Information Sheet

6. MECHANISATION

*2.8 ~~6.8~~ Improving machinery utilisation

Note: The number of this information sheet has been changed to fit in with our new classification system. Contents will be reviewed in due course.

Machinery costs are the highest farming input after land and buildings. Furthermore, they are escalating due to inflation, currency devaluation and increasing levels of technology. To remain viable, growers will have to develop new farming sytems. Machinery planning, performance, usage and maintenance will have to be improved, and machinery operators will have to be better trained.

Machinery costs

It is important to understand machinery costing to appreciate the need for improving performance and the utilisation of machinery.

There are several reasons for having an estimate of the operating costs of either individual or a fleet of machines:

- To compare the costs of operating different types and sizes of machine
- To compare the costs of owning a machine with that of hiring or leasing a similar machine, or using a contractor
- To negotiate prices for hiring out machinery
- To prepare farm budgets.

A typical graph of fixed and variable costs for agricultural machinery is presented in Figure 1. Fixed costs remain almost constant irrespective of annual usage, whereas annual variable and total annual costs increase in proportion to increased use.

Although the total operating costs increase the more the tractor is used per annum, the hourly costs decrease as the annual fixed costs such as depreciation and insurance are spread over a greater number of hours. On the other hand, variable costs per hour such as tyres, fuel, maintenance and repairs remain constant.

As can be seen in Figure 2, by increasing annual usage, hourly machinery costs are reduced. Therefore, one way of reducing costs is to utilise machinery fully. The machine must, however, be used productively and efficiently at all times.

Annual Mechanisation Costing Reports for land preparation and sugarcane handling operations, and cost curves for a range of sugarcane machinery and equipment, are prepared by the SASEX Agricultural Engineering Department. Copies of these reports are

A high capacity slewing push-pile loader in operation.

available from Extension Officers. The Directorate of Communication, National Department of Agriculture, also produces a comprehensive annual machinery costing report entitled, 'Guide to Machinery Costs'.

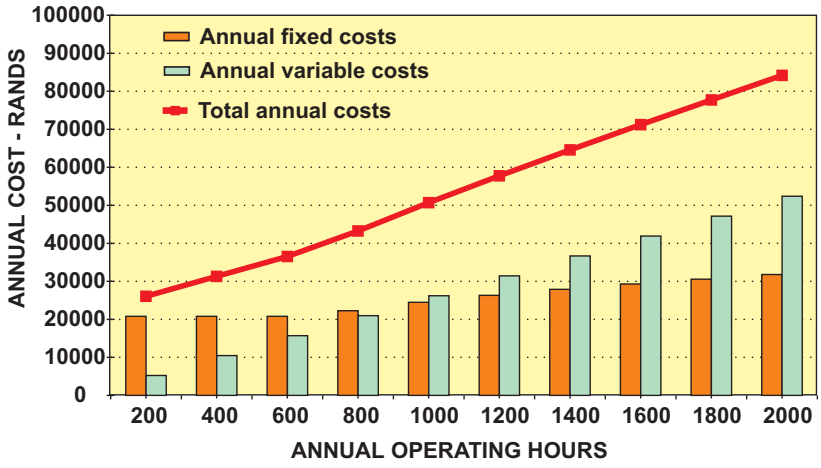


Figure 1. Total tractor fixed and variable costs versus annual usage.

One of the major factors contributing to high mechanisation costs is the under-utilisation of machinery and equipment, which results in higher running costs per hour. A survey showed that the average production of commercial and small scale growers is about 11 000 and 146 tons cane/annum respectively. Based on this information it is clear that the majority of small scale growers cannot economically justify conducting their own mechanical farming operations.

A survey of commercial growers showed that at present one tractor is used to cultivate approximately 40-50 hectares of land, or between 2 000 and 3 500 tons of cane. Tractor utilisation for the various cane producing regions is shown in Figure 3. It clear that significant improvements can be made, in machine utilisation, by both small scale contractors and commercial growers.

(Source: South African Cane Growers' Association, 1996)

Some of the ways by which machinery utilisation can be improved are given below.

Mechanisation planning

Most farmers are aware of the technology and skills required to realise full machinery and yield potential. The major problem is to co-ordinate the many operations that need to be carried out in such a way that they are timely and effective.

