Syndicat des
producteurs de porcs
de la Mauricie

COST-BENEFIT ANALYSIS OF FARMSTEAD SHELTERBELTS

INTRODUCTION

Establishing shelterbelts around hog barns has become an increasingly popular means of mitigating odor and cohabitation problems in eastern Canada. Furthermore, shelterbelts can help reduce heating and snow removal costs in addition to providing added income for farmers through the sale of timber or fruit. Shelterbelts that are well designed will also embellish the surroundings while enhancing biodiversity and playing a role in reducing greenhouse gas emissions. However, the establishment and maintenance of a shelterbelt entail certain costs, in addition to reducing farmer's income through the loss of a portion of tillable acreage.

This technical leaflet was developed for agricultural extension consultants who plan shelterbelts around hog barns and should be used to verify, for six different shelterbelt models, if the net outcome will be profitable to the farmer and, if so, what will be the recovery timeframe.

DESCRIPTION OF SHELTERBELT MODELS

The six models proposed in this study are those that are recommended for use in Quebec. They are made up of one, two, or three rows of trees or shrubs of various heights between 30 and 60 cm at the time of planting. However, the costs and revenues associated with each model have been established based on the use of higher trees (1.5 to 2 meters). The hedges have a length of 700 meters and are established over a black plastic mulch, which is a technique that is widely used in Quebec.

DESCRIPTION OF HOG FARM REQUIRING PROTECTION

The hog farm to be protected is a typical farrow-to-finish operation with 150 sows that produce 2,924 hogs annually, an average inventory of 915 grower-finisher hogs, a 766.5 m^2 farrowing barn and a 945 m^2(1) fattening building. A 300 m long lane connects the livestock barns. Heating costs were estimated at $10,000/year.

