acreage of the windbreak, for extra time and hassle in field operations (tillage, spraying, and harvesting) to maneuver around the area (3) ****Note**: See "Economic Budgeting for Agroforestry Practices" (6) for a sample budget for black walnut establishment.	MN-DOT estimates $17 benefit in avoided snow removal and vehicle accident costs for every $1 invested in living snow fence (3). This is a benefit to society but also to the landowner and/or farm operator if the improved roads are ones they frequently drive. Benefits of reduced drifting could also apply to windbreaks established along driveways and field roads within the farm itself.	

References:

(1) **Working Trees.** USDA National Agroforestry Center and United States Forest Service. http://nac.unl.edu/Working_Trees/infosheets.htm (accessed 8/12/13).

(2) **Sustaining Agroforestry Systems for Farms and Ranches**. USDA Natural Resources Conservation Service**.** www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/forestry/sustain/ (accessed 8/12/13).

(3) **Economic and Environmental Costs and Benefits of Living Snow Fences: Safety, Mobility, and Transportation Authority Benefits, Farmer Costs, and Carbon Impacts**. February 2012. Gary Wyatt, University of Minnesota Extension; Minnesota Department of Transportation Research Services. www.lrrb.org/media/reports/201203.pdf (accessed 8/12/13).

(4) **What does it take to earn a living on the farm?** April, 2013. Gary Hachfeld, University of Minnesota Extension. http://swroc.cfans.umn.edu/prod/groups/cfans/@pub/@cfans/@swroc/documents/asset/cfans_asset_440374.pdf (accessed 8/06/13)

(5) **Energy and Economic Returns by Crop Rotation.** September 2012. Ann M. Johanns, Craig Chase, and Matt Liebmann. Iowa State University Extension. www.extension.iastate.edu/agdm/crops/html/a1-90.html (accessed 8/12/13).

(6) **Economic Budgeting for Agroforestry Practices**. 2012. Larry Godsey. Center for Agroforestry, University of Missouri. www.centerforagroforestry.org/pubs/economichandbook.pdf (accessed 8/12/13).

(7) **Hazelnut Production Potential in the Upper Midwest: A Report on Hybrid Hazelnut Yields**. 2011. Jason Fischbach, Lois Braun, Mike Demchik, and Don Wyse. University of Wisconsin Extension. www.midwesthazelnuts.org/assets/files/Research%20Bulletin%2017_hybrid%20hazelnut%20yields.pdf (accessed 8/12/13).

(8) **Fruit and Tree Nut Yearbook**. 2011. USDA Economic Research Service. Table E-10: Hazelnuts: Production, Price, Value, U.S. 80-to date. http://usda.mannlib.cornell.edu/MannUsda/viewStaticPage.do?url=http://usda01.library.cornell.edu/usda/ers/./89022/2011/index.html (accessed 8/12/13).

(9) **Setting a Yield Goal for Hazelnut Breeding in the Upper Midwest**. 2012. Jason Fischbach and Lois Braun. University of Wisconsin Extension. www.midwesthazelnuts.org/assets/files/breeding%20goals_final.pdf (accessed 8/12/13).

Further Resources:

Agroforestry: An Overview: ATTRA
https://attra.ncat.org/attra-pub/summaries/summary.php?pub=62
Integrating trees and shrubs with other enterprises on a farm can create additional sources of income, spread farm labor throughout the year, and increase the productivity of those other enterprises — all while protecting soil, water, and wildlife. This publication presents an overview of common agroforestry practices, evaluating and planning considerations, marketing opportunities, several case studies, and an extensive list of further resources.

Mid-American Agroforestry Working Group (MAAWG)
http://midamericanagroforestry.net/
The purpose of the Mid-American Agroforestry Working Group (MAAWG) is to provide an organization for advancing the science, practice, and adoption of agroforestry by landowners and natural resource managers in the Midwest region of the U.S.

Profitable Farms and Woodlands: USDA National Agroforestry Center and Tennessee State University, 2012.
http://nac.unl.edu/documents/morepublications/profitable_farms.pdf
Manual (108 pages) to help landowners develop best management technologies in managing agroforestry projects.

Tree as a Crop: Rodale Center
http://rodaleinstitute.org/our-work/tree-as-a-crop/tree-as-a-crop-how-it-works/
A major project of this well-known research center, "Tree as a Crop" offers a way to put trees to work to improve ecosystems while helping to create a healthy prosperity for farmers and small forest landowners. "Tree as a Crop" shows farmers and other landowners how to maximize the potential of trees to improve biodiversity on forested and agricultural land, to capture carbon and to provide a diversified income stream for landowners.

Establishment & Maintenance Costs for a Living Snow Fence
(also applicable to windbreaks, shelterbelts and buffer strips with similar establishment procedures)

These figures were collected from interviews with farmers in southern Minnesota; also interviews and surveys of staff with Minnesota Department of Transportation (MN-DOT), Farm Service Agency, Natural Resources Conservation Service, and Soil and Water Conservation Districts.

Establishment costs:

- Land preparation, tillage + herbicide: $60 to $82 per acre; average $71/acre
- Planting trees and shrubs: $282 to $872 per acre, depending on tree species and other plants selected; average $464/acre
- Geotextile fabric purchase and installation as a weed barrier: $950 to $2,500 per acre; average $1,725/acre

Average establishment cost per acre: $71 + $464 + $1,725 = $2,260

Maintenance costs during 3-year establishment phase:

Years 1 & 2:

- $37 to $50 per acre per year for mowing; average $43/acre/year
- $200 to $400 per acre per year for watering; average $300/acre/year
- $20 to $50 per acre one-time replanting; average $15/acre/year
- $24/acre/year for spot spraying

Total average maintenance cost per year for first two years: $43 + $300 + $15 + $24 = $382

3rd year:

- $37 to $50 per acre per year for mowing; average $43/acre/year
- $24/acre/year for spot spraying

Total cost for third year: $43 + $24 = $67/acre

Average cost per year for first three years: ($382 + $382 + $67)/3 = $277/acre/year
Rounded = $280/acre/year

continued on next page …

Establishment & Maintenance Costs for a Living Snow Fence (pg. 2)

Reference:

Economic and Environmental Costs and Benefits of Living Snow Fences: Safety, Mobility, and Transportation Authority Benefits, Farmer Costs, and Carbon Impacts. February 2012. Gary Wyatt, University of Minnesota Extension; Minnesota Department of Transportation Research Services. www.lrrb.org/media/reports/201203.pdf .

Yield Gain/Loss from Windbreak

Farmers in Minnesota estimate a 10% to 15% loss of crop yield in the areas right next to a Living Snow Fence (1). Similar yield reductions have been seen right next to windbreaks or shelterbelts. These losses are seen out to a distance equal to about twice the height of the windbreak.

On the leeward (downwind) side, however; beyond a distance equal to twice the height of the windbreak; the yield reductions end. From a distance of two times the height out to a distance of 12 times the height of the windbreak, there is a yield increase of 5% to 25%, depending on the crop. Beyond 12 times the height of the windbreak, yields return to the field average.

Corn yield loss from 1 acre of windbreak, 33 ft. wide x ¼ mile long, with tree height of 12 ft.:

- Area affected by yield reduction: ¼ mile (1,320 ft.) x 24 ft. = 31,680 ft^2 = 0.73 acres
- Assume a 12% yield reduction for corn in the 24-ft. wide yield reduction area.
- Assume yield of 194 bu./acre of corn and price of $4.35/bu. (4)
- Lost income from crop yield reduction, per acre: 194 bu./acre x 0.12 = 23 bu.; x $4.35/bu = $100/acre/year loss
- $100/acre/year x 0.73 acres = $73/year loss from the yield reduction area.

Corn yield gain from the same 1 acre of windbreak, 33 ft. wide x ¼ mile long, with tree height of 12 ft.:

- Area affected by yield gain: ¼ mile (1,320 ft.) x 120 ft. = 158,400 ft^2 = 3.64 acres
- Assume a 12% yield increase for corn in the 120-ft. wide yield increase area (3)
- Assume yield of 194 bu./acre of corn and price of $4.35/bu. (4)
- Gained income from crop yield increase, per acre: 194/bu./acre x 0.12 = 23 bu.; x $4.35/bu = $100/acre/year gain
- $100/acre/year x 3.64 acres = $364/year gain from the yield increase area

Net gain per year in corn income due to windbreak:

$364 gain - $73 loss = $291/year net gain (rounded to $290).

Yield Gain/Loss from Windbreak, continued (pg. 2)

Similar calculations for soybean, assuming a 13% yield loss or gain (3):

- Assume yield of 50 bu./acre of soybean and price of $9.95/bu (4).

Lost income from soybean crop yield reduction on 0.73 acres:

- 50 bu./acre x 0.13 = 6.5 bu.; x $9.95 = $65/acre/year loss
- $65/acre/year x 0.73 acres = $47/year loss from the yield reduction area.

Gained income from soybean crop yield increase on 3.64 acres:

- 50 bu./acre x 0.13 = 6.5 bu.; x $9.95 = $65/acre/year gain
- $65/acre/year x 3.64 acres = $237/year gain from the yield increase area.

Net gain per year in soybean income due to windbreak:
$237 gain - $47 loss = $190/year net gain

Average net gain per year from a 1-acre windbreak with a corn/soybean system:
($290 for corn +$190 for soybean)/2 = $240/year.

References:

(1) Economic and Environmental Costs and Benefits of Living Snow Fences: Safety, Mobility, and Transportation Authority Benefits, Farmer Costs, and Carbon Impacts. February 2012. Gary Wyatt, University of Minnesota Extension; Minnesota Department of Transportation Research Services. www.lrrb.org/media/reports/201203.pdf (accessed 8/12/13).

(2) Conservation Practices that Save: Windbreaks and Shelterbelts. November 2006. USDA Natural Resources Conservation Service. www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_023631.pdf (accessed 8/12/13).

(3) Windbreaks. 2006. Chapter 6 in *Training Manual for Applied Agroforestry Practices*. Center for Agroforestry, University of Missouri. www.centerforagroforestry.org/pubs/training/sec6.pdf (accessed 8/12/13).

