A Net Present Value and Financial Feasibility Analysis of Converting from Plastic Pots to Degradable Paper Pots

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Abstract

This study estimates and compares the production costs and economic profitability of a greenhouse business adopting a sustainable floriculture production practice in their operation. We hypothesized that the adoption of this production system would result in increased profits for the business. Sustainable production practices that reduce or eliminate the use of plastic are very important in the floriculture industry due to increased concerns about plastic waste created by the industry, as well as increased oil and transportation costs. Using Net Present Value (NPV), financial feasibility and internal rate of return analysis, we determined that purchasing an Elleguard machine and converting to paper Ellepots instead of conventional plastic pots would be a profitable activity for this operation. We also compared the profitability of substrates, in terms of added value, and found that using the current substrate was the most profitable option. This study may provide greenhouse growers with a tool to help make better business decisions when considering a capital intensive addition to their operation.

INTRODUCTION

Sustainable floriculture production aims to reduce environmental degradation, maintain agricultural productivity, promote economic viability, conserve resources and energy and maintain stable communities and the quality of life (Krug et al., 2008). The production of greenhouse crops is very input intensive and requires the use of non-renewable resources for pesticides, fertilizers, growth regulators, heating, greenhouse glazing, and pots and packaging to make the crop uniform and consistent in quality (Lopez et al., 2008). These crops are often grown in non-recyclable, petroleum-based, plastic containers that are disposed of by consumers. Since most of the plastic containers are non-recyclable, this creates a significant landfill/waste issue for the horticulture industry (Evans and Hensley, 2004). Garthe and Kowal (1993) estimated that at least 408 million pounds of plastic were generated for use in the nursery and floriculture industry.

Due to increased concerns about the amount of landfill waste generated by plastic and pseudo-environmental consciousness related to high fuel prices, the floriculture industry has seen a rise in the use of biodegradable plastics, often called “green” products (Kale et al., 2007; Lubick, 2007). Biodegradable pots can be planted directly into the soil by the consumer, eliminating plastic waste as the pots will degrade naturally without affecting plant growth (Evans and Hensley, 2004). Most biodegradable containers are made of peat, paper or coir fibre, with peat containers being the most prevalent. Other examples include bio-resin, bio-fibre and compostable pots made of spruce fibres; sphagnum peat; wood fibre and lime; wheat and grain husks, predominately rice hulls; 100% recycled paper; non-woven, degradable paper; dairy cow manure; corn; coconut; sugar cane and straw (Rodda, 2008; Van de Wetering, 2008; White, 2009).
Ellepots

The Ellepot is a plant propagation and production system that utilizes “pots” made from degradable paper fabric wrapped around the growing substrate. The Ellegaard machine fills a round bottom-less paper sleeve with substrate by using an adjustable vacuum, which can adjust the density of the pot. Once filled, the sleeve resembles a long sausage which the machine then cuts into individual pieces. The pieces are then placed into reusable trays. Greenhouse growers who use Ellepots in their production systems indicate that there are many advantages including improved root development, more environmentally friendly and time conservation for landscapers (Wells, 2009).

Ellepots enable greenhouse growers to become more sustainable by reducing the waste created from the production and use of plastic pots. The trays that are used to transport the Ellepots are usually stackable and reusable and can be recycled. The ease of transplanting floriculture crops grown in Ellepots is a feature enjoyed by consumers, but especially by landscapers, in that they eliminate time spent transplanting and cleaning up, as well as decreasing the amount of plastic waste generated from the disposal of plastic pots.

Many believe that the floriculture industry should convert to more sustainable, environmentally conscious production and cultural practices without jeopardizing profitability and economic viability. In a recent survey, 65% of growers indicated that sustainability was important for the environment. Some 73% were recycling pots and greenhouse covering and 23% were using biodegradable pots (Hall et al., 2009). The objective of this study is to provide greenhouse growers with a tool to make better management decisions when considering an investment and to use Net Present Value (NPV), financial feasibility and internal rate of return analysis to determine whether adopting Ellepots will be profitable for interested greenhouse operation.

MATERIALS AND METHODS

Scenario

A medium-sized (0.8 ha), commercial greenhouse operation in the Midwest USA is interested in adopting a sustainable floriculture practice to replace the use of plastic pots. The sustainable practice will see the traditional 11.25 cm plastic pots replaced by the use of 90 mm Ellepots in order to reduce the amount of plastic waste generated by the business. The operation is interested in purchasing an Ellegaard machine to produce 130,000 Ellepots for annual and perennial bedding plant production. Conversion to Ellepots will require a significant capital investment in an Ellegaard machine, specialized paper and trays for the pots, and an air dryer. The grower will have the choice of using the substrate recommended by the manufacturer or the grower may continue to use their current substrate.

In Fall 2008, a face-to-face interview was conducted with a Midwest grower to examine barriers to the adoption of sustainable floriculture practices. Net present value analysis (NPV) was used to quantify the investment in a sustainable system, Ellepots, based on financial feasibility. Financial information was gathered based on face-to-face grower interviews and included the following: percent liability of the company; expected interest rate; cost of substrate; labour wage; current machine expenses; plastic pot expenses; price of substrates; and price of trays. Calculations were made based on the amount of substrate needed.

