CAPACITIES AND ECONOMICS OF AN EXISTING SYSTEM OF CANE TRANSPORT

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Sucraf, Kiliba, Zaïre

ABSTRACT

A study was made of an existing transport system in which Oliver 1750 tractors, Oliver 1950 tractors, Ford County tractors and Volvo trucks were used.

The trailers were Thomson, Michot and Sucraf, of which the average capacities are known.

For the different combinations the length of a transport-cycle was determined. On the basis of the results the productivity in t/hour was calculated.

To ascertain the cost per ton of cane and per ton/km the costs of ownership and operation were calculated for tractors, trucks and trailers.

A combination of 4 Thomson trailers has the highest capacity which approaches that of a Volvo truck as distance increases.

The most economical is a Ford County with Thomson trailers.

INTRODUCTION

The aim of management is to obtain continuously better financial results from an enterprise. This also holds true for a sugar estate. By the introduction of new cane varieties, labour saving devices etc. spectacular results can be obtained. However, it is often forgotten that efforts to use existing equipment more efficiently may considerably improve the returns of a company.

With this intention we have gathered some basic information about our actual system of cane transport in the hope that, with the aid of the results, we will arrive at a more economical use of our transport.

We therefore have investigated:

1) The relationship between time and distance for a complete transport cycle.
2) The tons of cane transported per hour in relation to distance for the different transport combinations.
3) The cost per ton of cane in relation to distance for the different transport combinations.
4) The cost per ton of cane per km for the different transport combinations.

The following were used, average loads being given in brackets:

- 3 Thomson trailers (7 737 t),
- 4 Thomson trailers (10 316 t),
- 1 Michot trailer (5 624 t),
- 1 Sucraf trailer (7 454 t),
- 1 Volvo truck (5 045 t).

The trailers could be coupled either to an Oliver 1950 tractor, an Oliver 1750 tractor or a Ford County 754. The cane is loaded mechanically.
In the yard, part of the cane is unloaded directly on the cane table and part in the yard itself, by means of a crane. The Thomson trailers in particular are unloaded in this way.

PROCEDURE

A time study was made of the different phases of a transport cycle for the different combinations. The results are shown in Table 1:

**TABLE 1.** Time in minutes for different phases of a transport cycle.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Tractor + 3 Thomsons</th>
<th>Tractor + 4 Thomsons</th>
<th>Tractor + Michot</th>
<th>Tractor + Sucraf</th>
<th>Volvo truck</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>5,8 min/km</td>
<td>5,8 min/km</td>
<td>5,6 min/km</td>
<td>5,8 min/km</td>
<td>2,7 min/km</td>
</tr>
<tr>
<td>Loading</td>
<td>7,5 min</td>
<td>10 min</td>
<td>5 min</td>
<td>7,5 min</td>
<td>6 min</td>
</tr>
<tr>
<td>Weighing</td>
<td>3 min</td>
<td>4 min</td>
<td>1,5 min</td>
<td>1 min</td>
<td>1 min</td>
</tr>
<tr>
<td>Unloading</td>
<td>6 min</td>
<td>8 min</td>
<td>8 min</td>
<td>7 min</td>
<td>7,25 min</td>
</tr>
</tbody>
</table>

On the basis of these findings, Fig. 1 shows the length of time of a transport cycle composed of travelling, loading, weighing and unloading for different distances. A cycle does not include stops such as time lost in waiting, repairs etc.

**FIGURE 1.** Length of time of a transport cycle for different distances.

RESULTS

On the basis of the load-capacities of the different combinations (Fig. 1) we have constructed Table 2 for the productivity in t/h against distance for these combinations.

**TABLE 2.** t/h per combination for different distances.

<table>
<thead>
<tr>
<th>Km</th>
<th>Volvo</th>
<th>Michot</th>
<th>Sucraf</th>
<th>3 Thomsons</th>
<th>4 Thomsons</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>12,1 t</td>
<td>9,1 t</td>
<td>11,5 t</td>
<td>11,6 t</td>
<td>13,6 t</td>
</tr>
<tr>
<td>8</td>
<td>8,5 t</td>
<td>5,7 t</td>
<td>7,2 t</td>
<td>7,3 t</td>
<td>9,0 t</td>
</tr>
<tr>
<td>12</td>
<td>6,5 t</td>
<td>4,1 t</td>
<td>5,3 t</td>
<td>5,4 t</td>
<td>6,7 t</td>
</tr>
<tr>
<td>16</td>
<td>5,3 t</td>
<td>3,2 t</td>
<td>4,2 t</td>
<td>4,2 t</td>
<td>5,4 t</td>
</tr>
</tbody>
</table>
These results, plotted in a graph (Fig 2), allow us easily to find the \( tc/h \) for the intermediate distances.