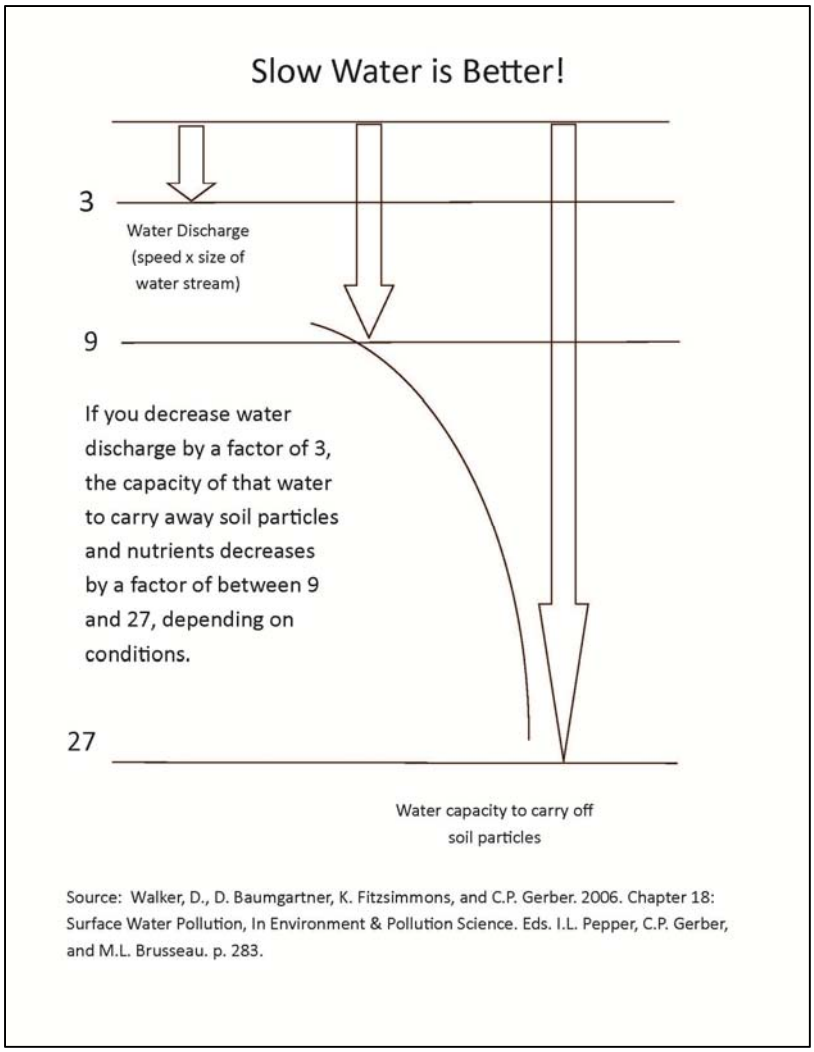
(4) Energy and Economic Returns by Crop Rotation. September 2012. Ann M. Johanns, Craig Chase, and Matt Liebmann. Iowa State University Extension. www.extension.iastate.edu/agdm/crops/html/a1-90.html (accessed 8/12/13).

Water Quality Management

Sustainable agriculture practices detailed in other sections of this publication are important ways to maintain or improve water quality on the farm and downstream from the farm.

- Crop rotations and cover crops can help cut down nitrogen fertilizer applications, which reduces nitrogen leaching into groundwater or runoff into streams and rivers.
- Properly applied manure used as a fertilizer can reduce problems of livestock manure runoff into surface waters.
- Agroforestry practices like buffer strips between fields and waterways can slow water runoff and trap soil particles and agricultural chemicals, preventing them from entering the waterway.
- Cover crops help hold nutrients, pesticides and soil particles in place. They do so by keeping roots in the ground to hold onto soil, and by cushioning the impact of raindrops and slowing down water runoff.

Water runoff with no surface cover to slow it down can be devastating to soil. Consider an example from May 4, 2003. Researchers tracked rainfall, runoff, and soil erosion over the entire state of Iowa on that date. Three townships in western Iowa received 5 inches of rain. They had average water runoff rates of 0.6 to 1.25 inches, and had average soil losses of 4.5 tons/acre from that single rainfall event (1). If the water discharge rate had been slowed down by a factor of three through use of conservation practices, then the capacity of that water to carry away sediment and nutrients could have dropped by a factor of nine to 27, so the soil loss from that heavy rain could have been limited to 0.5 tons/acre or less (2).



Wetland Restoration

Restoring wetlands on the farm is another idea to consider for water quality improvement. We use the term "restoring" or "restoration" for wetland construction because in most cases, low-lying or wet areas on the farm were once wetlands before the land was first converted to agriculture. Wetland restoration projects are often put in place on areas of a farm that are marginal or poor for growing corn or soybeans — acres that are producing yields of half or even less of the farm's average yields. Well-designed and placed wetlands can reduce nitrate losses from surrounding fields into surface waters by 40% to 90% (3). They can serve as water-quality buffers for more than one farm, and indeed for an entire watershed. The Wetlands Initiative estimates that putting less than 8% of the land area around a creek into carefully placed wetlands could reduce the nitrate pollution of that creek by 43% (4).

Wetlands can attract a variety of wildlife including frogs, ducks and other waterbirds, and turtles and other reptiles; as well as mammals like deer and raccoons that may visit the wetland to find food or drink. The NRCS reports that its Wetland Reserve Program has restored 2.6 million acres of private wetlands nationwide, providing essential breeding habitat for waterbirds and wintering habitat for 3.5 to 4.5 million waterfowl every winter. According to The State of the Birds report, "…private lands have critical conservation value, and … landowners can measure their yield not only in bushels and head and cords, but also in bluebirds, hawks, and canvasbacks (5)." There may be a "hassle factor" for a farmer in maneuvering equipment around the wetland; but that may be balanced by the reduced hassle of no longer trying to till and plant an area that was perpetually wetter than the rest of the field.

A retiring farmer or landowner who wants to see wetlands established on their property should make a plan for who will work with federal or state agencies or private organizations to get cost-share assistance and negotiate contracts and/or easements for those wetland acres. Will that background work be done by the retiring farmer or landowner, or will it be the new farm operator? If it is to be the new farm operator, that person should receive some form of compensation or credit for the background and paperwork they do prior to the actual construction of the wetland. Alternatively, a landowner who doesn't want an easement agreement with a public or private entity may choose to self-finance the wetland establishment and hire a contractor to do the construction work; or the new farm operator may put "sweat equity" into the construction work and receive a land value or rent credit for that work.

Once established, wetlands can be treated as a feature of the farm landscape. Fields around the wetland can be handled with annual rent, short-term or long-term lease, or sale of the land. Any rent, lease, or sale agreement should specify the boundaries of the wetland and include statements preventing destruction of any part of the wetland. If a conservation easement is established with a federal or state agency or private organization, that easement provides another level of protection for the wetland.

In the future, there may be a market for the ecosystem services such as nitrate removal that a wetland provides. Organizations such as The Wetlands Institute (TWI) are researching the potential for such markets (4). Investment in a wetland now could be partially a speculative move with an eye toward future payments for ecosystem services.

Nitrate Removal Services

Wetlands are effective at removing nitrate from waters that flow into the wetland. Monitoring of CREP-funded wetlands in Iowa found that they removed 40% to 90% of nitrate flowing in, when water flow levels were low to moderate (1). During floods, water may enter and leave the wetland too quickly for nitrate removal to occur.

The figures used in the following calculation come from research conducted at Michigan State University, published in 2001 (2). More recent figures presented by The Wetlands Initiative (3) indicate that the dollar figures used in the 2001 research are still relevant in 2013.

The Hennepin Levee District in Illinois involved 2,490 acres of wetlands and could remove an estimated 494 tons of nitrate per year, based on a 75% nitrogen removal rate (2).

- 494 tons nitrate per year / 2,490 acres = 0.2 tons nitrate/acre/year removal by wetland
- Cost of nitrate removal by a water treatment plant: $36,000/ton (2)
  Cost range: $30,000/ton to $94,000/ton (3)
- Cost of nitrate removal by wetland, based on cost of taking land out of production and cost of construction: $5,500/ton
  Cost range: $540 to $5,500/ton (2)
- $36,000/ton cost of nitrate removal by treatment plant, less $5,500/ton cost of nitrate removal by wetland = $30,500/ton of nitrate in “free” or “net profit” ecosystem services provided by the wetland
- $30,500/ton of nitrate removed x 0.2 tons/nitrate/acre/year removal by wetland = $6,100/acre/year ecosystem services value of the wetland
- $30,500/2 = $15,250/ton of nitrate removed: half of the value of the “net profit” in ecosystem services is an estimate of what a watershed district might be willing to pay to purchase the nitrate reduction credit (2).
- $15,250/ton of nitrate removed x 0.2 tons nitrate/acre/year removal by wetland = $3,050/acre/year potentially marketable ecosystem services value of the wetland.

continued on next page …

Nitrate Removal Services, continued (pg. 2)

Note that nitrate removal is only one ecosystem service of the wetland, one that happens to be fairly measurable. Other wetland services such as wildlife habitat are valuable, but harder to calculate.

References:

(1) **2012 Annual Report on Performance of Iowa CREP Wetlands: Monitoring and Evaluation of Wetland Performance.** William Crumpton and Greg Stenback. Department of Ecology, Evolution and Organismal Biology, Iowa State University, Ames, IA. http://iowacrep.ag.iastate.edu/sites/default/files/2012%20CREP%20Wetland%20Monitoring%20and%20Evaluation.pdf (accessed 8/15/13).

(2) **Using Illinois River Floodplains for Nitrate Removal: TWI's Hennepin Levee District Example.** Chapter 3.3 in Cheng, C.W., & Pierre, J.M.S. (2001). *A Resting Place for Ducks: A Multidisciplinary Analysis of Floodplain Restoration of the Hennepin Levee District, Illinois: A Master's Project Submitted in Partial Fulfillment … for the Degree of Master of Science and Master of Landscape Architecture (School of Natural Resources and Environment) …University of Michigan.* www.snre.umich.edu/ecomgt/pubs/wetlands/hennepin/3.3.PDF (accessed 8/15/13).

(3) **Growing Wetlands for Clean Water: Using markets to pay for efficient nutrient removal in the Farm Belt.** December 2012. The Wetlands Initiative. www.wetlands-initiative.org/images/pdf-docs/growing_wetlands_for_clean_water.pdf

Potential funding and information sources for wetland restoration (not a complete list):

- NRCS Wetland Reserve Program (WRP) www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands/
- Farm Service Agency (FSA) Conservation Reserve Enhancement Program (CREP) www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=cep
- North American Wetland Conservation Act (NAWCA) www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm
- The Wetlands Initiative (TWI) www.wetlands-initiative.org/
- The NRCS and Farm Service Agency (FSA) usually share office space. Find your local office: http://offices.sc.egov.usda.gov/locator/app?agency=nrcs

Wetland Restoration			
	- Column	**+ Column**	
Qualitative Benefits of the practice	**Cost of Implementation and Potential Income Loss**	**Potential Income Gain and Reduced/Avoided Costs**	**Your Judgment: Value Per Acre of This Practice on Your Land**
Reduces sediment, nitrogen and other chemical runoff into streams and rivers Creates wildlife habitat Flood mitigation Increases plant and animal species diversity **The numbers in this table are broad estimates, and you should adjust them for your farm's conditions.**	Loss of net income from cash crop on the wetland acres: $115/acre/year *(See Corn & Soybean Profitability text box in Crop Rotation section; wetlands can be placed on acres producing less than 50% of the farm average yield.)* Wetland establishment cost, national average of $1,280/acre, 2009 dollars (6)	Benefit to society: Value of nitrate removal services: $6,100/acre of wetland/year *(No, this is not a typo. See Nitrate Removal Services text box)* Up to 100% of wetland restoration cost from NRCS in exchange for a permanent easement; 75% of cost for a 30-year easement (7). Cost-sharing may also be available from other public or private sources. Annual payment for conservation contract with state or federal agency or private organization (varies) – or – upfront purchase of easement, spread over 15 years: $80 to $150/acre/year.	Potential income gain and costs avoided: + Potential income loss and costs to pay: - Your judgment on value to your farm of qualitative benefits: + Value to society or environment: + Add up the total net value per acre per year: Multiply by number of acres devoted to the practice: Multiply by a time frame (30 years?) Total value over time:

References:

(1) **Daily estimates of rainfall, water runoff, and soil erosion in Iowa**. 2006. R. Cruse, D. Flanagan, J. Frankenberger, B. Gelder, D. Herzmann, D. James, W. Krajewski, M. Kraszewski, J. Laflen, J. Opsomer, and D. Todey. *Journal of Soil and Water Conservation*. 61(4):191-199.