MAIN ECONOMICAL CRITERIA AND PRINCIPALS

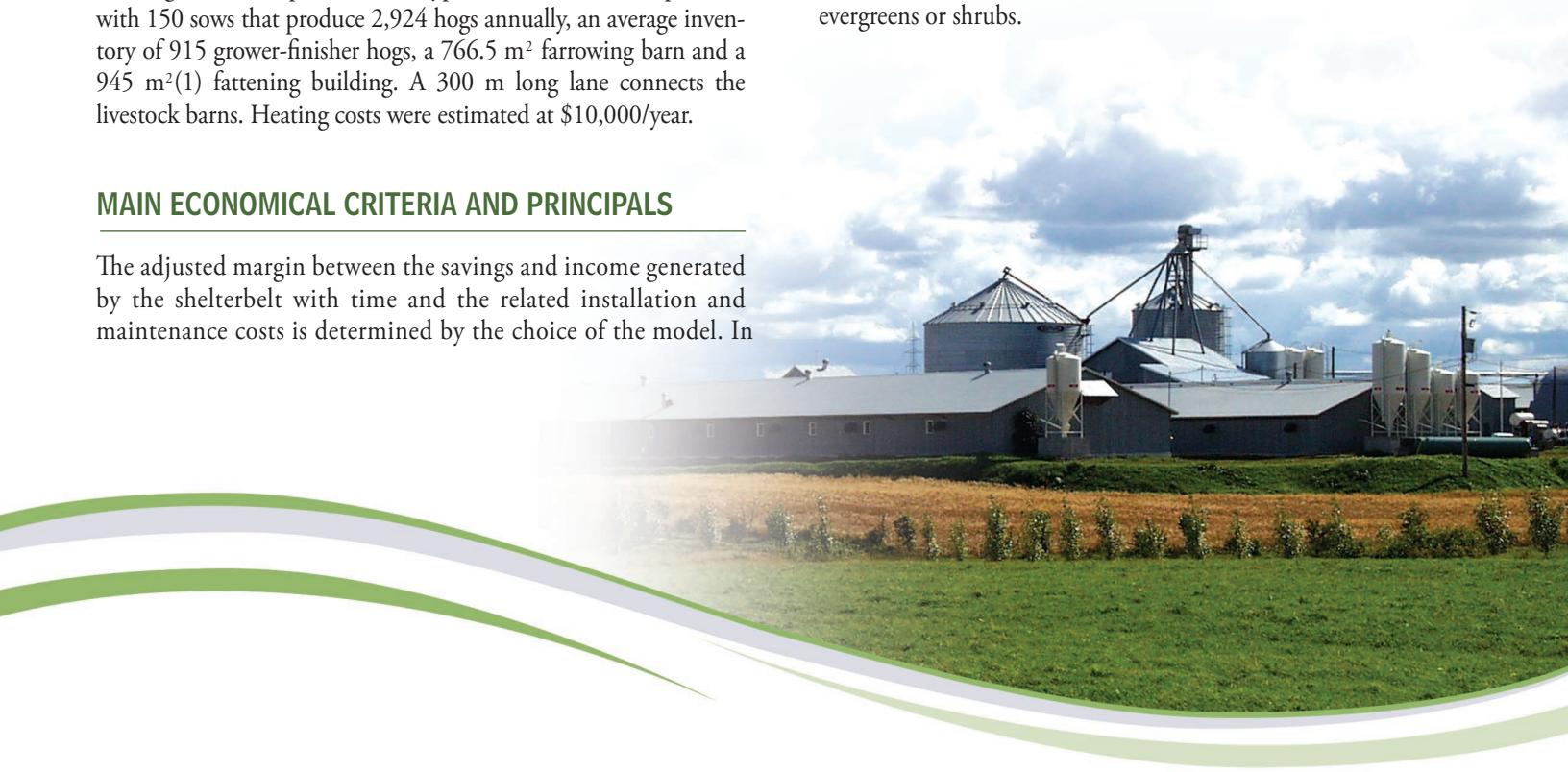
The adjusted margin between the savings and income generated by the shelterbelt with time and the related installation and maintenance costs is determined by the choice of the model. In order to estimate these parameters, the model takes into account the inflation rate based on the consumer price index, the opportunity cost related to the cost of money and an adjustment rate designed to translate the margin into constant dollars for any given reference year. These rates are based on the Bank of Canada's Data Analysis for 1995-2005.

REDUCTION OF BUILDING HEATING COSTS

A well-located shelterbelt will generate significant reductions in heating costs(2). These savings depend on the height of the hedge and, therefore, on the age of the plantation. Cost reduction percentages have been determined to be 0% for hedges that have been in place for 10 years or less, 2.5% for hedges that have been in place between 10 and 20 years, and over 10% for hedges ranging from 20 to 40 years of age. These proportions apply only in the case of shelterbelts that include at least one row of evergreens. In the case of shelterbelts made of hardwoods only, the cost reduction equals 40% of the above-mentioned percentages. Additional cost reductions are applied to poplars, a species that exhibits rapid vertical growth.

REDUCTION OF SNOW REMOVAL COSTS

A shelterbelt that is strategically located will also generate cost reductions related to snow removal(3). Savings related to snow removal operations will also vary according to the height (and thus, the age) of the hedge. Reduction percentages have been established at 0% for hedges that have been in place for 5 years or less, 10% for hedges that have been in place between 5 and 10 years, and 20 % for hedges ranging from 10 to 40 years of age. These proportions apply in the case of shelterbelts that include at least one row of evergreens or shrubs.



INCOME FROM TIMBER

The volumes of harvested timber have been calculated based on timber tables(4) and measurements made on shelterbelts in the Mauricie region. The price of timber used is the market price in June 2006 in that region(5). Most of the timber harvested is used to produce lumber, except for branch wood that is sold as firewood. Net revenues were calculated by multiplying wood volumes by the relevant price and by 0.35 to account for operating costs. Income from timber can be generated when the shelterbelt reaches 20 years of age for models containing hybrid poplars, and 40 years of age for models containing hardwoods.