Mechanisation planning enables the optimum number and size of machines required for a given farming enterprise to be determined. The best combination of machinery is that which satisfies the farmer's requirements, completes the various tasks in the specified time and results in the lowest cost per hectare or per ton of produce.

The number of tractors, loaders, implements and trailers and the timespans to complete the various farming activities, based on machinery operating capacities, working widths and payloads, are calculated and plotted on a yearly work schedule. Using this information the daily, monthly and yearly machinery requirements of a farm are easily computed, and it can be determined whether or not the machinery complement is adequate. If the grower wishes to go into part-ownership of equipment, a mechanisation plan will show immediately where bottlenecks are likely to occur, and any spare capacity at certain times of the year. A simple machinery planning spreadsheet, incorporating some of the more important mechanised tasks on a farm, is shown in Appendix 1.

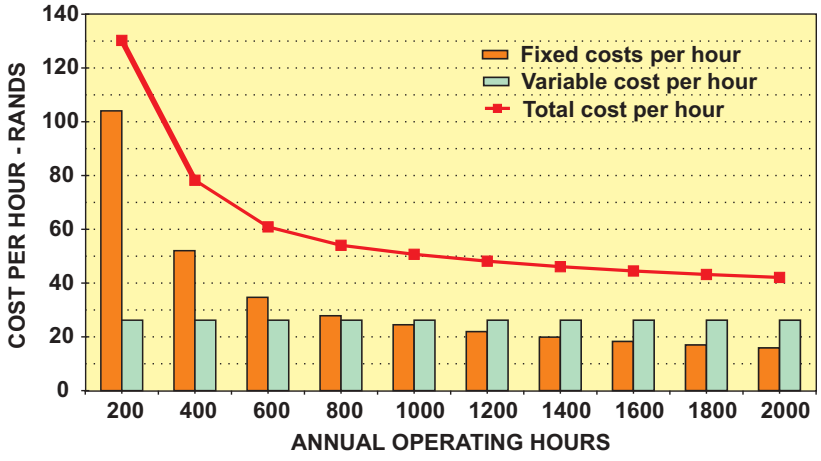


Figure 2. Typical tractor fixed and variable costs per hour versus annual usage.

Here the cane area, crop factors and selected activities of a typical 200 hectare farm are shown. The tractor requirements planned for each month and using the currently available tractors and implements at the work rates given in the spreadsheet, are shown at the bottom of the spreadsheet and graphically illustrated immediately below. As can be seen in the graph, four tractors are required to complete the allotted tasks during the months of October and November.

If a farmer decided to contract out his land preparation operations, i.e. ploughing, discing and ridging, his tractor requirement would be reduced to three tractors during the busy September to November period. This would reduce his total machinery costs substantially. Similar savings are possible by implementing a chemical cane eradication system in place of the mechanical system.

These savings are made possible by a cost effective machinery plan as a result of fleet reduction and increased utilisation without sacrificing spare machinery capacity at critical periods. To achieve optimum machinery productivity and utilisation, it is usually necessary to make some adjustments to the original programme of work.

No enterprise can afford to over-capitalise, i.e. to have machinery and equipment standing idle. On the other hand, there is a cost penalty attached to having inadequate machine capacity or performance, especially for critical operations such as applying fertilisers and weed control.

Transport scheduling

The principal aim of scheduling transport is to move sugarcane from the field to the mill in the shortest possible time using the least and most cost effective equipment. Factors that can affect cane transport costs are the weather, harvesting and delivery rates, loading and unloading rates and travelling distances. To optimise cane transport efficiency, there are analytical tools ranging from simple manual procedures to complex computerised techniques.

Reasons for scheduling cane transport operations include:

- Optimising vehicle numbers
- Ensuring rateable deliveries
- Vehicle selection, mix and module sizes
- Minimising transport costs
- Minimising infield and transloading costs.

Timeliness

The price of not being timely normally appears in the form of reduced yield or a lower grade product. An example of the latter is a reduction in sucrose yield due to an increase in the period between harvesting and crushing sugarcane. The average harvest to crush delay for the South African sugar industry has been estimated at about 72 hours. Assuming a 1-2% loss in recoverable sugar per day, this amounts to a significant revenue loss to both the growers and the millers.