(2) **Chapter 18: Surface Water Pollution**. 2006. In *Environment & Pollution Science*. Walker, D., D. Baumgartner, K. Fitzsimmons, and C.P. Gerber. Eds. I.L. Pepper, C.P. Gerber, and M.L. Brusseau. p. 283.

(3) **2012 Annual Report on Performance of Iowa CREP Wetlands: Monitoring and Evaluation of Wetland Performance.** William Crumpton and Greg Stenback. Department of Ecology, Evolution and Organismal Biology, Iowa State University, Ames, IA. http://iowacrep.ag.iastate.edu/sites/default/files/2012%20CREP%20Wetland%20Monitoring%20and%20Evaluation.pdf (accessed 8/15/13).

(4) **Growing Wetlands for Clean Water: Using markets to pay for efficient nutrient removal in the Farm Belt.** December 2012. The Wetlands Initiative. www.wetlands-initiative.org/images/pdf-docs/growing_wetlands_for_clean_water.pdf (accessed 8/15/13).

(5) **The State of the Birds 2013: Report on Private Lands, United States of America**. www.stateofthebirds.org (accessed 8/15/13).

(6) **Wetland Reserve Program: Final Programmatic Environmental Assessment**. January 2009. USDA Natural Resources Conservation Service. www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_006911.pdf (accessed 8/15/13).

(7) **Wetland Reserve Program**. USDA Natural Resources Conservation Service. www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands/ (accessed 8/15/13).

Further Resources:

Practices to Improve Water Quality. June 2012. Leopold Center for Sustainable Agriculture, Iowa State University. www.leopold.iastate.edu/sites/default/files/pubs-and-papers/2012-06-practices-improve-water-quality.pdf (accessed 9/04/13).
This publication presents a brief introduction to nine practices that farmers and ranchers can use to help maintain or improve the water quality on their property. Discussions of the mechanisms of each practice are also included.

Agricultural Nitrogen Management for Water Quality Protection in the Midwest. Heartland Regional Water Coordination Initiative. www.ksre.ksu.edu/waterquality/nitrogen%20pub.pdf (accessed 9/04/13).
Provides an overview of factors influencing nitrogen loss to ground and surface waters in the four-state Heartland region of Iowa, Kansas, Missouri, and Nebraska; and practices to reduce or mitigate losses.

Proceedings of Practical Farmers of Iowa annual conferences, 2012 and 2013. http://practicalfarmers.org/events/annual-conference.html (accessed 9/04/13).
Videos and presentations on a variety of topics, including soil and water conservation.

Managed Grazing in Riparian Areas. 2003. Barbara Bellows. Appropriate Technology Transfer for Rural Areas (ATTRA). https://attra.ncat.org/attra-pub/summaries/summary.php?pub=116 .
This publication is designed to help farmers and ranchers identify and use locally appropriate grazing practices to protect riparian resources. Methods include keeping livestock from stream banks, properly resting pastures to restore degraded land, and determining the proper duration and season for grazing pastures.

Protecting Riparian Areas, Farmland Management Strategies. 2003. Barbara Bellows. Appropriate Technology Transfer for Rural Areas (ATTRA). https://attra.ncat.org/attra-pub/summaries/summary.php?pub=115 .
This publication is designed to help farmers, watershed managers, and environmentalists understand what healthy riparian areas look like, how they operate, and why they are important for the environment and society. It also provides information on the costs and benefits of riparian management.

Protecting Water Quality on Organic Farms. 2003. Barbara Bellows. Appropriate Technology Transfer for Rural Areas (ATTRA). https://attra.ncat.org/attra-pub/summaries/summary.php?pub=114 .
This publication deals with environmental concerns related to organic farming in the areas of the transition period from conventional to organic, nutrient management planning practices, and improper storage of manure or compost materials. It discusses strategies for preventing water pollution by addressing those concerns.

Alternative & Specialty Crops

For growers in the Midwest, anything other than corn and soybeans can be considered an alternative crop. Alternative crops such as small grains (oats, wheat, rye, barley) and oilseed crops (canola, safflower, sunflower) can be grown as part of a crop rotation on large acreages. Legume crops such as alfalfa and dry beans can help build soil by hosting bacteria on their roots that "fix" atmospheric nitrogen into the soil. Alternative crops in the rotation can help reduce disease and insect problems, as well as diversify a farming operation to spread income out more evenly during the year.

"Specialty" crops like fruits, vegetables, and nuts; and even more unusual specialty enterprises like agritourism and aquaculture (fish farming) can be quite profitable. Fresh fruit and vegetables can return up to $18,000 in net income per acre, or sometimes even significantly more; for example, $54,000 per acre for heirloom tomatoes. However, these high-dollar estimates do not include marketing costs (1). Based on farmers' financial reports from 2008 through 2011 in Minnesota, average net income was about $1,800 per acre for mixed vegetable

Labor Hours for Fruit & Vegetable Specialty Crops

Financial records from 2008 through 2011 were collected from specialty crop farmers in Minnesota as part of a USDA-funded Specialty Crop Block Grant. The records included the farmers' reports of time requirements to plant and manage various crops:

Specialty Crop	Labor Hours/Acre/Year
Apples (avg.)	160
Apples (2011)	236
Blueberries	482
Cantaloupe	161
Grapes	186
Pumpkins	70
Raspberries	138
Strawberries	235
Mixed Vegetables	287
AVERAGE	217 (round: 220)

A charge for these labor hours is already included in the calculation of net income per acre per year for fruit and vegetable specialty crops, so you would not reduce the net income figure based on these hours of labor. The labor hours are shown here to illustrate that the time commitment is high, and there is a risk of not always getting all necessary tasks done in time to prevent crop losses.

Reference:

Minnesota Specialty Crops, An Analysis of Profitability and Performance: Minnesota Department of Agriculture www.mda.state.mn.us/~/media/Files/food/organicgrowing/specialtycrop2012.ashx

production and $2,200 for strawberry production (2), so a figure of $2,000/acre/year net income for mixed fruit and vegetable production is used in the costs and benefits table.

Specialty crop operations do not require the large acreages typically seen for grain and forage production operations. A hundred acres would be considered a large vegetable farm in the Midwest. A vegetable or fruit operation in which the farmers sell directly to the public typically involves fewer than 30 acres. This presents an opportunity for a larger-acreage farm to split off smaller parcels that could support one or several new specialty crop farmers.

If alternative crops are something that you want to encourage for the future as part of a crop rotation or if you want to foster a beginning specialty crop farm on your land, then farm transition process should include enterprise budgeting to determine likely cash flows of the future farm(s) and the farmer's ability to pay the rental, lease, or sale price that you want for your property. Your farm's distance from potential markets should be a consideration in deciding whether this is a reasonable option to pursue for your property. Direct-marketing farm operations generally do better when they are close to large urban markets, for instance.

Specialty crops are often a riskier option than cash grain crops. While some Federal crop insurance options are available for some specialty crops, the insurance options are generally much better established and easier to use for cash grains. Some specialty crops are more sensitive to weather variations, diseases, and pests than grains are. Crop protection chemicals (herbicides, insecticides, and fungicides) that are available to grain producers are often not labeled for use on specialty crops. Limited available crop protection tools increases the risk of crop yield reduction or loss of salable product. High labor requirements per acre are also a type of risk. With specialty crops on small acreage, the time required per acre is high and failure to get necessary tasks done in the time window required by the crop can lead to losses.

The farm transition plan should include recognition of all these risks as potential costs and barriers to a new farmer starting up an enterprise. It is also true that the potential profits from a specialty crop can be much greater per acre than from a cash grain crop. Rent, lease, or sale terms can be structured so that the retiring farmer or landowner shares in the risks, but also in the potential rewards from a lucrative specialty crop.

Uninsured/Under-insured Risk

For some specialty crops, it is difficult, very costly, or even impossible to obtain crop insurance. Some specialty crop farmers who have access to insurance still choose to assume all of the risk of loss rather than pay high crop insurance premiums.

Specialty crop farmers have risk due to production costs: they may spend money to plant and tend a crop, but not end up with a crop to sell. These figures show only the lost production costs that have to be made up from somewhere if the crop fails; they don't include lost profit that the farmer may have been counting on to cover family living expenses. These costs are estimates that may not apply to a particular farm's situation.

Iowa State University Extension's Ag Decision Maker spreadsheets for vegetable crops show figures based on a 100' x 4' bed. The table below shows expenses per acre. The per-acre figure was calculated thus:

- 100' x 4' = 400 square feet
- 1 acre = 43,560 square feet
- 43,560 square feet / 400 square feet = 108.9 beds/acre
- Reduce the figure to 100 beds/acre to allow for space between beds or other non-planted areas.

continued on next page …

Uninsured/Underinsured Risk, continued (pg. 2)

Pre-harvest production costs per bed x 100 = Pre-harvest production costs per acre:

Specialty Crop	**Annual crop pre-harvest production costs per acre**
Asparagus	$5,227
Basil	$5,149
Specialty Green Beans	$5,056
Carrots	$2,831
Eggplant	$5,951
Garlic	$9,879
Salad Greens	$2,013
Snow Peas	$6,148
Potatoes	$5,118
Sweet Potatoes	$3,255
Red Raspberries*	$2,946
Strawberries*	$1,902
Cherry Tomatoes	$6,722
Heirloom Tomatoes	$6,722
AVERAGE	$4,923 (round: $5,000)
*Includes annual production costs plus one-year value of establishment costs. The total establishment costs are amortized over 10 years for raspberries and over three years for strawberries.	

Reference:

Ag Decision Maker, Iowa Fruit and Vegetable Production Budgets. Craig Chase. Iowa State University Extension.
www.extension.iastate.edu/agdm/crops/html/a1-17.html

Alternative & Specialty Crops			
	- Column	**+ Column**	
Qualitative Benefits of the Practice	**Cost of Implementation and Potential Income Loss**	**Potential Income Gain and Reduced/Avoided Costs**	**Your Judgment: Value Per Acre of This Practice on Your Land**
May reduce pesticide use More profitable choice than corn & soybeans on some soils and in some climates (3) Choice of a suitable alternative crop can reduce or eliminate irrigation water use in dry climates. Restricting irrigation benefits water conservation efforts. Increased species diversity on the landscape **The numbers in this table are broad estimates, and you should adjust them for your farm's conditions.**	Risk of uninsured or under-insured loss of production costs for specialty fruit or vegetable crop: $5,000/acre/year *(See Uninsured/Under-insured Risk text box)* High labor requirements per acre of specialty fruit/vegetable crop; average of 220 hours/acre/year *(See Labor Hours text box; 2)* Loss of net income from cash grain crop on the alternative or specialty crop acres: $230/acre/year. *(See Cash Grain Profitability Calculation text box on page 4).* If dryland acres, loss of income from corn/soybean is about $80/acre/year (3)	Specialty fruit and vegetables have widely varying income potential. $2,000/acre/year, net income for mixed fruit and vegetable production; range of $1,200 to $18,100 or potentially higher (note high-end figure does not include marketing costs) (1, 2) Heirloom tomatoes, net income of $54,000/acre/year, not including marketing costs (1) Dry beans, net income of $200/acre/year (3) Confectionary sunflowers, net income of $184/acre/year (3)	Potential income gain and costs avoided: + Potential income loss and costs to pay: - Your judgment on value to your farm of qualitative benefits: + Value to society or environment: + Add up the total net value per acre per year: Multiply by number of acres devoted to the practice: Multiply by a time frame (5 years? 10 years?) Total value over time:

References:

(1) **Ag Decision Maker, Iowa Fruit and Vegetable Production Budgets. Craig Chase.** Iowa State University Extension. www.extension.iastate.edu/agdm/crops/html/a1-17.html

(2) **Minnesota Specialty Crops, An Analysis of Profitability and Performance:** Minnesota Department of Agriculture
www.mda.state.mn.us/~/media/Files/food/organicgrowing/specialtycrop2012.ashx

(3) **Projected 2012 Crop Budgets, North Central North Dakota**. December 2011. Andrew Swenson and Ron Haugen. North Dakota State University Extension Service.
www.ag.ndsu.edu/pubs/agecon/ecguides/nc2012.pdf (accessed 8/19/13)

Further Resources:

Crop Insurance Options for Specialty, Diversified and Organic Farmers. 2012. Jeff Schahczenski. Appropriate Technology Transfer for Rural Areas (ATTRA).
https://attra.ncat.org/attra-pub/summaries/summary.php?pub=413
This publication reviews federally subsidized crop insurance, with special attention to options available to specialty, diversified, and organic farmers. It gives special attention to understanding whole-farm revenue insurance options, which may be of particular interest to growers of diverse specialty and organic crops and livestock.