![Graph showing \( tc/h \) per combination for different distances.]

Having obtained this information it will be easier to make an efficient distribution of the transport for the different distances.

To be able to make more economical use of the transport it is necessary to know the transport costs per ton of cane for different distances. We have therefore calculated the costs of owning and operating per hour for:

1) Oliver 1750 tractors
2) Oliver 1950 tractors
3) Ford County tractors
4) Volvo trucks
5) Thomson trailers
6) Michot trailers
7) Sucraf trailers.

The method used is shown in the following calculation of the costs of owning and operating/h of an Oliver 1750 tractor:

**Depreciation value**

1) Price delivered \( Z \ 8,833,00 \)
2) Less cost of replacement of tyres \( Z \ 908,20 \)
3) Price delivered without tyres \( Z \ 7,924,80 \)
4) Net depreciation value \( Z \ 7,924,80 \)

**Costs of owning**

5) Value \( \frac{7,924,80}{12,000} \) \( \frac{Z}{0.66} \)
6) Interest, insurance etc. \( \pm 14\% \)

\[
\text{factor} \times \text{delivered price} = 120 \text{ days} \times 20 \text{ hours} = 2,400 \text{h per crop} \\
0.037 \times 8,833 = Z \ 0.33
\]
7) Total cost of owning

Operation costs

8) Fuel
   Z 0.085 × 11.6 l/h
   Z 0.99

9) Lubricants, filters
   Z 0.27

10) Tyres
    cost of replacement
        Z 908.20
    estimated tyre life
        Z 4 000
    Z 0.23

11) Repairs
    Z 0.06 × 7 924.80
    Z 0.48

12) Total costs of operation/h
    Z 1.97

13) Salary driver
    Z 0.07

14) Total costs of owning and operation/h
    Z 3.03

Note: 1 Zaire (Z) = approximately 2 US dollars.

For the calculation of items 6 and 11 we have consulted Caterpillar Handbook, 1972. To be able to calculate the cost of owning and operating/h for the trucks it was necessary to convert our usual depreciation on the basis of 100,000 kilometers to a depreciation on the basis of hours.

According to Table 1, a Volvo truck for cane transport under our conditions takes 2.7 min/km, which results in

\[ \frac{100,000 \times 2.7}{60} = 4,500 \text{ hours.} \]

We find then the following costs of owning and operating/h:

1) Oliver 1750 tractor
   Z 3.03

2) Oliver 1950 tractor
   Z 3.28

3) Ford county tractor
   Z 1.77

4) Volvo truck
   Z 3.59

5) Thomson trailer
   Z 0.28

6) Michot trailer
   Z 0.49

7) Sucraf trailer
   Z 0.44

With these results and with the tc/h shown in Table 2 it is now possible to calculate the transport costs per ton cane and per ton cane/km.

For example: the costs of owning and operating/h of the combination Oliver 1750 + 4 Thomson trailers are 3.03 + (4 × 0.28) = Z 4.15.

A round trip of 4 km will bring in: 13.6 tc/h (Table 2). This results in Z 0.31/tc and in 0.31 : 4 = Z 0.078/t/km.

Table 3 shows the results of these calculations.

The costs per ton per km are shown in Table 4.

These results, plotted in a graph, will permit us to find immediately the information for the intermediate distances. With the aid of these graphs it will be possible to make an economical distribution of the transport over different distances.
TABLE 3. Transport costs per ton cane.