The major causes of delays have been identified as weather conditions, lengthy intervals between burns by burning too large an area, poor machinery performance, and stockpiling on transloading zones or in the millyard. A computer based program, suitable for a mill area, is available to identify and explore scenarios on how best to reduce harvest to crush delays.

Systems analysis

By carefully analysing cane production systems it is possible to improve both machine productivity and utilisation, and thereby reduce overall costs. The outcomes of an actual investigation conducted by SASEX is illustrated in Figure 4. In the case of Alternative 3,

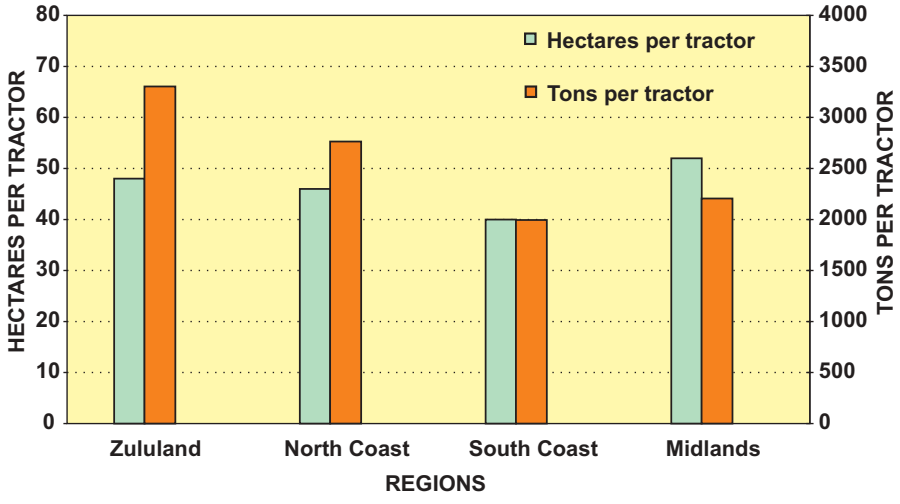


Figure 3. Tractor utilisation for various regions.

the introduction of a mechanical loading system and a shorter haul-out distance reduced the number of haul-out tractors by 50% and total cane handling costs by 20%.

Alternative methods of achieving optimum machinery utilisation

Contracting

A farmer can improve his machinery utilisation and reduce his costs by contracting his machinery out. However, care must be taken to determine optimum size of the contracting operations.

Syndication and co-operatives

Sharing a machine with neighbours can result in substantially increased machine utilisation and reduced costs, provided the syndicate can operate well together. For this arrangement to be successful it is essential that members plan their operations carefully so that machines are not required by several farmers at the same time. Another form of syndication is 'cross-purchase' where each enterprise buys a different machine and these are exchanged as required.

Machinery rings

Machinery rings are popular both in Britain and Europe, with more than 250 in Germany alone. Machinery rings are non-profit making associations which stand as companies in their own right and are run by either a part-time or full-time manager, depending on the number of members. They are ideally suited to small farms that cannot justify owning certain machinery or equipment. A farmer (demander) wishing to have a certain task carried out contacts the 'ring' manager who in turn finds the nearest member (supplier) or contractor who can assist the farmer. On completion of the job the 'ring' manager ensures that the demander pays the supplier, while adding a small 'ring' commission.

Self-drive hire

The concept of self-drive hire is being successfully used by small farmers in Barbados. Farmers hire toolbar equipment such as ridgers, planters, tip trailers and ditching equipment on a daily or weekly basis and in this way avoid owning such equipment and not utilising it fully.

Modern technology

Effective machinery performance can be improved by fully exploiting modern technology such as computers and their high powered software programs. Software relevant to sugarcane includes the Geographic Information System (GIS), the Global Positioning System (GPS), and vehicle transport fleet modelling and simulation programs. Computer based vehicle performance simulation programs have been developed to facilitate the optimum selection of vehicle and road parameters to minimise transport costs. The use of such tools will enable the sugar industry to maximise vehicle and equipment utilisation, and will optimise sugarcane loading and transport requirements on an individual estate, on group estates or on a mill group basis.

A comprehensive report entitled, 'Machinery management, performance and utilisation' is available free of charge through your local Extension Officer.

