Financial Feasibility of Using Shelterbelts for Swine Odor Mitigation

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Funded by: National Agroforestry Center; CSREES

USDA National Research Initiative Integrated Programs
USDA NRI Grant #: 0188753

1) Main Objectives:

- To assess the farm level financial nature of planting & maintaining odor mitigation shelterbelt systems over a 20 year planning horizon for 4 different model swine finishing farms.
- To compare shelterbelt costs with known figures (WTP) on pork producer expenditures strictly for odor control.
- To assess the effect of current federal cost share programs (specifically Environmental Quality Incentive Program) on reducing the financial burdens to swine producers.

2) Key Analytical Assumptions:

- The farms are located in central Iowa. Summer winds = S, SE, and SW; Winter winds = N and NW.
- Each shelterbelt design assumes the use of both deciduous & coniferous trees species which are appropriate for the geographic location of each swine farm.
- Two planting stock cost scenarios were used (See Table 2):
  - A low seedling price for 1 to 2 year old deciduous & conifer trees = $0.50 per plant.
  - A high price for older (6 + year) ball & burlap tree & shrub stock = Ave. $9.59/ plant
    - Note: Each model facility has its own facility/shelterbelt specific "high-price".
- Each finishing farm has 2.8 turns/year of animal stock; animal mortality not considered.

3) Financial Models:

$$PVC = PVSB^{SP} + PVSB^{E} + PVSB^{M} \quad [1]$$

$$PVCGOV = PVSB^{SP} + PVSB^{E} + PVSB^{M} - PV^{EQIP} \quad [2]$$

The total discounted cost for each scenario is converted into equivalent annual value (EAV) of costs using a capital recovery factor (CRF):

$$EAV_K = PVC * CRF \quad [3]$$

$$CRF = [\, i(1+i)^N] \,/\, [(1+i)^N - 1] \quad [4]$$

EAV divided by # (pig)'s = **$/ PIG** [5]

Where:
- **PVC** = Present value of total costs;
- **PVSB^{SP}** = Present value of shelterbelt site prep costs (e.g. tilling)
- **PVSB^{E}** = Present value of shelterbelt establishment (e.g. planting stock, planting, etc.);
- **PVSB^{M}** = Present value of shelterbelt maintenance (e.g. weed management, irrigation, tree/shrub replacement, etc.)
- **K** = 1 Without government assistance; 2 With government assistance
- **CRF** = Capital Recovery Factor, i = 7% annual real discount rate, N = number of years in the evaluation.

Introduction

As research suggests (e.g. Lin et al, 2006; Malone, 2004; Tyndall, 2003) if shelterbelts are utilized appropriately (proper species, scale, location, etc.), they can play a significant incremental role within a "suite" of odor mitigation strategies. Collectively, these strategies reduce odor nuisance risk for all stakeholders in rural air quality. Yet despite the apparent bio-physical promise of shelterbelts for odor mitigation, very little is known about the financial requirements for installation (e.g. site preparation and planting) and long term management of these shelterbelt systems. Since the long term use of shelterbelts represents an "out of pocket" expense for most producers, the use of shelterbelts is ultimately contingent upon the financial feasibility of the technology at the farm level. **The Results** of this analysis show that the planting and long term maintenance costs of shelterbelts for odor mitigation are indeed within the range of acceptable expenses for odor management.

CONCLUSION – Shelterbelts are an inexpensive technology, in most cases well below swine producer willingness to pay for odor management allowing financial room for multiple odor strategies. Cost share support (e.g. EQIP) may be critical.

Table 1. Model Farm and shelterbelt system details.

	Farm A: Full confinement facility	Farm B: Full confinement facility	Farm C: Full confinement facility	Farm D: Hoop Barn Facility
Annual Pig Production	10,500	2,025	1,600	1,000
Building Ventilation Type	Tunnel	Mechanical	Natural	Natural
Manure Storage	Above ground concrete	Above ground concrete	Earthen manure pit	Solid/bedding
Farm Acreage	5.91	1.38	0.90	0.83
Number of Trees Planted (6 feet between trees)	950	325	178	122
Number of Shrubs Planted (4 feet between shrubs)	214	141	51	145

4) Results:

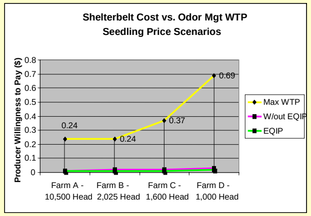
- Across all model facilities and over a 20 year period the average establishment/ maintenance costs associated with the shelterbelts range from $0.01 to $0.03/ pig for seedling price scenarios and $0.15 to $0.31 for the high price (RARR @ 7%). See Table 2.
- When EQIP programming is factored in, the average costs fall to a range of $0.01 to $0.13/ pig.
- A sensitivity analysis (RARR's of 6% and 8%) showed that the costs are not unusually affected by differing discount rates.