<table>
<thead>
<tr>
<th>Transport combination</th>
<th>Distance in km</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Oliver 1750 + 4 Thomsons</td>
<td>Z 0,31</td>
</tr>
<tr>
<td>Oliver 1750 + 3 Thomsons</td>
<td>Z 0,33</td>
</tr>
<tr>
<td>Oliver 1750 + 1 Sucraf</td>
<td>Z 0,30</td>
</tr>
<tr>
<td>Oliver 1750 + 1 Michot</td>
<td>Z 0,39</td>
</tr>
<tr>
<td>Oliver 1950 + 4 Thomsons</td>
<td>Z 0,32</td>
</tr>
<tr>
<td>Oliver 1950 + 3 Thomsons</td>
<td>Z 0,36</td>
</tr>
<tr>
<td>Oliver 1950 + 1 Michot</td>
<td>Z 0,41</td>
</tr>
<tr>
<td>Oliver 1950 + 1 Sucraf</td>
<td>Z 0,33</td>
</tr>
<tr>
<td>Ford County + 3 Thomsons</td>
<td>Z 0,23</td>
</tr>
<tr>
<td>Ford County + 1 Michot</td>
<td>Z 0,24</td>
</tr>
<tr>
<td>Volvo truck</td>
<td>Z 0,30</td>
</tr>
</tbody>
</table>

CONCLUSION

A combination of 4 Thomson trailers has the highest capacity per hour, but with increased distances the capacities of a Volvo truck and of the 4 Thomson trailers approach each other.

For the transport costs per ton cane and per ton per km, a Ford county with 3 Thomson trailers is cheapest, followed by a Ford County with a Michot trailer up to 12 km, after which the Volvo trucks take second place.

These results also give valuable information for the planning of future investments for transport of cane. Having established these figures the transport manager can try and approach them in actual service by cutting down time lost. The results obtained may be expressed as a percentage of the theoretically obtainable maximum.
TABLE 4. Costs per ton per km.

<table>
<thead>
<tr>
<th>Transport combination</th>
<th>Distance in km</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Oliver 1750 + 4 Thomsons</td>
<td>Z 0.078</td>
</tr>
<tr>
<td>Oliver 1750 + 3 Thomsons</td>
<td>Z 0.083</td>
</tr>
<tr>
<td>Oliver 1750 + 1 Sucraf</td>
<td>Z 0.075</td>
</tr>
<tr>
<td>Oliver 1750 + 1 Michot</td>
<td>Z 0.098</td>
</tr>
<tr>
<td>Oliver 1950 + 4 Thomsons</td>
<td>Z 0.080</td>
</tr>
<tr>
<td>Oliver 1950 + 3 Thomsons</td>
<td>Z 0.090</td>
</tr>
<tr>
<td>Oliver 1950 + 1 Michot</td>
<td>Z 0.103</td>
</tr>
<tr>
<td>Oliver 1950 + 1 Sucraf</td>
<td>Z 0.083</td>
</tr>
<tr>
<td>Ford County + 3 Thomsons</td>
<td>Z 0.058</td>
</tr>
<tr>
<td>Ford County + 1 Michot</td>
<td>Z 0.060</td>
</tr>
<tr>
<td>Volvo truck +</td>
<td>Z 0.075</td>
</tr>
</tbody>
</table>

ACKNOWLEDGEMENT

I wish to thank Mr. J. M. Garin for his kind co-operation in drawing the graphs for Figs 1 and 2.

CAPACIDADES Y ECONOMIA EN UN SISTEMA DE TRANSPORTE DE CAÑA DE AZÚCAR EN OPERACIÓN

P. A. Koopman

RESUMEN

Se realizó un estudio de un sistema de transporte de caña en operación. En el sistema se usaron tractores Oliver 1750, Oliver 1950, tractores Ford County y camiones Volvo. Los remolques eran de la marca Thomson, Michot y Sucraf. Se conoció la capacidad y promedio de estos remolques.
Para las diferentes combinaciones de tractores y remolques el largo del ciclo de transporte fue determinado. En base a estos resultados la productividad en tcl/hora fue determinada. Para poder determinar el costo por tonelada de caña y el costo de la tonelada de kilómetro recorrido, hubo que determinar primero los costos de poseer el equipo y los costos de operación por hora para tractores, camiones y remolques.

Una combinación de cuatro remolques Thomson tienen la capacidad mayor de producción, la cual se acerca a la capacidad de producción de un camión Volvo.
La combinación más económica es la de un tractor Ford County con un remolque Thomson.