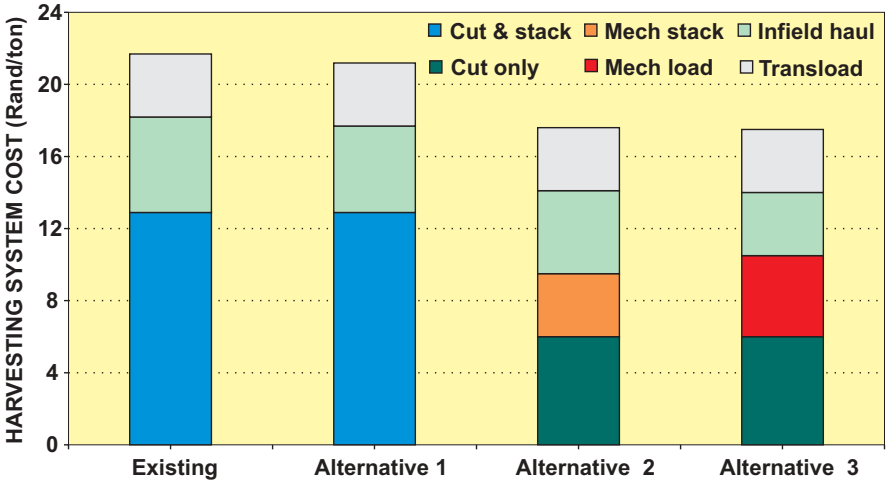


Figure 4. Summary of alternative cane handling systems.

Appendix 1

Machinery Planning Chart

Typical 200 ha Farm

Option 2

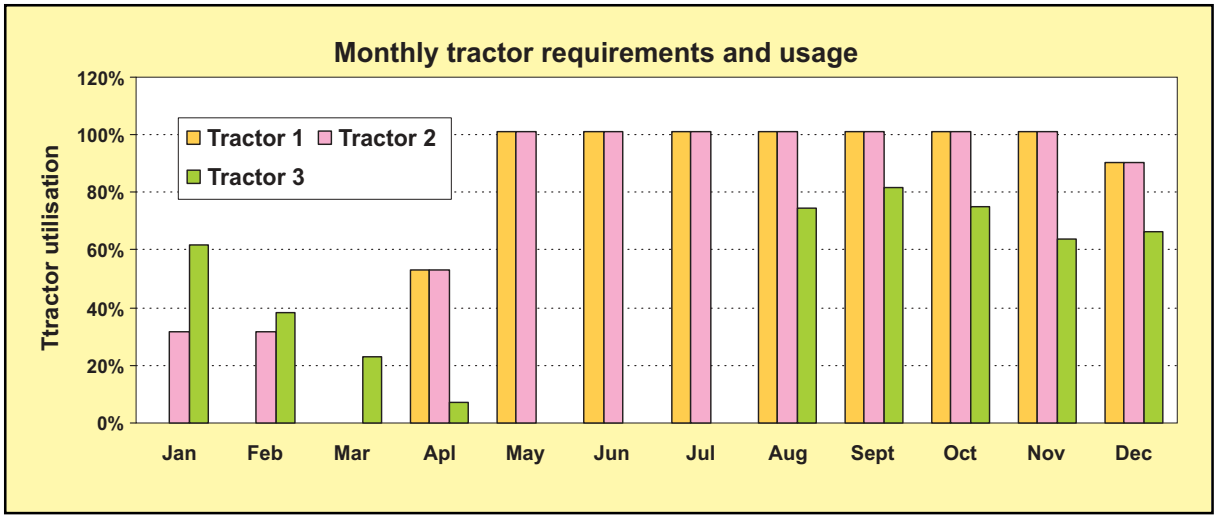
Planning parameters

Total cane area	200	ha
Annual crop	11200	tons
Area harvested/annum	160	ha
Cane yield	70	t/ha
Harvesting days/year	200	days
Operating days/month	20	days
Eff. operating hours/day	6	hours
Machinery availability	85	%

Machinery performance standards

Transporting cane	6.00 h/ha	Transporting fert.	0.50 h/ha
Transloading cane	1.90 h/ha	Transporting water	0.50 h/ha
Herbiciding	0.62 h/ha	Transporting seed	1.50 h/ha
Fertilising	0.56 h/ha	Slashing verges	2.08 h/ha
Ploughing	3.27 h/ha	Minimum tiller	3.00 h/ha
Discing	1.39 h/ha		
Ridging	2.06 h/ha		

