AN ECONOMIC ANALYSIS OF THE TOPDRESSING INDUSTRY

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Abstract.

Over recent months, there have been some well publicised reports which raise doubts about the financial viability of the topdressing industry within New Zealand. There seems little evidence of a systematic analysis of the business model and suitability of the charging structures in place.

This paper considers three aspects of topdressing costs in order to estimate the actual costs of spreading fertiliser and lime. The questions posed are; what are the actual costs of operating the two main models of aircraft flown in New Zealand? What size of aircraft fleet is required to fulfil the spreading requirements? What are the on-farm infrastructure costs that also need to be considered in order to calculate the true costs of servicing the application of fertiliser to our hill country sector?

Topdressing services mainly the sheep and beef sectors which contribute 22.5% of New Zealand’s agricultural output. Farm income in this sector is nearly $4 billion. Application of fertiliser is important to sector productivity and the possible collapse of the topdressing industry would have far reaching consequences for these farming sectors and New Zealand’s export earnings.

The model finds that there is no financial return on capital invested in the industry. Therefore, the best returns are found by applying fertiliser from old aircraft with aged support vehicles all with little capital value. This is clearly unsustainable as even old aircraft require large injections of capital periodically to maintain airworthiness.

As fertiliser prices have increased, application rates have fallen which increases application cost per tonne applied. The agreed fixed price charging model is traditionally based on an application charge per tonne. It is likely that farmers perceive increased application charges per tonne as a price increase, whereas it is only compensating the applicator for the additional time of sowing at a lower rate.

Introduction

The spike in fertiliser prices experienced over the last two years, (see Figure 1) has reduced demand for both the products and aerial application services. The agricultural aviation industry has been thrown into crisis, putting further pressure on application pricing. Downward pressure on pricing further compromises the fixed pricing model assumptions as applicators marginally price to cover their operating variable costs, leaving their margins and fixed costs to chance.
There has been recent publicity and industry comment which leaves little doubt that the New Zealand fixed wing aerial application industry is in difficulty (Van Den Bergh, 2009). This probably stems from the New Zealand Agricultural Aviation Association (NZAAA) Conference of 2009, which was themed “Industry in Crisis”. The keynote presentation and report to the Association was an industry structural analysis (structure, conduct, performance) conducted by Lockhart (Lockhart, 2009).

The report concluded that the industry is failing to achieve an adequate margin that allows for replacement of existing equipment and is, therefore, consuming the capital invested in existing plant and machinery. In short, the industry was identified as failing to meet the cost of capital. Evidence of this being included low replacement rates of aircraft (only two replacement aircraft have been introduced into New Zealand within the past three years), and price competition in the absence of technological change (Lockhart, 2009).

**Aircraft operator issues**

To raise load capacity and, therefore, reduce marginal costs the industry has been repowering existing aircraft, constructed between 1968 and 1984, with turbine engines instead of purchasing new aircraft (CAA, 2008; Lockhart, 2009). In some cases the repowering has exceeded the original airframe’s design envelope.

Furthermore, the difficulty of achieving reasonable returns appears to eventually lead to operator failures. Pilot safety is being, unwittingly, compromised and puts at risk an
essential service to the hill country farming sector of an agriculture dependent nation. The two major fertiliser manufacturing cooperatives identified the financial risk to their hill country shareholders and have vertically integrated their businesses by purchasing agricultural aviation companies. Services to their farmer shareholders are then assured in the short-term, providing that the cooperative members support the cross subsidisation of this service.

One of the main problems is the inconsistency in demand for fixed wing aerial application services. Between 1994 and 2006 inclusive the total hours flown has fluctuated between a low of 15,000 hours and a high of 52,500 hours (see Figure 2).

![Fixed Wing Agricultural Hours](Figure 2: Annual Fixed Wing Aircraft hours by type; source CAA Agricultural Aircraft Review December 2008, source www.CAA.govt.nz sourced Dec. 2008)

The inconsistency of demand is symptomatic of the sheep and beef farming sector which is generally located on the poorest easy to steep hill country land and is also the sector making the lowest returns on capital invested. Therefore, it is the sector most influenced by the law of marginal returns; and by the nature of the topography is the main user of fixed wing
agricultural aircraft. When either, sheep and beef prices are low, or fertiliser prices are high, sheep and beef farmers reduce application of fertiliser.