Net Present Value (NPV) Analysis

Net Present Value analysis determines whether an investment will be worthwhile for a business by examining financial characteristics and focusing on whether the new technology can generate profits that will cover initial costs. After calculations are made,
the number generated by the NPV analysis should be greater than zero. This is an indicator of the added value to the firm and the proposed investment should be accepted. A number less than zero indicates that an investment should be rejected. In order to conduct the NPV analysis, six steps are conducted: (1) determine the discount rate; (2) determine the present value of the capital outlay; (3) determine and calculate benefits or annual cash flows for each year; (4) determine the present value of benefits; (5) calculate the NPV; and (6) make a decision to accept or reject the investment (Boehlje and Ehmke, 2005).

Two forms are needed to calculate NPV. The Balance Sheet (BS) and Income Statements (IS) are needed to obtain the capital structure, cost of debt and the opportunity cost of equity. Expected cash flows are estimated from projections of the net cash earnings of the asset/investment. To calculate the NPV, first the weighted average cost of capital (WACC) or discount rate (d) was calculated based on the operation’s financial statements. The WACC equation is as follows:

$$WACC = Ke \cdot We + Kd \cdot Wd \cdot (1-t)$$

where:

- $Ke =$ cost of equity funds or return on equity rate;
- $We =$ proportion of equity funds used in the business;
- $Kd =$ cost of debt funds (interest);
- $Wd =$ proportion of debt funds in the business;
- $t =$ marginal tax rate.

The greenhouse operation interested in adopting Ellegaard had a $Ke$ of 12%, $We$ of 38.86%, $t$ of 30.76% (includes federal, state and local tax), $Kd$ of 8% and $Wd$ of 61.14%. Thus their discount rate was roughly 8.05%. The estimated 8% interest rate for a loan was determined by the grower to be a realistic interest rate. This discount rate means that in order for the investment to be profitable, it must provide a return equal to or surpassing the discount rate of 8.05%.

The second, third and fourth steps of the NPV analysis were calculated through a spreadsheet developed in Excel, outlining the benefits gained from the conversion and the expected expenses. Table 1 outlines the difference in costs between the current potting machine and the Ellegaard machine. The differences are classified as savings or losses associated with using the Ellegaard machine to produce 130,000 pots compared to the current potting machine. Due to the Ellegaard machine being a relatively new technology, the life of the machine was estimated to be 20 years for a new machine and 16 years for a used machine (Jensen, pers. commun.). Using @RISK, an Excel simulation software package that allows for variability in assumptions, an inflation rate was imposed on the costs of labour, plastic/paper pots, plastic trays and substrate supplies. Using the past 12 years of inflation rates in the US, the range of inflation was 1.55 to 3.85%.

### Financial Feasibility Analysis

Financial feasibility analysis determines whether the cash flow will be able to meet the principal and interest payments on the funds borrowed to purchase the asset. If the analysis shows a deficit in any year, the business will not be able to meet payment arrangements and the business may need to apply additional capital from other sources to make payments. The five steps used to conduct a financial feasibility analysis are: (1) calculate the annual net cash flows; (2) calculate the loan repayment schedule; (3) calculate the tax savings from interest deductibility; (4) calculate the after tax payment schedule; and (5) calculate the surplus or deficit from each year (Hall, 2009).

The NPV and financial feasibility analysis was conducted for four options. All options included the use of a semi-automatic H201 Ellegaard machine, which is used to produce 50 to 80 mm pots. Option 1 includes purchasing a new Ellegaard machine for $38,200 and using the manufacturer’s recommended growing substrate. Option 2 includes purchasing the new machine and using the growers existing growing substrate. Option 3 includes purchasing a three-year-old used machine for $27,500 from another greenhouse and using the recommended growing substrate. Option 4 includes purchasing the used machine and using the growers existing growing substrate. The four options are important because each one changes the estimated expenses used in the analysis.
Many assumptions were made based on typical expenses and maintenance for the machinery used. A maintenance allocation of $1,000 was used for any given year the equipment was operational. Electricity used to run the Ellegaard machine was also considered in the analysis. One thousand dollars was allocated to the replacement of the air dryer in five year increments. Business tax expenses and non-monetary depreciation from adopting the Ellepot system were also considered.

The new machine with recommended substrate (Option 1) was calculated, based on the grower securing a loan for 15 years at 8%. The total initial capital output for the new machine was $41,700, which includes $38,200 for the machine, $2,500 for training and set-up, and $1,000 for the air dryer. The grower would make a down payment of 10% or $4,170 and $37,530 would be financed. Annual loan payments were calculated to be $4,384.61. The used machine current substrate (Option 4) assumed that the total initial cost to buy the Ellegaard machine was $28,500, which included $27,500 for the actual machine and $1,000 for a new dryer. The grower would also make a 10% down payment or $2,850 and would finance $25,650 at an 8% interest rate for 10 years. The annual loan payment would be $3,822.61. Variability in assumptions were addressed by using @Risk, which enabled an inflation rate on the costs of labour, plastic/paper pots, plastic trays and substrate supplies.