Alternative Agronomic Crops. 2000. Patricia Sauer and Preston Sullivan. Appropriate Technology Transfer for Rural Areas (ATTRA).
https://attra.ncat.org/attra-pub/summaries/summary.php?pub=84
This publication provides an overview of the considerations involved in selecting, cultivating, and marketing alternative agronomic crops. Many additional resources for alternative crop information are referenced in this publication.

Horticulture Crops as Alternative Crops. Appropriate Technology Transfer for Rural Areas (ATTRA).
https://attra.ncat.org/horticultural.html
This series of six publications offers detailed information on production of specific horticultural crops, focusing on sustainable and organic production methods for traditional produce and also introducing a range of alternative crops and enterprises. It includes information on strategies for more sustainable greenhouse and field production of everything from lettuce to trees.

Organic Risk Management. 2010. Editors: Kristine Moncada and Craig Sheaffer. University of Minnesota.
www.organicriskmanagement.umn.edu/alternative_crops.pdf
This online manual is intended as a guide for organic and transitioning producers in the Upper Midwest. It includes a lot of good, basic agronomic and soil science information that is useful for non-organic farmers as well.

Perennial Forages and Grazing

Perennial forage plantings are excellent practices for soil and water improvement. An established perennial forage stand is like a sponge, soaking up both water and nutrients and allowing very little of either to escape into groundwater or surface water. Land in a perennial forage crop is not tilled, which is beneficial for soil health. Tillage – plowing, disking, or similar operations – destroys both soil structure and soil organic matter; so the more years in a rotation that the soil is in a perennial crop and not tilled, the better for the soil (1).

Alfalfa Nitrogen Credit

A fair stand of alfalfa on medium-textured soil can provide 160 lbs./acre of nitrogen to the corn crop that comes after it (1). Using a 2012 nitrogen price of $0.60 per lb. (2):

160 lbs. nitrogen/acre x $0.60/lb = $96/acre nitrogen credit from the alfalfa crop

Because breakdown of plant matter in the soil takes place gradually over time, the plowed-down alfalfa crop will also supply nitrogen to the second year of corn after the alfalfa is plowed down.

50 lbs. nitrogen/acre 2nd-year credit (1) x $0.60/lb (2) = $30/acre 2nd-year credit from the alfalfa crop.

References:

(1) **Using Legumes as a Nitrogen Source**. June 1997. L.G. Bundy, K.A. Kelling and L. Ward Good. University of Wisconsin Extension, publication #A3517. http://ipcm.wisc.edu/download/pubsNM/Usinglegumes.pdf

(2) **Fertilizer Use and Price**. Reports from the Economic Research Service, USDA. www.ers.usda.gov/data-products/fertilizer-use-and-price.aspx#26727. (accessed 6/11/13)

Legume forage crops are very useful in crop rotations as a way to break weed, pest and disease cycles and add nitrogen to the soil. Forage crops help reduce weed pressure in several ways. The thick ground cover of forage reduces the amount of sunlight that reaches the soil surface, which prevents some weed seeds from germinating. The forage crop out-competes most weed seedlings that do sprout, and harvest of the forage removes growing weeds before they can produce seeds. Forage crops in a rotation reduce the level of insect pests and diseases because the forage crop is typically not the host plant for insects and diseases that harm cash crops. Having a field planted to something other than the host plant (the grain crop) for at least a year means those insects and disease organisms don't have the food or shelter they need from the host plant in order to complete their life cycle, so they die off (2).

Long-term perennial forage is a reasonable choice to consider on your land's most productive acres. Alfalfa hay production can be financially competitive with cash grain production. Perennial forage also has potential to generate income and environmental benefits on the more marginal land. Acres that produce less than the farm's average yield of corn or soybeans might be more profitable in a forage crop. Acres that are difficult to plant to row crops because they are too steep, too wet, too dry, or are in odd-shaped areas that don't work well with large field equipment are all good candidates for a permanent forage planting.

Many programs administered by the Natural Resources Conservation Service offer incentives for conservation practices such as perennial pastures. Some examples include the Conservation Reserve Enhancement Program (CREP), the Conservation Reserve Program (CRP), the Conservation Stewardship Program (CSP) and the Grassland Reserve Program (GRP).
The Conservation Stewardship Program is a "working lands" program that provides payments for whole farm plans in which acres in perennials can be harvested, either by

Federal Farm-Level Conservation Programs

USDA conservation programs are administered by the Farm Service Agency (FSA) and Natural Resources Conservation Service (NRCS) which are accessible throughout the nation in county and regional field offices called USDA Service Centers. Find the USDA Service Center nearest to you at http://offices.sc.egov.usda.gov/locator/app

USDA Natural Resource Conservation Service conservation programs:

- Wetland Reserve Program
  www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands/
- Grasslands Reserve Program
  www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/grassland/
- Healthy Forests Reserve Program
  www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/forests/
- Farm and Ranch Lands Protection Program
  www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/farmranch/
- Environmental Quality Incentive Program
  www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/
- Conservation Stewardship Program
  www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/

USDA Farm Service Agency conservation programs:

- Conservation Reserve Program
  www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp
- Transition Incentive Program
  www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=tipr

machine or by grazing livestock. The other programs are land retirement programs, in which cost-share is available for planting, nothing is harvested, and contract payments substitute for crop sales (see Federal Farm-Level Conservation Programs text box). If having acreage permanently in perennial grasses or legumes is something you want for your legacy on the land, then these programs can be part of the total package that makes it financially feasible for you or future farmers to plant and maintain those acres. Your local NRCS office can explain the details of these programs, the requirements and restrictions associated with them, and the contract payment amounts. Search for your local NRCS office: http://offices.sc.egov.usda.gov/locator/app?agency=nrcs.

Perennial forages combined with contract grazing can be a good entry option for a beginning farmer. If helping a new farmer get started is part of your family's goal for the land, this is a path to consider. A new farmer can lease or rent acres in perennial forage, get a contract to graze someone else's cattle on those acres, and only have to invest capital in fencing equipment. This type of farmer is called a "grazier" -- a person who manages the grazing of livestock on pastures. Managed grazing can be a profitable, productive, and environmentally beneficial use of land (3). Pasture rental agreements or pasture leases should be structured to be fair to the landowner, the livestock owner, and the grazier (two or three of those roles might be held by the same person). In a typical rental or lease agreement, the landowner is responsible for the perimeter fence and the grazier is responsible for the internal, temporary fences needed to move cattle through the pasture in a managed grazing system (4).

Hay or haylage production requires different planting and harvest equipment than grain production, as well as more labor. Those costs are accounted for in the net income figure for alfalfa, but in spite of those costs being accounted for on paper, they remain a barrier to many farmers who are strapped for time. Dealing with a different set of equipment and a different type of crop adds a level of complexity to a grain farm operation, which requires management effort and knowledge. Those issues are not well captured by traditional accounting methods, but they are costs or barriers that must be considered in a farm transition plan.

If you want to ensure that perennial forages are part of the farming operation on your land in the future, then your expectations for sale, rental, or lease price for your land must match up with what is affordable for a farming operation that includes or is wholly based on perennial forages. For hay crops, leases should be for at least three years to ensure that the farmer gains the benefits from her or his investment in planting a perennial forage crop. The terms of the lease should include a credit to the farm operator for the nitrogen benefit to the next grain crop if a different farmer will have the land after the hay crop is plowed down. With both pasture and hay, consider including a credit to the farm operator for management efforts that contribute to improved soil health and reduced soil erosion and water runoff.

Fencing & Watering Costs

These calculations are based on a 40-acre square pasture, ¼ mile on each side. One mile of fence will enclose the pasture. Other pasture sizes and shapes are very common. Cost per acre of fencing will increase if a smaller area or oddly-shaped area is enclosed. Cost per acre of fencing will decrease if a larger area is enclosed.

Fencing:

Construction cost per foot of high-tensile electrified five-wire fence: $1.24

- Construction cost per mile: $1.24 x 5,280 ft. = $4,699.20 (rounded up to $4,700)
- If the 1-mile fence encloses 40 acres, construction cost = $117.50/acre.
- This fence has a 25-year lifetime, so $117.50/25 = $4.70/acre/year fence construction cost

Annual maintenance and ownership cost of high-tensile electrified five-wire fence: $0.12/foot/year (1)

- Annual maintenance cost per mile: $0.12/ft. x 5,280 ft. = $633.60
- Spread over 40 acres: $633.60/mile/year / 40 acres = $16/acre/year fence maintenance cost

Cost for temporary divider fence for managed grazing: $0.20/ft. (1)

- Cost for ½ mile of temporary fence: $0.20/ft. x 2,640 ft. = $528
- Four-year lifespan, so $528/4 = $132/year
- Spread over 40 acres: $3.30/acre/year for temporary fencing to do managed grazing

continued on next page …

Fencing & Watering Costs, continued (pg. 2)

Watering:

Cost to run 1 mile of 1-1/4" irrigation plastic pipe with fittings and a 100-gallon tank: $3,000 (2)

Spread over 40 acres: $75/acre

Estimated 10-year lifespan, so $7.50/acre/year for watering system

A couple of things to note:

- This is for an above-ground system and the cost figure does not include the labor costs to lay the pipe in spring and remove it in fall.
- Thoughtful layout of paddocks and configuration of the watering system can reduce costs; the system may require significantly less than 1 mile of pipe.

References:

(1) **Estimated Costs for Livestock Fencing**. Updated December 2012. Ralph Mayer and Tom Olsen; revised by William Edwards and Andy Chamra. Iowa State University Extension and Outreach. File B1-75. www.extension.iastate.edu/agdm/livestock/html/b1-75.html (accessed 8/20/13).

(2) **The ABCs of Livestock Watering Systems**. 2006. Ben Bartlett. Midwest Plan Service, Iowa State University. www.extension.org/mediawiki/files/d/d2/9_Watering.pdf (accessed 8/20/13).

Grazing Income

Income from grazing varies widely depending on the productivity of the land, the condition of the pasture, and the grazing season. This example draws from two specific sample leases from south-central Wisconsin (1,2). The dollar figures used fall within ranges reported for custom grazing of cattle in Wisconsin and Iowa (3).

Assumptions for this example:

- The $/head/day amount includes the cost of the land lease plus the grazing management. In other words, in this example a landowner does custom grazing of another person's cattle.
- The stocking rate is a season-long average. Some graziers stock at a higher rate in the spring and reduce the rate as forage production declines in the fall. Drought results in earlier and larger reduction in the stocking rate.
- Rotational grazing is used
- Pasture is an upland grass and clover mixture with no fertilizer applied.