INCOME FROM SMALL FRUIT

The establishment of fruit shrubs in hedges can generate added income for farmers. The total revenue from fruit is calculated by multiplying the yield by the market price of the American elder which have been established at 1.25 kg/plant and $800/ton(6), respectively. This figure is quite conservative because it was calculated based on shelterbelts where the shrubs had possibly not reached their maximum yield potential. Net income was calculated by multiplying total revenue by 0.2 in order to account for picking and marketing costs.

COSTS ASSOCIATED WITH LOSS OF TILLABLE ACREAGE

The costs associated with loss of tillable acreage increase as the hedges grow horizontally with time. The loss of income was established based on a typical corn-corn-soybean rotation(7). We calculated these costs for a surface obtained by multiplying the width of the hedge by its length and by 0.5 to account for the fact that the hedge will no doubt be located on a piece of land that would otherwise by used on half of its entire length.

IMPLEMENTATION AND MAINTENANCE COSTS

The establishment costs for all six models take into account planning, soil preparation, mulch installation (1.2 m in width) and planting as well as the grant awarded by the government (70%) through the Prime-Vert program(8). Maintenance costs include replacement of trees one year after planting, weed removal, protection from scavengers, shearing and pruning(9).

RESULTS AND DISCUSSION

Adjusted cumulative margins after 5, 10, 20 and 40 years, for all six models, are presented in Table 1. After 40 years, cumulative margins range from $35,000 and $40,000 for most shelterbelts, except for the model composed of hardwoods and fruit shrubs ($25,913) and the model composed of larger trees ($10,715). In the case of unsubsidized shelterbelts, the margin after 40 years is relatively unchanged since it is reduced by approximately $3,000, or 7%, only. In the sort run, the absence of a grant has a more significant impact, as is evidenced by the cumulative margins after 5 years, which are reduced respectively by $4,206 and $7,412 for shelterbelts established with and without the help of a grand.

A single row shelterbelt made of evergreens will produce a slightly lower cumulative margin, compared to that of a 2- and 3-row shelterbelt containing, in addition, hardwoods and harvestable poplars. However, the maintenance, harvesting and processing of timber produced by shelterbelts made of 2 and 3 rows will generate greater economical activity. Moreover, it is easier to ensure the sustainability of protection afforded by the 2- and 3-row models, compared to that of the single row models. Lastly, the more plants there are in a shelterbelt, the greater the contribution to biodiversity and carbon sequestration.

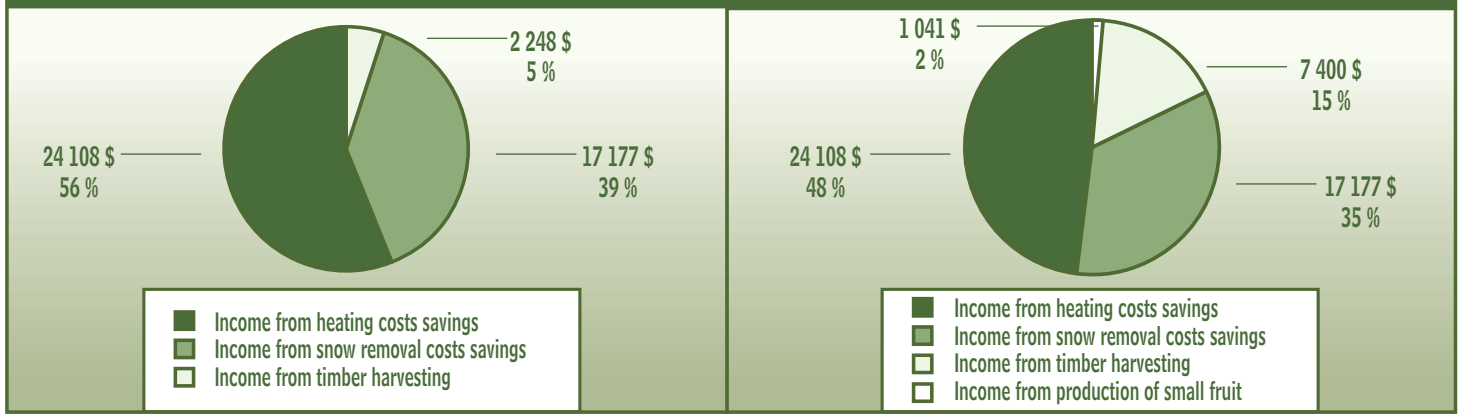
For all models, the recovery timeframe is between 10 and 20 years, except for the model where larger trees are planted. For this model, the recovery timeframe is 36 years due to the higher costs associated with establishing the hedge.