Table 2. Cost breakdown per pig produced at 7% Real Alternative Rate Return for each model farm. The weighted average high prices are listed for each model farm. PVC = Present Value Cost and EAV = Equivalent Annual Value. Costs in 2004 $ US.

Model Farm	Seedling Price: A	B ($0.50/tree)	C	D	High Price: A $10.26 /tree	B $12.11 /tree	C $6.88 /tree	D $9.12 /tree
PVC	$1,498	$640	$448	$299	$16,446	$8,339	$3,440	$3,058
EAV	$0.01	$0.02	$0.02	$0.03	$0.15	$0.31	$0.27	$0.29
EQIP[1]								
PVC^{GOV}	$1,052	$373	$316	$261	$9,302	$3,300	$993	$2,370
EAV^{GOV}	$0.01	$0.01	$0.01	$0.02	$0.08	$0.13	$0.07	$0.23

[1] EQIP pays 75% cost share for planting stock and installation

It is difficult to determine if these costs are high or low relative to other singular odor mitigation management approaches because such cost information is scarce. Therefore the calculated costs for shelterbelts have been compared with reported swine producer revealed willingness to pay (WTP) for odor mitigating technology as detailed by the USDA (USDA, 1996).



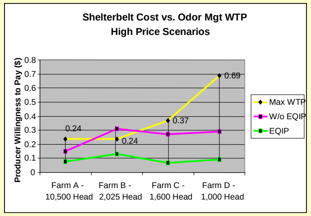
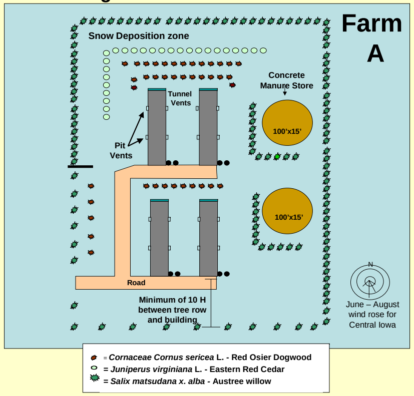
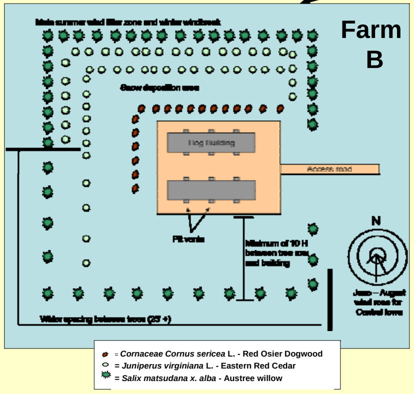
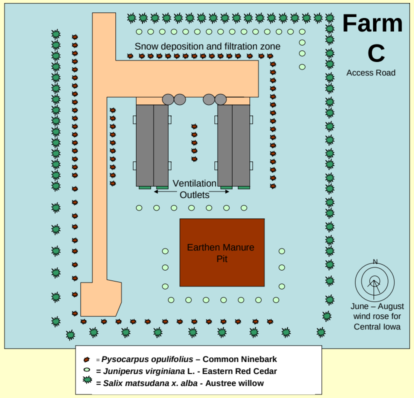


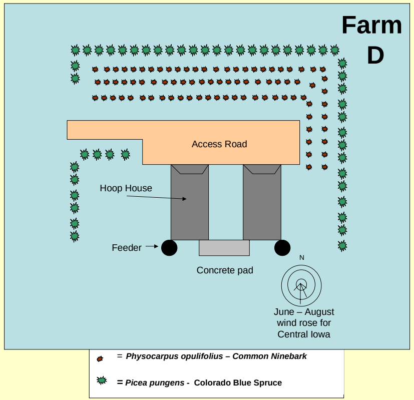
Figure 1 . Displays the revealed odor management WTP per pig produced for farms similar in scale to the model farms and the cost differential after comparing the costs of the shelterbelts to the WTP. All lines below the yellow Max WTP represents "money left over" to spend on multiple odor management strategies. All costs associated with EQIP are well below the max WTP line.

Note: Diagrams not to Scale.









Shelterbelts as Part of the ISU Odor Control Demonstration Project

Literature Cited:

Lin et al. 2006. Influence of windbreaks on livestock odor dispersion plumes in the field. Agriculture Ecosystems and Environment. Article in Press (2006).

Tyndall, J.T., 2003. A Socio-Economic Analysis of the Use of Shelterbelts for Swine Odor Mitigation. PhD – Dissertation – Iowa State University, 2003.

Malone, G. et al. 2004 . Efficacy of Trees to Capture Emissions from Tunnel Ventilated Poultry Houses. Proceedings to International Poultry Scientific Forum. Jan. 27, 2004.

United States Department of Agriculture (USDA). 1996. Economic Research Service, Natural Resources and Environment Division. Manure Management by U.S. Pork Producers in 1992. AREI UPDATES, no. 7, Aug. 1996.