Stocking rate permitted (1) = 0.625 AU/acre (AU=Animal Unit = 1000 lbs. of cow)

Contract for custom-grazing dairy heifers (2):

- 230 animals, average weight of 600 lbs. = 138,000 lbs. = 138 AU
- 138 AU / 0.625 AU/acre stocking rate = 220 acres
- Contract grazing rate: $1.37/animal/day (1) x 230 animals = $315.10/animal/day
- Days of grazing: approximately 180 days (mid-April through mid-October) (2)
- Total payment due under contract: $315.10/day x 180 days = $56,718
- Payment per acre: $56,718/220 acres = $258/acre (round: $260/acre)

Note: The $260/acre is a gross income figure. The landowner doing the custom grazing has costs for labor and management time, perimeter fence maintenance, a watering system, mineral supplements, and fencing supplies for temporary fence.

References:

(1) **Contract for grazing on 320 acres, livestock managed by livestock owner**. 2013. Midwest Perennial Forage Working Group. http://greenlandsbluewaters.net/Perennial_Forage/sample_contracts_leases.html

(2) **Contract for custom grazing of dairy heifers, livestock managed by landowner**. 2013. Midwest Perennial Forage Working Group. http://greenlandsbluewaters.net/Perennial_Forage/sample_contracts_leases.html

(3) **Rates Charged for Contract Grazing Arrangements.** 2013. Midwest Perennial Forage Working Group. http://greenlandsbluewaters.net/Perennial_Forage/CG_Rates_final_0313.pdf

Perennial Forage			
	- **Column**	**+ Column**	
Qualitative Benefits of the Practice	**Cost of Implementation and Potential Income Loss**	**Potential Income Gain and Reduced/Avoided Costs**	**Your Judgment: Value Per Acre of This Practice on Your Land**
Improved soil structure through having living roots in the ground year-round. Less soil erosion and less water runoff from a forage crop or well-managed pasture than from a grain crop Reduces weed pressure in the next cash crop Reduces insect and disease pressure in the next cash crop	Loss of net income from cash grain crop: $230/acre/year. *(See Corn & Soybean Profitability text box in the Crop Rotation section)* Cost to build perimeter fence around a 40-acre pasture: $4,700 for a 25-year fence; $4.70/acre/year *(See Fencing & Watering Costs text box)* Annual maintenance cost for high-tensile electrified wire perimeter fence: $16/acre *(See Fencing & Watering Costs text box)* Cost of temporary, movable fence for managed grazing: $3.30/acre/year *(See Fencing & Watering Costs text box)* 1-mile watering system:	Grazing land lease of $50/acre/year (lease only; not counting potential additional income from labor and management of grazing system)(6) Grazing land plus grazier services (labor and management for cattle herd on pasture): $230/acre/year **gross** income *(see Grazing Income text box)* Alfalfa hay production, net income: $228/acre/year (7) Plow-down value of alfalfa in providing nitrogen to next cash crop: $96/acre *(See Alfalfa Nitrogen Credit text box)* Plow-down value of alfalfa in providing nitrogen to the second-year cash crop: $30/acre *(See Alfalfa Nitrogen Credit text box)*	Potential income gain and costs avoided: + Potential income loss and costs to pay: - Your judgment on value to your farm of qualitative benefits: + Value to society or environment: + Add up the total net value per acre per year: Multiply by number of acres devoted to the practice: Multiply by a time frame (5 years? 10 years?) Total value over time:

The numbers in this table are broad estimates, and you should adjust them for your farm's conditions.	$7.50/acre/year *(See Fencing & Watering Costs text box)* Cost of land ownership: $27/acre/year (includes interest, taxes, depreciation on facilities) (5)	$8.60/acre/year gain in fertilizer value of soil by saving 4.1 tons/acre/year from soil erosion; cumulative over years *(See Value of Saving Soil text box in the Crop Rotation section)* Benefit to society: approximately $20/acre/year gain in water quality value of soil by saving 4.1 tons/acre/year of soil from erosion *(See Value of Saving Soil text box in the Crop Rotation section)*	

References:

(1) **Organic Matter Management**. In The Soil Management Series. Revised 2008. Ann Lewandowski. http://www.extension.umn.edu/distribution/cropsystems/components/7402_02.html (accessed 6/11/13).

(2) **Rotation**. 2010. Kristine Moncada and Craig Sheaffer. In *Organic Risk Management*. http://www.organicriskmanagement.umn.edu/rotation2.html (accessed 8/20/13).

(3) **The Basics of Contract Grazing**. 2013. Midwest Perennial Forage Working Group. http://greenlandsbluewaters.net/Perennial_Forage/CG_Basics_final_0313.pdf (accessed 8/20/13).

(4) **Pasture Rental and Lease Agreements**. 2013. Jim Paulson and Richard Cates. Midwest Perennial Forage Working Group. http://greenlandsbluewaters.net/Perennial_Forage/CG_ContractLeases_final_0313.pdf (accessed 8/20/13).

(5) **Pasture Rental Agreements for Your Farm**. December 2011. North Central Farm Management Extension Committee. http://greenlandsbluewaters.net/Perennial_Forage/NCFMEC-03%20Pasture%20lease.pdf (accessed 8/20/13).

(6) **Contract for grazing on 320 acres, livestock managed by livestock owner**. 2013. Midwest Perennial Forage Working Group. http://greenlandsbluewaters.net/Perennial_Forage/sample_contracts_leases.html (accessed 8/20/13).

(7) **What does it take to earn a living on the farm?** April, 2013. Gary Hachfeld, University of Minnesota Extension. http://swroc.cfans.umn.edu/prod/groups/cfans/@pub/@cfans/@swroc/documents/asset/cfans_asset_440374.pdf (accessed 8/06/13).

Further Resources:

Contract Grazing. 2013. Green Lands Blue Waters, Midwest Perennial Forage Working Group. http://greenlandsbluewaters.net/Perennial_Forage/contract.html (accessed 6/11/13). *Series of four fact sheets: Basics of Contract Grazing, Evaluating Land Suitability for Grazing Cattle, Pasture and Rental Lease Agreements, and Rates Charged for Contract Grazing Agreements.*

Forages. 2010. Craig Sheaffer. In *Organic Risk Management*. Editors: Kristine Moncada and Craig Sheaffer. University of Minnesota.
www.organicriskmanagement.umn.edu/forages12.html
This online manual is intended as a guide for organic and transitioning producers in the Upper Midwest. The Forages section includes a lot of good forage crop production information that is useful for non-organic farmers as well.

Pasture and Rangeland Management During Drought: ATTRA
https://attra.ncat.org/downloads/water_quality/drought_mgmt.pdf#search=forages
This PowerPoint presentation illustrates some common-sense guidelines on how to manage livestock during a drought. It also discusses strategies that can be implemented before a drought starts that could make life easier for a rancher when the eventual drought conditions do begin.

Perennial Pastures & Hayfields: What's in them?

Grasses	Legumes	Forbs
Perennial grasses form dense mats of fibrous roots that hold soil in place. Grasses for pasture and hay are generally divided into "cool-season" grasses, which have their main growth in the spring and fall; and "warm-season" grasses, which grow well in the heat of summer. In northern states, cool-season grasses are what you most commonly see in pastures and hayfields.	Legumes are plants related to beans and peas. They have a close relationship with a particular group of bacteria that live in the soil, called *Rhizobia*. *Rhizobia* "infect" legume roots where they collect nitrogen that the plants take in from the atmosphere, which is about 70% nitrogen gas. The bacteria transform this atmospheric nitrogen into a form useable by plants. Well-managed legume crops reduce the need for purchased synthetic nitrogen fertilizer, which is produced using fossil fuels.	Forbs are broad-leaved plants that are neither grasses nor legumes. Most of the plants that you recognize as weeds in your garden are forbs. Some forbs are weeds in pasture, and may be harmful to livestock. Some forbs are planted intentionally in pastures to provide variety in the livestock diet. Certain types of forbs have other beneficial effects such as long and fleshy roots that can loosen compacted soil and "scavenge" water and nutrients from deep in the soil.
Common types of cool-season hay & pasture grasses: Timothy, smooth bromegrass, orchardgrass, quackgrass, fescues, ryegrasses	**Most common hay & pasture legumes:** Alfalfa , red clover, white clover, birdsfoot trefoil	**Common planted forbs for pasture:** Turnip, chicory
Common types of warm-season grasses in the Midwest: Switchgrass, Big Bluestem, Indiangrass	**Less common hay & pasture legumes:** Kura clover, sainfoin, crownvetch, alsike clover	**Common pasture weeds that are forbs:** Canada thistle, goldenrod, curly dock, wild carrot

Reference:

Evaluating Land Suitability for Grazing Cattle. 2013. Midwest Perennial Forage Working Group, Green Lands Blue Waters. http://greenlandsbluewaters.net/Perennial_Forage/CG_Evaluating%20Land_final_0313.pdf

Pollinator & Beneficial Insect Habitat

One of the biggest stories in the agricultural press during the past several years has been the decline of domesticated honey bee populations all over the United States. Wild bee populations are also in decline due to loss of habitat, and this poses risks for agricultural crops that depend on bees for pollination. Insect pollination results in $26.9 billion in crop value per year. (1; *see Pollinator & Beneficial Insect Services text box*).

A key strategy to counter declines in pollinators is to plant and maintain habitats that promote and protect them by providing nectar and pollen, shelter, and protection from agricultural chemicals (2). Pollinator habitats can attract domestic honeybees, but also wild bees and other wild beneficial insect species. These beneficial species include many different wasps, beetles, lacewings, predatory mites, and more. Beneficial insects prey upon the kinds of insects that damage crops, so keeping them around can help reduce pesticide applications. Wild beneficial insects protect an estimated $4.5 billion per year in crop value by reducing insect pest damage (3).

Habitat Costs

These calculations are based on research on prairie strips within cropped fields (the STRIPS project) at the Neal Smith National Wildlife Refuge near Prairie City, IA.

Average cost of establishment of habitat:

- Site preparation including tillage and herbicide application: $86/acre
- Seeding including seed purchase, planting, and packing soil: $218/acre
- Mowing three times in first year: $90/acre

Total establishment cost: $394/acre (round up to $400/acre)

Establishment cost spread over 15-year lifetime = $400 per acre/15 years = $27/acre/year

Annual management and maintenance costs:

- Management average = 2% of establishment cost: $8/acre/year
- Mowing once/year = $30/acre/year
- Baling once/year = $11/acre/year

Total annual management+maintenance = $49/acre/year (round up to $50/acre/year)

Reference:

The Cost of Prairie Conservation Strips. August 2013. Leopold Center for Sustainable Agriculture, Iowa State University. www.leopold.iastate.edu/sites/default/files/pubs-and-papers/2013-08-cost-prairie-conservation-strips.pdf (accessed 8/21/13).

Pollinator habitat is recognized as critically important by the USDA, and programs are available that offer cost-share for habitat establishment as well as annual contract payments (4). Privately funded cost-sharing and contracts are also available in some areas (5).

Pollinator and beneficial insect habitats can sometimes use marginal or poor cropland. In those cases, the loss of income from corn or soybeans will be less than it would be on prime cropland. There can be benefits to having pollinator/beneficial insect habitat right within prime cropland areas, however. Having beneficial insects living close to crops can reduce damage from insect pests. If the crop is dependent on insect pollination, it makes sense to have pollinators nearby. There are also potential soil and water quality benefits. Research in Iowa shows that strategically placing narrow strips of native prairie species within crop fields, on as little as 10% of the crop field acreage, can reduce sediment movement by 95% and water runoff by 60%. The strips, which provide prime habitat for pollinators and other beneficial insects, also provide greater soil and water conservation benefits than expected from the size of the strips (6).