TABLE 1 – ADJUSTED CUMULATIVE MARGINS IN VARIOUS PERIODS FOR THE 6 MODELS PRESENTED

NUMBER OF ROWS	SPECIES	ADJUSTED CUMULATIVE MARGIN AFTER 5 YEARS ($)	ADJUSTED CUMULATIVE MARGIN AFTER 10 YEARS ($)	ADJUSTED CUMULATIVE MARGIN AFTER 20 YEARS ($)	ADJUSTED CUMULATIVE MARGIN AFTER 40 YEARS ($)	COST RECOVERY TIMEFRAME (YEARS)
1	SPRUCE, PINE OR CEDAR	-1 885	-677	6 873	35 756	11
1	HYBRID POPLAR AND SPRUCE	-2 351	-811	9 809	38 692	11
1	HARDWOODS AND FRUIT SHRUBS	-2 633	-1 920	3 884	25 913	14
2	HYBRID POPLARS/ SPRUCE, PINE OR CEDAR	-2 992	-1 688	9 408	38 291	13
2	HARDWOODS/ SPRUCE, PINE OR CEDAR	-3 239	-2 945	3 658	37 459	15
3	HYBRID POPLARS/ SPRUCE, PINE OR CEDAR/ HARDWOODS AND FRUIT SHRUBS	-4 206	-3 340	7 172	40 107	15
3	HYBRID POPLARS/ SPRUCE, PINE OR CEDAR/ HARDWOODS AND FRUIT SHRUBS (UNSUBSIDIZED)	-7 412	-6 545	3 967	36 902	19
3	HYBRID POPLARS/ SPRUCE, PINE OR CEDAR/ HARDWOODS AND FRUIT SHRUBS (LARGER TREES ARE PLANTED)	-33 599	-32 733	-22 220	10 715	36