The operating costs of two typical aircraft types under New Zealand conditions has been described in detail by Grafton (2010). Table 1 summarises those costs and calculates a cost per tonne spread. The costs are based on spreading superphosphate and urea and are based on an assumed annual workload of 600 hours. The Cresco applies 20 tonnes and the Fletcher applies 12 tonnes of superphosphate per hour respectively.

Table 1. Operating cost per tonne applied of Cresco and Fletcher aircraft.

<table>
<thead>
<tr>
<th>Expense Item</th>
<th>Aircraft Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cresco</td>
</tr>
<tr>
<td>Engine operating</td>
<td>4.15</td>
</tr>
<tr>
<td>Airframe maintenance</td>
<td>5.30</td>
</tr>
<tr>
<td>Insurance</td>
<td>8.66</td>
</tr>
<tr>
<td>Fuel</td>
<td>15.12</td>
</tr>
<tr>
<td>Salaries and support vehicles</td>
<td>13.28</td>
</tr>
<tr>
<td>Overhead</td>
<td>1.30</td>
</tr>
<tr>
<td>Ownership (including depreciation)</td>
<td>14.99</td>
</tr>
<tr>
<td>Total operating and fixed cost per tonne</td>
<td>85.40</td>
</tr>
</tbody>
</table>

Assumes a Cresco 08-600 powered by a Pratt and Whitney PT6-34 Ag; a Fletcher FU 24 powered by a Lycoming IO 720 engine, with little capital value approaching overhaul.

The current application charges are less than the total operating cost, there is no return on capital and in many circumstances the cost of ownership is not being fully recovered. Thus the capital in the plant is being eroded as identified by Lockhart (2009).

On farm infrastructure issues

On-farm infrastructure also appears to be both dated; heavily depreciated; an additional source of safety problems and cost to the industry; and, therefore, in need of considerable investment. Grafton (2009) identified many of the difficulties and limitations with existing on-farm facilities. The first generation of airstrips were built for underpowered aircraft where taking off, downhill, from an elevated location was desirable. Early site locations often created additional problems as access roads became impassable for trucking in and loading fertiliser, particularly in wet conditions. Storage facilities were often primitive, or non existent and lack of capital investment and maintenance mean that many are now in a very poor state of repair.

If aerial topdressing is to have a future in New Zealand then an economically viable system must be developed to deliver fertiliser and lime to the hill country of both islands. This paper attempts to identify the level of on-farm investment required to achieve this and assesses the true cost of delivering fertiliser to hill country properties.
Grafton, Yule and Lockhart (2010) calculated the average cost of application within a circumference from an airstrip for commonly applied materials at farm fertility maintenance rates, using a Cresco 08-600 aircraft, see Figure 3. (which aircraft)

![Figure 3: The relationship between fertiliser application costs and distance flown from the airstrip.](image)

New Zealand is well served by farm airstrips, having 2,545 in the North Island and 1,114 in the South Island, see Figure 4. However most of them don’t meet the standard specified in the “Safety guideline farm airstrips and associated fertiliser cartage, storage and application” CAA (2006). Most airstrips in use in New Zealand were developed in the 1950’s and 1960’s. The number of airstrips is related to the increased application cost over distance as in, Figure 3. In this era health and safety and employment standards were very different to the responsibilities that are required in the Health and Safety in Employment Act 1992.

The cost involved in bringing airstrip facilities up to the standard largely depends on their location in respect of public roads; the facilities that are currently present; and, the amount of fertiliser applied from the airstrip. The cost of producing an all weather shell-rock road with drainage is about $10,000 per kilometre; the cost of a covered weatherproof 200 tonne bin is around $70,000; while an all weather airstrip costs around $90,000. Although the requirement for an all weather strip is not essential in the guide (cost indication through Pers. Comm. Mike Manning, General Manager Key Clients and R &D, Ravensdown Fertiliser Co-op Ltd, 2009).
Figure 4: New Zealand airstrip locations

If all airstrips were to have adequate storage facilities, then the need for all-weather access tracks is reduced, providing that the aircraft loader can access or has accessed the airstrip. Either way there is some $231 million to be immediately spent on farm infrastructure.