If pollinator/beneficial insect habitat is something you want to see on your land in the future, then you can work pollinator habitat acreage into your farm transition plan. Federal, state, or private programs can support the cost of habitat creation and offset the loss of crop income from those acres. Rental agreements, leases, or sale terms should specify the boundaries of any established habitat planting and forbid damage to that area. See “Considerations for Landowners” in the Agroforestry section for more ideas for the farm transition plan. The points to consider are quite similar for agroforestry and habitat plantings.

Pollinator/Beneficial Insect Habitat			
	- Column	**+ Column**	
Qualitative Benefits of the Practice	**Cost of Implementation and Potential Income Loss**	**Potential Income Gain and Reduced/Avoided Costs**	**Your Judgment: Value Per Acre of This Practice on Your Land**
Pollinators are critical to productivity of many fruit, vegetable, seed, and nut crops Beneficial insects prey on other harmful insects, reducing crop damage Possible reduced insecticide application to crops Pollinator/beneficial insect habitat contributes to species diversity on the farm; attracts birds and other wildlife Reduced soil erosion and water runoff from habitat strips strategically located on 10% of crop fields.	Establishment cost spread over 15 years: $27/acre of habitat/year *(See Habitat Costs text box)* Management and maintenance cost for habitat: $50/acre/year *(See Habitat Costs text box)* Loss of net income from cash crop on the pollinator habitat acres: $230/acre/year. *(See Cash Grain Profitability Calculation text box in Crop Rotation section).* Reduce this number if planting on less-productive acres. $30/acre/year cost for the acreage of the habitat, for extra time and hassle in field operations (tillage, spraying, and harvesting) to maneuver around the area. (7)	Full funding for habitat establishment through public or private programs (5,6) $150/acre/year contract payment for acres in pollinator habitat (5) Benefit to society: $29/acre/year from pollination services. This applies to **total farm acres**, not just acres in pollinator habitat. *(See Pollinator & Beneficial Insect Services text box)* $5/acre/year in crop protection services from beneficial insects. This applies to **total farm acres**, not just acres in pollinator habitat. *(See Pollinator & Beneficial Insect Services text box)* $8.20/acre/year gain in fertilizer value of soil by saving 95% of 4.1 tons/acre/year from soil erosion if	Potential income gain and costs avoided: + Potential income loss and costs to pay: - Your judgment on value to your farm of qualitative benefits: + Value to society or environment: + Add up the total net value per acre per year: Multiply by a time frame (5 years? 10 years?) Total value over time:

The numbers in this table are broad estimates, and you should adjust them for your farm's conditions.		habitat is on 10% of cropland acres. This amount applies to **total farm acres**. *(See Value of Saving Soil text box in the Crop Rotation section).* Benefit to society: approximately $19/acre/year gain in water quality value of soil by saving 95% of 4.1 tons/acre/year of soil from erosion if habitat is on 10% of cropland acres. This amount applies to **total farm acres**. *(See Value of Saving Soil text box in the Crop Rotation section).*	

References:

(1) **Insect Pollinated Crops, Insect Pollinators and US Agriculture: Trend Analysis of Aggregrate Data for the Period 1992-2009.** May 2012. Nicholas Calderone. PLoS-ONE 7(5): e37235. http://dx.doi.org/10.1371/journal.pone.0037235

(2) Pollinators. Conservation Marketplace Midwest. http://conservationmarketplace.org/case-studies/pollinators/ (accessed 8/21/13).

(3) **The Economic Value of Ecological Services Provided by Insects.** 2006. John Losey and Mace Vaughan. BioScience 56(4):311-323. http://dx.doi.org/10.1641/0006-3568(2006)56[311:TEVOES]2.0.CO;2

(4) **Using Farm Bill Programs for Pollinator Conservation, Technical Note No. 78. August 2008. Mace Vaughan and Mark Skinner.** The Xerces Society, USDA-NRCS, and San Francisco State University. www.xerces.org/wp-content/uploads/2009/04/using-farmbill-programs-for-pollinator-conservation.pdf (accessed 8/21/13).

(5) **Pollinator Habitat Project with General Mills**. April 2012. Linda Meschke. Conservation Marketplace Midwest. www.gberba.org/Tech%20Page/TechHandouts2012/Technical%20-%20Handout%20-%202012%20-%205%20-%20CMM%20-%20Pollinator%20Habitat%20Project%20with%20General%20Mills(May12).pdf (accessed 8/21/13).

(6) **A Landowner's Guide to Prairie Conservation Strips.** The Leopold Center for Sustainable Agriculture, Iowa State University. www.leopold.iastate.edu/sites/default/files/pubs-and-papers/2013-08-landowners-guide-prairie-conservation-strips.pdf (accessed 8/21/13).

(7) **Economic and Environmental Costs and Benefits of Living Snow Fences: Safety, Mobility, and Transportation Authority Benefits, Farmer Costs, and Carbon Impacts**. February 2012. Gary Wyatt, University of Minnesota Extension; Minnesota Department of Transportation Research Services. www.lrrb.org/media/reports/201203.pdf (accessed 8/12/13).

Further Resources:

Alternative Pollinators: Native Bees. 2010. Eric Mader, Mace Vaughan, Matthew Shepherd and Scott Hoffman Black. The Xerces Society for Invertebrate Conservation and National Center for Appropriate Technology.
https://attra.ncat.org/attra-pub/summaries/summary.php?pub=75.
This publication provides information and resources on how to plan for, protect and create habitat for native bees in agricultural settings.

Pollinator Conservation. Center for Urban Ecology and Sustainability, Department of Entomology, University of Minnesota.
www.entomology.umn.edu/cues/pollinators/plants.html (accessed 8/26/13).

Pollinator & Beneficial Insect Services

Analysis of pollinator services based on 2009 crop yields shows that in the United States, domestic and wild bees and other insect pollinators were responsible for:

- $15.1 billion per year in crop value from crops directly dependent on insect pollination (mainly fruits, vegetables, and nuts)
- $11.8 billion per year in crop value from crops indirectly dependent on insect pollination (forage crops and other crops planted from seed that is produced via insect pollination)

Total annual value of insect pollination services to United States agriculture: $26.9 billion (1)

- Total acres in farms in United States in 2009: 919.8 million acres (2)
- Value of pollination services per acre of farmland in the U.S.:
- $26.9 billion / 919.8 million acres = $29.25/acre of farmland; rounded down to $29/acre

Value of crop protection services from beneficial insects: $4.5 billion per year (3)

- Value of crop protection services per acre of farmland in the U.S.:
- $4.5 billion / 919.8 million acres = $4.89/acre of farmland; rounded up to $5/acre

continued on next page …

Pollinator & Beneficial Insect Services, continued (pg. 2)

A couple of things to note:

- These values for pollinator services and for crop protection services are calculated on total United States farm acreage, so you should multiple the $/acre figure by the total number of acres of your farm to calculate your farm's share of the total benefit to the U.S. farm economy from pollinator services.

- Actual benefits to the farm from pollinator services or crop protection services will depend on amount of pollinator habitat established and where it lies in relation to crop fields (4).

References:

(1) **Insect Pollinated Crops, Insect Pollinators and US Agriculture: Trend Analysis of Aggregrate Data for the Period 1992-2009.** May 2012. Nicholas Calderone. PLoS-ONE. 7(5):e37235. http://dx.doi.org/10.1371/journal.pone.0037235 .

(2) **Farms, Land in Farms, and Livestock Operations 2009 Summary**. February 2010. National Agricultural Statistics Service (NASS), USDA. http://usda01.library.cornell.edu/usda/nass/FarmLandIn//2000s/2009/FarmLandIn-02-12-2009.pdf (accessed 8/21/13).

(3) **The Economic Value of Ecological Services Provided by Insects**. 2006. John Losey and Mace Vaughan. BioScience 56(4):311-323. http://dx.doi.org/10.1641/0006-3568(2006)56[311:TEVOES]2.0.CO;2

(4) **Alternative Pollinators: Native Bees. 2010.** Eric Mader, Mace Vaughan, Matthew Shepherd and Scott Hoffman Black. The Xerces Society for Invertebrate Conservation and National Center for Appropriate Technology. https://attra.ncat.org/attra-pub/summaries/summary.php?pub=75

Wildlife Habitat

Many of the principles for establishing and managing habitats for beneficial insects also apply to establishment of wildlife habitat in general. Establishing and maintaining habitat can be purely for aesthetic and conservation purposes, or it can be done with an eye toward encouraging the presence of game species. Fee hunting or hunting leases can be a significant source of farm income if the farm acreage is large enough and productive enough. Tennessee reports an average hunting lease size of 663 acres. (1) It is not necessary for all or even most of the farm's acreage to be in habitat plantings in order for it to be a good location for hunting game species. According to the Mid-America Hunting Association, "… once there is food then there [are] good deer to be found. The deer will make use of whatever cover that is near their dinner table (2)."

Many wildlife species thrive in edges between their nesting and shelter areas and tilled crop areas, so arranging a farm to have several relatively smaller habitat plantings can be as good as or better than a large single block of habitat in terms of species diversity and productivity (3,4).

Habitat plantings might be permanent native grass and prairie plant species to provide shelter, nesting areas, food and space for whatever species you want to encourage. Game examples include quail, pheasants, grouse, ducks, geese or deer. Non-game birds as well as mammals, reptiles and amphibians will also be

Profitability of a Hunting Lease

This example uses the figures from the Wildlife Habitat table. References are not repeated here; refer to the table and other text boxes for references.

Sample calculation for 633-acre farm (average hunting lease size in Tennessee), assuming that wildlife habitat is strategically placed to reduce soil erosion on 10% of those acres (63 acres).

Annual gains due to wildlife habitat:

- Annual hunting lease: $30/acre x 633 acres = $18,990
- Annual gain in soil fertility on all acres by reducing soil erosion: $8.20/acre x 633 acres = $5,191

Total annual gain = $24,181

Annual costs for wildlife habitat:

- Annual amount of total habitat establishment cost: $27/acre x 63 acres = $1,701
- Annual maintenance cost for habitat: $50/acre x 63 acres = $3,150
- "Hassle cost" of maneuvering farm equipment around habitat: $30/acre x 63 acres = $1,890
- Lost cash crop income on habitat acres: $230/acre x 63 acres = $10,868

Total annual costs = $17,609

Net annual gain = $24,181 - $17,609 = $6,572

attracted to habitat areas. Attracting wild game and non-game species to agricultural property might also involve planting food plots of annual crops, or leaving unharvested strips of cropland for winter feed (5).

The table below does not include any mention of cost-sharing or annual payments from public or private programs. Land in wildlife habitat may certainly be eligible for such programs, especially if the habitat placement is done to maximize soil and water conservation benefits. Some (but not all) of those programs may restrict the landowner's ability to also charge a fee for hunting on the property. This table shows costs and benefits of habitat with no program support, with a hunting lease as an income source and leaving you to place your own value on benefits to non-game wildlife species.