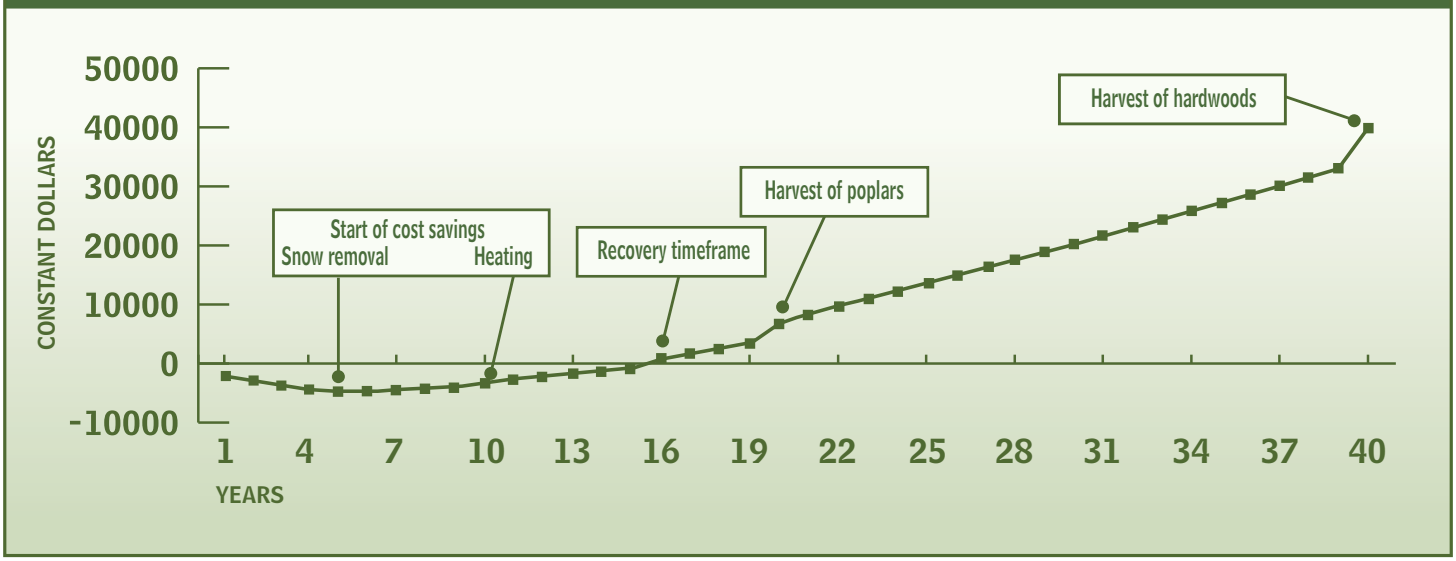
Models made up of a single row, including hardwoods, are those with the shorter cost recovery timeframe, mainly due to lower maintenance costs. Excluding the impact of the grant, the recovery timeframe increases from 16 to 19 years for the 3-row model. We analyzed in detail 2 of the proposed models to breakdown both costs and income: the single-row shelterbelt made of hybrid poplars and spruce, and the 3-row shelterbelt (first row made of hybrid poplars and spruce, second row made of evergreens and third row made of hardwoods and fruit shrubs). In the case of the first model made of alternating hybrid poplars and spruce, the income generated from heating costs savings are the highest (56%), followed by snow removal savings (39%), and timber harvesting (5%) (Figure 1). For the 3-row model, the income generated from heating costs savings (48%) and snow removal savings (35%) remain high, but the income generated from harvested timber is considerably higher (15%). Income generated from the sale of fruit is relatively low (2%).

FIGURE 1- BREAKDOWN OF ADJUSTED INCOME AFTER 40 YEARS FOR 2 SHELTERBELT MODELS



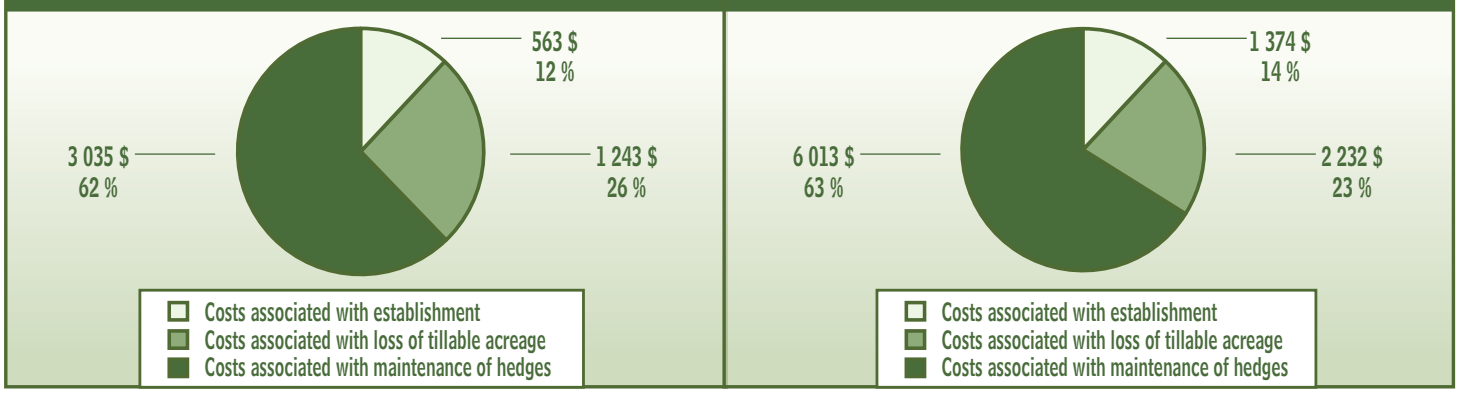
The impact of the various sources of income on the adjusted cumulative margin is outlined in Figure 2, after 5 years, the margin's rising gradient becomes positive, before the snow removal costs savings quick in. After 10 years, the gradient starts to increase significantly, as 10 years marks the beginning of heating costs savings. Harvested timber provides considerable income when the trees are cut down.