In a poor (low demand) year some 205 tonnes are flown off each strip while in a good year some 400 tonnes will be flown off each strip, given that 600,000 - 1,000,000 tonnes are sown each year. The actual infrastructure costs would then need to be spread over applications of 300t per annum. The cost of maintenance is reflected by depreciation rates (likely to be underestimated), which are 4% for buildings of this type, and higher for tracks and strip surfaces. The actual costs, in terms of tonneage applied, return on investment and,
therefore, cost per tonne applied are presented in Table 2. Comparisons are provided between an all weather strip and its ongoing maintenance with that of a new bin purchase on an existing strip.

Table 2: Required strip hire charges for implementing the New Zealand Farm Airstrip Guide.

<table>
<thead>
<tr>
<th>Airstrip Type / Cost</th>
<th>Maintenance / Depreciation ($)</th>
<th>Tonnes Applied from</th>
<th>Return On Investment At cost of credit 9% ($)</th>
<th>Charge per Tonne strip hire ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Weather $200,000</td>
<td>8,000</td>
<td>500</td>
<td>18,000</td>
<td>52</td>
</tr>
<tr>
<td>Bin Purchase $70,000</td>
<td>2,800</td>
<td>300</td>
<td>6,300</td>
<td>30</td>
</tr>
</tbody>
</table>

At present strip hire charges for using another farmer’s airstrip range from $2 to $10 per tonne for a general grass strip through to an all weather airstrip. These charges are well short of that required to sustain the investment required. A realistic price per tonne could well be $30 per tonne, assuming a desired ROI of 9%, using the current number of strips (if 90% of them were to be rebuilt).

**Results**

The balance between greater aircraft flying hours and the number of airstrips needs to be examined. If the aircraft was to service the farming area immediately around the strip then a simple optimisation could be achieved. An estimate of aircraft costs and on-ground costs on that basis is presented in Figure 5. Assuming an application rate of 160 kg/ha for superphosphate the total cost is represented by the average cost from the airstrip which is \(5.6x + 38.53\), where \(x\) is the boundary distance from the airstrip. The cost of the airstrip can be represented by the tonnage off it by the area covered assuming 800,000 tonnes is spread per annum. For a bin only purchase airstrip the cost against distance spread is \(312x^2\). By differentiating the addition of these equations the cheapest total cost occurs at 4.8 km, covering a circular area of 7,238 ha. If each strip were to service this land area the aerial topdressing requirements of New Zealand could be met by 1,192 strips, less than half the number currently in existence.

This scenario is somewhat unlikely in the short term. But the cost of servicing a farm lying between four and seven kilometres from the airstrip can be calculated. Assuming the airstrip was servicing a number of farms the on-ground cost per tonne could be calculated and added to the aircraft operating costs. Another way to look at it would be to decide what proportion of the area requires application of fertiliser and use that as the basis for cost calculation. This approach could help in planning the number of airstrips required, given land use and topographic requirements.

The mathematics taken to develop this economic model are not complex and can be easily represented on a spreadsheet. Some flexibility can be developed to allow for the planning of on-ground facilities.
Further simple calculations, based on the annual use of each aircraft of 1,000 hours, suggest that at the present level of fertiliser application to this farming sector a fleet of 54 aircraft would be sufficient, this would mean retiring a significant number of the current 116 aircraft on the register, although not necessarily flying operationally.

Conclusion

Present requirements for topdressing in New Zealand could be satisfied by as few as 30 – 40 Cresco aircraft or turbine equivalents. If today’s fleet were rationalised it would mean the 22 Crescos, 2 Air Tractor 402 aircraft and about 30 turbine Fletchers would cope with a peak demand of 1 million tonnes spread. This would mean a significant downsizing of the industry and a significant number of businesses closing. This process may take place in a relatively short period as a number of operators have ageing aircraft and support vehicles. Operators faced with major overhaul costs and or engine replacements are likely to exit the industry rather than undertake these costs with little hope of a return from the investment.

In order to achieve economically optimum performance, the fleet of 54 aircraft are likely to operate from around 1,200 airstrips that adhere to the standard suggested by the CAA. Rather than service 2,300 ha, each one will service up to 7,240 ha and as application rates
continue to decline this area is likely to increase. The likely application cost per tonne of product applied will be in the region of $80 per tonne at the present application rate and would increase to $120 per tonne when all costs are properly accounted for, especially if application rates further reduce.

This paper makes no attempt to assess if this is a cost that can be sustained by the industry. The true cost of fertiliser application has not been factored in for many years, perhaps decades, and the capital within the industry has been eroded. If the true cost cannot be sustained, then significant reductions in the productivity of the hill sheep and beef sector can be expected.

References:

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