If having wildlife habitat is part of your vision for the future of your land, then your farm transition plan should include:

- A plan for who will do the work of habitat establishment and maintenance. A beginning farmer could put "sweat equity" into the establishment work and receive a credit on the land lease or sale price for that effort.
- A plan for fair division of costs and benefits from the wildlife habitat. There could be a wide variety of arrangements. For example, if retiring farmers or landowners want to retain the hunting rights for themselves and family members, then the value of those hunting rights should be included in the financial planning and the farm operator should receive a credit to make up for hunting lease fees he or she won't be able to charge.
- Terms of the lease or sale should specify the boundaries of the habitat areas and prohibit damage to or removal of the habitat.

Even if you ultimately choose not to enroll habitat acres in a conservation program, your local NRCS office could still be helpful in the process by providing maps of your farm and technical advice. Find your local NRCS service center:
http://offices.sc.egov.usda.gov/locator/app?agency=nrcs

Wildlife Habitat			
	- Column	**+ Column**	
Qualitative Benefits of the Practice	**Cost of Implementation and Potential Income Loss**	**Potential Income Gain and Reduced/Avoided Costs**	**Your Judgment: Value Per Acre of This Practice on Your Land**
Increase species diversity of farm by as much as 380% (3) Nesting habitat for songbirds Food source for migrating birds and insects Pollinator and beneficial insect habitat **The numbers in this table are broad estimates, and you should adjust them for your farm's conditions.**	Establishment cost spread over 15 years: $27/acre of habitat/year *(See Habitat Costs text box in Pollinator Habitat section)* Management and maintenance cost for habitat: $50/acre of habitat/year *(See Habitat Costs text box in Pollinator Habitat section)* Loss of net income from cash crop on the wildlife habitat acres: $230/acre/year. *(See Cash Grain Profitability Calculation text box in Crop Rotation section).* Reduce this number if planting on less-productive acres. $30/acre/year cost for the acreage of the habitat, for extra time and hassle in field operations (tillage, spraying, and harvesting) to maneuver around the area. (7)	$30/acre/year on **total farm acres**; hunting lease price for exclusive right to hunt entire farm. (Range $10-$60 per acre) (6) $8.20/acre/year gain in fertilizer value of soil by saving 95% of 4.1 tons/acre/year from soil erosion if habitat is on 10% of cropland acres. This amount applies to **total farm acres.** *(See Value of Saving Soil text box*; 3) Benefit to society: approximately $19/acre/year gain in water quality value of soil by saving 95% of 4.1 tons/acre/year of soil from erosion if habitat is on 10% of cropland acres. This amount applies to **total farm acres**. (*See Value of Saving Soil text box*; 3).	Potential income gain and costs avoided: + Potential income loss and costs to pay: - Your judgment on value to your farm of qualitative benefits: + Value to society or environment: + Add up the total net value per acre per year: Multiply by a time frame (5 years? 10 years?) Total value over time:

References:

(1) **Earning Additional Income Through Hunt Leases on Private Land**. Craig Harper, Charles Dixon, Paul Jakus, and Alan Barefield. University of Tennessee Agricultural Extension Service, publication #PB1627. https://utextension.tennessee.edu/publications/Documents/PB1627.pdf (accessed 8/21/13).

(2) **Deer Hunting on Private Land in Kansas, Iowa, and Missouri.** Mid-America Hunting Association. www.magba.com/deerhunting.html (accessed 8/21/13).

(3) **A Landowner's Guide to Prairie Conservation Strips**. The Leopold Center for Sustainable Agriculture, Iowa State University. www.leopold.iastate.edu/sites/default/files/pubs-and-papers/2013-08-landowners-guide-prairie-conservation-strips.pdf (accessed 8/21/13).

(4) **Field Borders for Wildlife**. 2013. Virginia Department of Game and Inland Fisheries. www.dgif.virginia.gov/habitat/landowners/infosheets/field-borders.asp (accessed 8/21/13).

(5) **Enhancing Wildlife Habitat on Farmlands.** 2002. Marja H. Bakermans and Amanda D. Rodewald. The Ohio State University Extension, publication #W-14-2002. http://ohioline.osu.edu/w-fact/0014.html (accessed 8/21/13).

(6) **Prices for Leasing Hunting Property.** 2011. Discussion thread on Quality Deer Management Association Forum. www.qdma.com/forums/archive/index.php/t-42639.html (accessed 8/21/13).

(7) **Economic and Environmental Costs and Benefits of Living Snow Fences: Safety, Mobility, and Transportation Authority Benefits, Farmer Costs, and Carbon Impacts**. February 2012. Gary Wyatt, University of Minnesota Extension; Minnesota Department of Transportation Research Services. www.lrrb.org/media/reports/201203.pdf (accessed 8/12/13).

Further Resources:

Farmlands and Wildlife: Pennsylvania State University, College of Agricultural Sciences. http://pubs.cas.psu.edu/FreePubs/pdfs/agrs104.pdf
This manual emphasizes the importance of agriculture in maintaining habitat for wildlife. It is also intended as a guide to farmland wildlife, habitat management methods and their benefits, methods of wildlife damage control, sources of financial assistance for habitat projects, and additional educational resources.

Organic Certification

Any or all of the practices in this publication can be part of an organic farm operation. The important aspects of crop rotations, soil fertility management, and water quality management are all mandatory for an organic farmer.

What makes a farm USDA Certified Organic, and thus qualifies the farmer to receive price premiums for farm products in the marketplace, is the use and documentation of production practices specified by the requirements of the USDA's National Organic Program (NOP) (1). Following NOP-specified practices, developing a record-keeping system to document all practices on the farm, paying certification fees, and undergoing an annual inspection by a certified inspector is how farmers achieve organic certification (2).

One of the most daunting barriers to organic cropping conversion is the three-year transition period usually required before the land can be certified. The transition period can be a difficult time for a producer to be profitable. She or he has to spend time creating an organic farm plan and interacting with the certifying agency. Converting farmland to an organic management system can cause unexpected challenges in the form of disease, insect, and weed pressure if chemical methods of controlling those are suddenly withdrawn. Eventually the system re-balances and those problems diminish, but that's why there is a three-year transition period: it takes some time to work out the system.

An organic farmer can't access the organic price premiums during the transition period, so for that period there may be lower yields but not yet the organic premium prices for the farm's products; although there are some niche markets such as non-GMO (non-genetically modified organisms) that farmers can sell to during the transition. Some farmers do a gradual transition; for instance, a field at a time to organic production (2). This strategy can reduce the risk of no or low whole-farm profits during the transition phase, but it comes with its own costs of maintaining buffer areas between the organic and conventional fields, and extra procedures during and after harvest to make sure that none of the conventional crop gets mixed in with the organic.

Size and potential sales volume of a future organic farm are also factors to consider. Financial record collection and analysis for organic farms in Minnesota shows that from 2006 to 2010, organic farms that could generate at least $100,000 per year in sales were generally more profitable than smaller organic farms, although there was much variation from year to year (3). Organic farms average about 33% fewer acres than conventional farms, and require more management time per acre and more kinds of equipment *(see Organic Costs text box)*. It's important in a farm transition plan to make sure that the future organic farm has the right size and production capacity to give the farmer a reasonable chance to make it work, both financially and in terms of time management (*see Organic Profits text box*).

If part of the legacy that you want for your land is to have it farmed organically, then it is important that your farm transition plan recognizes the particular challenges of organic agriculture. It is very difficult for an organic farmer to deal with an annual cash rent situation or a short-term lease, because of the large investment of money, labor, and management time they need to make the transition to certified organic production. Organic farmers typically need a lease term of at least five years, and even longer would be better. If the land is not already certified organic and must undergo the three-year transition period to organic, then the new farmer would greatly benefit from a stepped rent arrangement with lower payments during the transition period. In a sale arrangement, lower payments in the first few years would be beneficial for giving the farmer the "breathing room" needed to complete the three-year organic transition period and become profitable.

Organic Certification			
	- Column	**+ Column**	
Qualitative Benefits of the Practice	**Cost of Implementation and Potential Income Loss**	**Potential Income Gain and Reduced/Avoided Costs**	**Your Judgment: Value Per Acre of This Practice on Your Land**
Reduced pesticide (insecticide, herbicide, or fungicide) use Reduced synthetic nitrogen fertilizer use Manure use benefits of building soil organic matter Crop rotation benefits of reduced soil erosion and reduced water runoff Guarantees pasture access for dairy cattle Buffer strip requirements generate wildlife habitat **The numbers in this table are broad estimates, and you should adjust them for your farm's conditions.**	Organic certification net costs: $1.60/acre *(See Certification Costs text box)* Higher management time, complexity cost, and machinery ownership cost over conventional agriculture: $117/acre *(See Organic Costs text box)*	Average net return from established organic cropping system with four-year rotation: $470/acre/year (*See Organic Profits text box*) $8.60/acre/year gain in fertilizer value of soil by saving 4.1 tons/acre/year from soil erosion; cumulative over years (*See Value of Saving Soil text box in Crop Rotation section*) Benefit to society: approximately $20/acre/year gain in water quality value of soil by saving 4.1 tons/acre/year of soil from erosion (*See Value of Saving Soil text box in Crop Rotation section*) $15.70/acre/year of nitrogen, phosphorus, potassium, and sulfur for each 1% of soil organic matter; it takes about a decade of regular manure application to raise the SOM by 1%. *(See Value of Soil Organic Matter textbox in Soil Fertility Management section)*	Potential income gain and costs avoided: + Potential income loss and costs to pay: - Your judgment on value to your farm of qualitative benefits: + Value to society or environment: + Add up the total net value per acre per year: Multiply by a time frame (5 years? 10 years?) Total value over time:

References:

(1) **National Organic Program (NOP). USDA Agricultural Marketing Service.** www.ams.usda.gov/

(2) **Minnesota Guide to Organic Certification.** 2007. Jim Riddle and Lisa Gulbranson. http://conservancy.umn.edu/bitstream/51829/1/MN_Guide_to_Organic_Certification.pdf (accessed 8/27/13).

(3) **2010 Organic Farm Performance in Minnesota.** 2011. Dale Nordquist and Meg Moynihan. Minnesota Department of Agriculture. www.mda.state.mn.us/~/media/Files/food/organicgrowing/organicperformance2010.ashx (accessed 8/23/13).

Further Resources:

Midwest Organic and Sustainable Education Service (MOSES).
www.mosesorganic.org/
Collection of fact sheets on organic transition and certification process, sample forms and budgets, resource directory, online organic classified ads, online bookstore with many titles relevant to organic and sustainable farming.

Organic Agriculture. Minnesota Department of Agriculture.
www.mda.state.mn.us/food/organic.aspx
Information and tools for Minnesota organic farmers, some of which would be useful to farmers in other states; including cost-share application forms, lists of accredited certifying agencies, Minnesota organic farm directory, scholarships, financial reporting, Driftwatch registry, and specific items like "No Spray" signs.

Organic Agriculture Program. Iowa State University Extension.
http://extension.agron.iastate.edu/organicag/
Iowa field day and conference information; general information on certification and production; research reports; National Organic Program standards; information on suppliers of organic farm inputs and buyers of organic products.

Organic Farming. Appropriate Technology Transfer for Rural Areas, National Center for Appropriate Technology. https://attra.ncat.org/organic.html
Collection of informational fact sheets on organic field crop, livestock, and horticultural crop production; certification and marketing; the transition to organic; and explanation of National Organic Program guidelines.

Organic Risk Management. 2010. Editors: Kristine M. Moncada and Craig C. Sheaffer. www.organicriskmanagement.umn.edu/ (accessed 8/27/13)
Extensive research-based guide to organic crop production and management, including chapters on crop rotation; soil health and fertility; weed biology and management; transitioning to an organic system; organic corn, soybean, small grain, and forage production; cover crops; and alternative crops. Useful for non-organic farmers, too; there is a lot of good basic agronomic information in this resource.