FIGURE 2 - EVOLUTION OF CUMULATIVE ADJUSTED MARGIN OVER 40 YEARS FOR 3-ROW MODEL



In the case of the single row model with alternating hybrid poplars and spruce, the costs associated with maintenance over a period of 40 years represent 62% of total costs, the remaining portion is attributable to the loss of tillable acreage (26%) and establishment (12%). These figures are substantially the same for the 3-row mode (Figure 3).

FIGURE 3- BREAKDOWN OF ADJUSTED COSTS AFTER 40 YEARS OF 2 MODELS OF SHELTERBELTS



CONCLUSION

Investing in the establishment of shelterbelts around hog barns will reap benefits after 10 to 20 years, except in the case of a hedge made of larger trees. In this case, establishment costs are quite high and the recovery timeframe is 35 years.

Reductions in heating and snow removal costs constitute the main source of income. For this reason, models including a row of evergreens generate higher adjusted margins (between $35,000 and $40,000 after 40 years). A hedge made of 3 rows (hybrid poplars,

spruce and hardwoods) will generate the highest adjusted margin and offers the added benefits of rapid protection due to the exceptional growth rate of poplars, as well as timber harvesting from poplars and hardwoods.

Shelterbelts established around hog barns can also reduce odours, dust and noise produced by the operations in addition to embellishing the surroundings, which is beneficial to harmonious cohabitation between hog producers and their communities. Furthermore, although shelterbelts have a beneficial impact on biodiversity and reduction of greenhouse gas emissions, both these criteria were omitted from our study because they are more difficult to quantify. However, they should nevertheless be considered when determining the composition and structure of the hedge. These environmental benefits are more readily attained when three rows are planted instead of just one, without penalizing the farmer in the medium run. With that being said, however, the farmer will require funding at the time of planting (which is precisely the purpose of the Prime-Vert program) and, if possible, during maintenance operations to ensure good quality timber is produced by the shelterbelt.

In collaboration with the ITA, La Pocatière Campus, the CEPAF will be developing a decision support tool in 2007 for consultants who wish to establish shelterbelts around farm buildings, fields and buffer strips. The tool will be designed to simulate the impact of various types of shelterbelts in multiple situations.

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3. Snow removal costs were calculated by Guy Beauregard, agronomist at the MAPAQ.
4. Honer, T.G. M.P. Her and I.S. Alemdag. *Metric timber tables for the commercial tree species of central and eastern Canada*, Service canadien des forêts, Information Report M-X-140, 1983.
5. Prices used are timber prices posted by buyers in June 2006 (Source: Patrick Lupien, personal communication).
6. Income generated by small fruit was established using data provided by the CEPAF for American elder after conducting a study on the use of forest produce in shelterbelts and buffer strips (to be published, 2007).
7. Costs associated with the loss of tillable acreage were calculated by Guy Beauregard, agronomist at the MAPAQ.
8. Establishment costs were calculated using a spread sheet developed by the CEPAF (Centre d'expertise sur les produits agroforestiers). Establishment costs for shelterbelts containing larger trees were also calculated for 2 models, based on Néri data (personal communication).
9. Maintenance costs were provided by the CEPAF tree maintenance services.

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MRC Maskinongé

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