**RESULTS AND DISCUSSION**

Option 1 (new machine, recommended substrate) and Option 4 (used machine, current substrate) were the most profitable options. The new Ellegaard machine with the recommended substrate (Option 1) had a positive NPV ranging from $26,746 to 28,852 based on a 15 year loan. Since the NPV value is greater than zero, the investment should be adopted. The NPV range shows the greenhouse operation could expect added value of almost $28,000 over the life span of the loan by implementing this system. The new machine option showed a surplus of approximately $70,000 over the 15 years of the loan and had a surplus in every year except for Year One where there was a deficit of $167. The new machine with the recommended substrate, was assumed to be the most common option since a used machine would not always be available for purchase. The operation would however, need to find additional capital from another source to cover the $167 deficit that they would experience in Year One or try to extend their loan period in order to avoid experiencing this deficit.

Option 2, new Ellegaard machine and current substrate, yielded a positive NPV in the range of $71,761 to 74,894. Option 3, used Ellegaard machine with the recommended substrate, had a positive NPV in the range of $35,079 to 37,318. If the grower used the recommended substrate, this option would be the best for profitability because the grower would earn nearly $10,000 more over the lifespan of the used machine than if they were to purchase a new machine. Option 4, used Ellegaard machine and grower substrate, yielded the highest NPV from the investment ranging from $78,288 to 81,496 and yielded the largest profit. The average expected NPV was $79,729, implying that the income generated from the adoption of the Ellegaard machine exceeded the costs associated with the machine by $79,729. The firm would experience an added value to their business of nearly $80,000 over the lifespan of the used machine and all principal and interest payments would be met each year.

The savings and profits earned from the adoption of the Ellepot system are attributed to several key areas such as decreased labour, elimination of the use of plastic/paper pots and trays and lower amounts of substrates used with the new system. The most profitable options in this study suggest using the current substrate, which makes the transition easier for the grower, whether considering a new or used machine. However, growers should note that used machines are not always readily available.

This case was based on an average greenhouse size of 0.8 ha. Since this is a case and is not representative of the greenhouse population, other greenhouse operations that are interested in adopting the Ellepot system should consider conducting a Net Present Value analysis to determine the financial consequence of purchasing this type of system.
Growers should keep in mind the importance of keeping accurate financial data (i.e., balance sheets and income statements) because it is imperative that the financial data that is gathered is accurate in order to determine the worthiness of the investment. Estimations or inaccurate data may result in a NPV analysis that determines that a project is profitable when in reality it is not.

ACKNOWLEDGEMENTS

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Literature Cited


Table 1. NPV Assumptions for current potting machine and Ellegaard Machine.

<table>
<thead>
<tr>
<th>Current potting machine</th>
<th>Ellegaard machine</th>
<th>Savings from Ellegaard machine ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Labor costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor cost per pot:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$0.006538/pot</td>
<td>$0.005885/pot</td>
<td></td>
</tr>
<tr>
<td>Actual: 130,000 pots filled based on</td>
<td>Actual: 130,000 pots filled based on</td>
<td></td>
</tr>
<tr>
<td>18.1 hours of labor</td>
<td>40.6 to 43.3 hours</td>
<td></td>
</tr>
<tr>
<td>Labor assumed for calculation: 19 hours</td>
<td>Labor assumed for calculation: 45 hours</td>
<td></td>
</tr>
<tr>
<td>5 employees at $ 8.50/hour</td>
<td>2 employees at $ 8.50/hour</td>
<td>85</td>
</tr>
<tr>
<td><strong>Pots costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price per individual pot:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$0.0737/pot</td>
<td>$0.02478/pot</td>
<td></td>
</tr>
<tr>
<td>Need 8.36 rolls¹;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rolls assumed for calculation: 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$9,581 for 130,000 plastic pots</td>
<td>$3,221 for 130,000 paper pots based on</td>
<td>6,360</td>
</tr>
<tr>
<td>$256 per roll of paper/1000 m; 1400 m of paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tray costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$9,620 for 13,000 trays (10 pots/tray)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price per individual tray:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$0.0740/tray/pot</td>
<td>$0.04/pot</td>
<td>4,420</td>
</tr>
<tr>
<td><strong>Current substrate option costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$185/bag; each bag fills 3,093 pots</td>
<td>$185/bag; each bag fills 7,911 pots</td>
<td></td>
</tr>
<tr>
<td>$7,955 for 43 bags</td>
<td>$3,145 for 17 bags</td>
<td></td>
</tr>
<tr>
<td>Price per individual:</td>
<td>$0.010112/pot</td>
<td>4,915</td>
</tr>
<tr>
<td>$0.06119 per pot</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Recommended substrate option costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$91.26/m³; each bag fills 1,248 pots</td>
<td>$9,506 for 104 bags</td>
<td>$0.073125/pot (1,551)</td>
</tr>
</tbody>
</table>

¹ Rolls calculated as following: (130,000/(1400/0.09)).