Certification Costs

Certification costs involve several different types of fees: application fee, annual renewal fee, assessment on annual production or sales, and inspection fee (1). Since some of the cost depends on gross annual production or sales, costs per acre can vary greatly depending on the value of the crop grown.

This example uses certification cost figures from the Minnesota Crop Improvement Association (2); but note that certifying agencies vary in their charges. The example assumes a U.S. Midwest (MN, WI, or IA) organic farm size average of 190 acres and gross annual sales average of $129,000 (3).

Base certification fee:	$325	
Annual membership:	$50	
Inspection fee:	$150	(assuming 2 hours at $75/hour)
% of gross sales:	$645	(0.5% of $129,000 in sales)
TOTAL:	$1,170	total certification cost for the farm.

The USDA offers 75% reimbursement of organic certification costs once a farm is certified (1).

- $1,170 x 0.25 = $292.50 certification cost after 75% reimbursement
- $292.50 total certification cost / 190 acres = $1.53/acre (round up to $1.60/acre)

References:

(1) FAQ: Becoming a Certified Operation. 2012. USDA, National Organic Program. www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateN&navID=NOPFAQsHowCertified&topNav=&leftNav=NationalOrganicProgram&page=NOPFAQsHowCertified&description=FAQ:%20%20Becoming%20a%20Certified%20Operation&acct=nopgeninfo

(2) Organic Fee Schedule and Scale of Sanctions. 2011. Minnesota Crop Improvement Association. www.mncia.org/assets/documents/pub/organic/Organic_Fee_Schedule_and_Scale_of_Sanctions.pdf (accessed 8/23/13).

(3) **Farms, Land Use, and Sales of Organically Produced Commodities on Certified and Exempt Organic Farms: 2008**. In *2008 Organic Producers Survey*. USDA National Agricultural Statistics Service. www.agcensus.usda.gov/Publications/2007/Online_Highlights/Organics/organics_1_01.pdf (accessed 8/23/13).

Organic Costs

Certified organic agricultural production systems are more complex than conventional corn and soybean production. Organic farmers need to have an organic farm plan that documents the fertilizers, manure, or any other substances applied to every field, every year. They need to document seed lots planted, keep logs of every operation done to every field, and document harvested crops with enough detail that every crop can be traced back to the field it came from (1). Organic farmers need to manage long rotations; and planning good rotations is a very complex task that requires time and thought (2). Because they are growing more types of crops, organic farmers need more types of planting and harvesting equipment. Because they are using machinery instead of herbicides for weed control, they need more types of tillage, cultivation, and other weed-control equipment. Reliance on machinery for weed control requires careful timing of field operations, and sometimes that's not possible due to weather. As a result, another potential cost is yield reduction due to weeds getting ahead of the crop (3). Organic farms also tend to involve livestock to a greater degree than conventional cash grain farms, which adds to the complexity of managing the whole system.

These background costs of machinery ownership and maintenance, as well as management of complex systems, are difficult to capture in an enterprise budget. Enterprise budgets for crop production generally document only the costs of field operations (4). Analysis of long-term organic and conventional crop production systems in Minnesota shows that the requirement for more types of machinery in organic systems can limit the size of organic farms (3).

The following example is a rough estimate of the amount of cost per acre that applies to organic farms as a result of the factors that tend to restrict the size of organic farms. The total cost of complexity, machinery ownership, and background management on organic farms is not well documented, so as a stand-in for those costs, this example uses Agricultural Census data on the average size of organic farms and of all farms (5,6). A key assumption is that the *total* time spent on managing the average farm is the same, whether a farm is organic or conventional. With that assumption, the difference in average farm size can be used to estimate the extra costs of being organic.

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Organic Costs, continued (pg. 2)

- Average size of all farms in MN, WI, and IA; 2008 data: 287 acres
- Average annual return to management from conventional corn & soybean production: $230/acre (7)
- Valued at a management cost of $40/hour *(*see note, below):* $230/acre / $40/hour = 5.75 hours/acre of management time for conventional corn and soybean production.
- 5.75 hours/acre x 287 acres average farm size = 1,650.25 hours per farm (round to 1,650 hours)

**Note: The $40/hour figure for management is an arbitrary figure chosen for this calculation, and the hours spent per acre and per farm are estimates that include not only actual management time, but also costs relating to yield loss due to untimely field operations, equipment ownership costs, and other unspecified costs associated with complexity of the organic farming system.*

Now, working the calculation in reverse:

- Average size of organic farms in MN, WI, and IA; 2008 data: 190 acres
- 1,650 hours/farm / 190 acres average organic farm size = 8.68 hours/acre of management time for an organic farm
- 8.68 hours/acre x $40/hour = $347.20/acre management charge for organic farms.
- $347.20/acre organic - $230/acre conventional corn and soybean = $117/acre higher background management + complexity + machinery ownership cost for organic farms.

This calculation returns very similar results if nationwide figures are used. Nationwide average size of all farms is 418 acres, and nationwide average size of organic farms is 280 acres. Difference in management cost per acre using national figures = $114/acre higher for organic farms.

Delbridge et al., using financial data from Minnesota organic farms, calculated that machinery ownership costs averaged about $3.30/acre higher for organic farms than for conventional corn and soybean farms (3).

continued on next page …

Organic Costs, continued (pg. 3)

Thus, the cost of background management + complexity on organic farms:
$117/acre - $3.30/acre machinery ownership cost = $113.70/acre

References:

(1) **Minnesota Guide to Organic Certification.** 2007. Jim Riddle and Lisa Gulbranson. http://conservancy.umn.edu/bitstream/51829/1/MN_Guide_to_Organic_Certification.pdf (accessed 8/27/13).

(2) **Crop Rotation on Organic Farms: A Planning Manual**. 2009. Editors: Charles L. Mohler and Sue Ellen Johnson. Natural Resource, Agriculture and Engineering Service; published by Sustainable Agriculture Research and Education (SARE). www.sare.org/Learning-Center/Books/Crop-Rotation-on-Organic-Farms (accessed 8/25/13).

(3) **A whole-farm profitability analysis of organic and conventional cropping**. 2013. Timothy A. Delbridge, Carmen Fernholz, Robert P. King, William Lazarus. *Agricultural Systems*. http://dx.doi.org/10.1016/j.agsy.2013.07.007

(4) **Organic Crop Production Enterprise Budgets.** July 2011. Craig Chase, Kathleen Delate, Ann Johanns. Iowa State University. www.extension.iastate.edu/agdm/crops/html/a1-18.html (accessed 8/23/13).

(5) **Farms, Land Use, and Sales of Organically Produced Commodities on Certified and Exempt Organic Farms: 2008**. In 2008 Organic Producers Survey, USDA National Agricultural Statistics Service. www.agcensus.usda.gov/Publications/2007/Online_Highlights/Organics/organics_1_01.pdf (accessed 8/23/13).

(6) **Farms, Land in Farms, and Livestock Operations 2008 Summary**. February 2009. USDA National Agricultural Statistics Service. http://usda01.library.cornell.edu/usda/nass/FarmLandIn//2000s/2009/FarmLandIn-02-12-2009.pdf (accessed 8/23/13).

(7) **What does it take to earn a living on the farm?** April, 2013. Gary Hachfeld, University of Minnesota Extension. http://swroc.cfans.umn.edu/prod/groups/cfans/@pub/@cfans/@swroc/documents/asset/cfans_asset_440374.pdf (accessed 8/06/13)

Organic Profits

This example uses organic crop enterprise budgets from Iowa State University Extension, and assumes a four-year crop rotation: corn – soybean – oats + alfalfa – alfalfa. These budgets assume a 17% yield reduction for organic corn and a 20% yield reduction for organic soybean, compared to conventional crop yields (1).

The amount of yield reduction due to organic production is hotly debated. Research at the University of Minnesota from 1993 to 1999 with land that had completed the three-year transition period showed yield reductions of 7% for corn and 21% for soybean compared to a high-input conventional system (2). Depending on the length of time the organic system has been in place, the management skill of the farmer, weather conditions during the growing season, and other factors; organic crop yields may sometimes equal or even outpace conventional yields.

University of Minnesota researchers looked at 22 studies from across the United States and found that organic corn yields ranged from 59% to 108% of conventional corn yields, with a median of 86%. Organic soybean yields ranged from 50% to 113% of conventional soybean yields, with a median of 92% (3). The Iowa budgets used here, therefore, are based on fairly middle-of-the-road estimates for an organic farm that has finished the three-year transition period.

Net returns to management (costs for labor, equipment operations, seed, fertilizer, etc. to plant, tend, harvest, and dry the crop have been deducted; as well as the cost of land rent per acre):

Organic Corn:	$988/acre
Organic Soybean:	$478/acre
Organic Oat + Alfalfa:	$228/acre
Alfalfa:	$191/acre

four-year rotation average: $471.25/acre (round to $470/acre)

continued on next page …

Organic Profits, continued (pg. 2)

Note: It may look very tempting to just raise organic corn and soybeans for those high per-acre returns, and not do the 4-year rotation. However, a two-year corn and soybean rotation is not a certifiable organic system. Longer rotations are required as part of an organic farm plan (4).

References:

(1) **Organic Crop Production Enterprise Budgets.** July 2011. Craig Chase, Kathleen Delate, Ann Johanns. Iowa State University. www.extension.iastate.edu/agdm/crops/html/a1-18.html (accessed 8/23/13).

(2) **Long-Term Effects of Crop Management: Yield.** April 2004. Results from the VICMS study at the Southwest Research and Outreach Center, Lamberton, Minnesota. Paul Porter, Dave Huggins, Catherine Perillo, Steve Quiring, and Kent Crookston. University of Minnesota. http://swroc.cfans.umn.edu/prod/groups/cfans/@pub/@cfans/@swroc/documents/asset/cfans_asset_236359.pdf

(3) **Productivity, economics, and soil quality in the Minnesota variable-input cropping systems trial.** 2013. Coulter, J. A., Delbridge, T. A., King, R. P., Allan, D. L., and Sheaffer, C. C. Online. Crop Management doi:10.1094/CM-2013-0429-03-RS. www.plantmanagementnetwork.org/pub/cm/symposium/organic/farm/variable/variable.pdf (accessed 8/27/13).

(4) **Minnesota Guide to Organic Certification.** 2007. Jim Riddle and Lisa Gulbranson. http://conservancy.umn.edu/bitstream/51829/1/MN_Guide_to_Organic_Certification.pdf (accessed 8/27/13).

Summary: Total Value of Conservation and Sustainable Agriculture Practices

Use this summary worksheet to calculate the total net value to your farm from all of the practices you intend to include in a farm transition plan. From the Cost/Benefit table for each practice, copy the following numbers into the corresponding columns below:

- The total net value of each practice per acre per year
- That total net value for each practice, multiplied by a time frame (5 or 10 years)

Then, add up the values for all of the practices you chose both on a per-acre per-year basis, and on a five- or ten-year basis, and enter those totals at the bottom of each column.

Value of Sustainable Practices Summary		
Practice	Net Value (Cost) per acre per year	Net Value (Cost) per acre over time frame selected, 5 or 10 years
Crop Rotation		
Manure Management		
Cover Crops		
Agroforestry		
Wetland Restoration		
Alternative & Specialty Crops		
Perennial Forage		
Pollinator & Beneficial Insect Habitat		
Wildlife Habitat		
Organic Certification		
TOTAL Net value of all practices:		