Operation	Tractor/imp No:		Ha/day	H/ha	No of:	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Transporting cane	Tractor	1	0.80	6.00	(ha)				10	19	19	19	19	19	19	19	17	160
	Implement	10			(days)	0.0	0.0	0.0	12.5	23.8	23.8	23.8	23.8	23.8	23.8	23.8	21.3	200
					(hours)	0	0	0	75	142.5	142.5	142.5	142.5	142.5	142.5	142.5	127.5	1200
Transloading cane	Tractor	2	0.80	1.90	(ha)				10	19	19	19	19	19	19	19	17	160
	Implement	11			(days)	0.0	0.0	0.0	12.5	23.8	23.8	23.8	23.8	23.8	23.8	23.8	21.3	200
					(hours)	0	0	0	24	45	45	45	45	45	45	45	40	380
Weed control pre-emergent	Tractor	3	9.68	0.62	(ha)	24	10						40	29	19	19	19	160
	Implement	12			(days)	2.5	1.0	0.0	0.0	0.0	0.0	0.0	4.1	3.0	2.0	2.0	2.0	17
					(hours)	15	6	0	0	0	0	0	25	18	12	12	12	99
Weed control post-emergent	Tractor	3	9.68	0.62	(ha)	10	10	10						47	39	25	19	160
	Implement	13			(days)	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	4.9	4.0	2.6	2.0	17
					(hours)	6	6	6	0	0	0	0	0	29	24	16	12	99
Transporting water	Tractor	3	12.00	0.50	(ha)	34	20	10					40	76	58	44	38	320
	Implement	14			(days)	2.8	1.7	0.8	0.0	0.0	0.0	0.0	3.3	6.3	4.8	3.7	3.2	27
					(hours)	17	10	5	0	0	0	0	20	38	29	22	19	160
Top-dressing	Tractor	3	10.71	0.56	(ha)	17	10	10					47	19	19	19	19	160
	Implement	15			(days)	1.6	0.9	0.9	0.0	0.0	0.0	0.0	4.4	1.8	1.8	1.8	1.8	15
					(hours)	10	6	6	0	0	0	0	26	11	11	11	11	90
Transporting fertiliser	Tractor	3	12.00	0.50	(ha)	17	10	10					47	19	19	19	19	160
	Implement	16			(days)	1.4	0.8	0.8	0.0	0.0	0.0	0.0	3.9	1.6	1.6	1.6	1.6	13
					(hours)	9	5	5	0	0	0	0	24	10	10	10	10	80
Minimum tilling	Tractor	2	2.00	3.00	(ha)	10	10											20
	Implement	22			(days)	5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
					(hours)	30	30	0	0	0	0	0	0	0	0	0	0	60
Harrowing	Tractor		4.32	1.39	(ha)													0
	Implement				(days)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
					(hours)	0	0	0	0	0	0	0	0	0	0	0	0	0
Ridging	Tractor		2.91	2.06	(ha)													0
	Implement				(days)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
					(hours)	0	0	0	0	0	0	0	0	0	0	0	0	0
Transporting seedcane	Tractor	2	4.00	1.50	(ha)	10	10											20
	Implement	20			(days)	2.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5
					(hours)	15	15	0	0	0	0	0	0	0	0	0	0	30
Verge control	Tractor	3	2.88	2.08	(ha)	15	10	5	5				5	5	10	10	15	80
	Implement	21			(days)	5.2	3.5	1.7	1.7	0.0	0.0	0.0	1.7	1.7	3.5	3.5	5.2	28
					(hours)	31	21	10	10	0	0	0	10	10	21	21	31	166
Total tractor days/month						22.1	16.5	5.4	26.7	47.5	47.5	47.5	65.0	66.8	65.2	62.5	58.2	531
Total tractor hours/month						132.3	98.8	32.2	109.2	187.6	187.6	187.6	292.6	303.3	293.5	277.8	261.8	2364
Total number of tractors/month						0.9	0.7	0.2	1.1	2.0	2.0	2.0	2.8	2.8	2.8	2.7	2.5	23



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