MECHANISATION SYMPOSIUM

THE RESULTS ACHIEVED BY INTRODUCING A HIGH CAPACITY LOADER ON A LARGE MILLER-CUM-PLANTER ESTATE

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For a number of years there has been an ever increasing interest in mechanisation on sugar farms and estates. The interest was originally directed towards cultivation and planting. More recently transport methods have changed and the development in this direction will continue beyond the cane loader in which great interest is being shown at the present time. In those countries where costs of labour are higher than they are in South Africa the need for this development has caused more rapid progress and already in those countries a tremendous amount of work has been done on cane harvesters. In Australia, for example, the development of the chopper harvester and the need to get chopped cane into the factory within hours of being harvested is once again revolutionising transport methods in that country with the introduction of "Canetainers" or "Binerisation". The Tongaat Sugar Company Limited have for many years been conscious of the necessity for mechanisation and since the latter part of 1953 have developed, copied and improved infield cane handling and transport methods and also introduced to this industry the large Hilo-type cane trailers. More recently, the Crossman Cane Loader was developed at Tongaat in conjunction with Mr. Roy Hemingway. This machine was a development of earlier cane loaders modified to meet the demands of Tongaat where the terrain is anything but flat. This machine has now been developed to the stage where its mechanical efficiency is reasonably good and many of the "bugs" have been eliminated. What has been achieved by introducing high capacity loaders? An attempt to answer this question forms the basis of this paper.

TABLE 1

Averages for 1968-9 Season
Output per Unit

	Tons per Unit	% Labour	% Cut by
Trash LOADER	4.37	22.7%	26.6%
Burnt	6.59	3.1%	5.4%
Trash S-LOADER	3.34	64.5%	57.6%
Burnt	3.5	97%	10.4%
Overall Average	4.57	100%	100%

Effects on labour output

Before we consider the effects on output let us first consider the effects on labour. What was the reaction of the African cane cutter to this monster which was being brought into the fields? When first introduced at Tongaat, labour reaction was most unfavourable. Perhaps it was fear — fear that this new machine would take the bread from the mouths of their children. They didn't look upon this as an aid to greater production — greater earning. Perhaps, as has been suggested by one of the senior field personnel, the approach to the introduction of this machine was wrong insofar as a task was set before the machine had really gone into operation. The set tasks consisted of six rows of cane with the length of the row being estimated so as to give the pre-determined basic task. The labour was psychologically upset at what appeared to be too great a task, and they gave up without really trying. A new approach was made and in due course it was found that, in fact, the original task was quite reasonable, and confidence was restored, and the Grab Loader has now been accepted by the labour as a very useful aid, and when, in fact, the machine is undergoing repairs or servicing, its absence is certainly felt by the labour.

	Tons	Bonus paid	Total bonus per ton	Bonus per load	Bonus per ton cutters only
Trash CROSSMAN	1,400	188.37	13.4c	43c	9.3c
Burnt	1,400	141.03	10.0c	50c	8.0c
Trash S-LOADER	1,500	211.90	14.1c	37c	10.8c
Burnt	1,500	187.63	12.5c	23c	8.6c

During the 1967/68 season the cutting capacity per man was 6.6 tons per day — exactly double that of the cutters who were cutting and building a bundle for the conventional side loader method. This represents a 50% saving in labour. This exercise was based on an allocation of 350 tons per day and a crop of 7,000 tons, and the Grab Loader system was compared with the traditional Side Loader system previously in operation at Tongaat.

The *crew requirements* were as follows:

Class of labour	*Side Loader Method*	*Grab Loader Method*
Induna	2	1
Driver	1	1
Clerk	1	1
Standard and Chain Boys	6	0
Other non-cutters	4	4
	14	7
Cutters	100	50
TOTAL UNITS	114	57

DAILY CREW REMUNERATION

(Direct and Indirect)

UNITS	*SIDE LOADER METHOD*		*GRAB LOADER METHOD*	
	No.	*Remuneration*	*No.*	*Remuneration*
Induna	2	R2-20c	1	R1-10c
Driver	1	R1-30c	1	R1-30c
Other non-cutters	11	R6-60c	5	R3-00c
Cutters	100	R60-00c	50	R30-00c
Cutters' Bonus		R44-00c		R68-00c
Rations, housing and medical	114	R36-48c	57	R18-24c
		R150-58c		R121-64c

This represents an appreciable saving, but on the other hand there is equipment operating and depreciation cost, which is made up as follows:

EQUIPMENT AND USEAGE

Capital cost of basic unit	*Side Loader Method*	*Grab Loader Method*
Replacement cost of units	R4,470	R12,120
Additional cost of modified trailers	Nil	600
TOTAL COST	R4,470	R12,720

The expected life of the equipment in each case has been taken as 8 years.

The estimated useage of the Side Loader was taken at 6 hours per day and the Grab Loader at 12 hours per day.

HOURLY FUEL AND MAINTENANCE COSTS

	Side Loader	*Grab Loader*
Fuel	R1-24c	R1-24c
Repairs	56c	R1-46c
	R1-80c	R2-70c

COMPARISON OF DAILY COSTS

	Side Loader	*Grab Loader*
Crew remuneration	R150-58c	R121-64c
Depreciation	R2-79c	R7-95c
Interest on capital	67c	R1-91c
Useage:		
6 hours at R1-80c	R10-80c	
12 hours at R2-70c		R32-40c
COST PER DAY	R164-84c	R163-90c
COST PER TON	47c	47c

Savings per day (Grab over Side Loader) 94 cents

Saving per ton on 350 tons = .25 cents per ton, or a negligible saving.

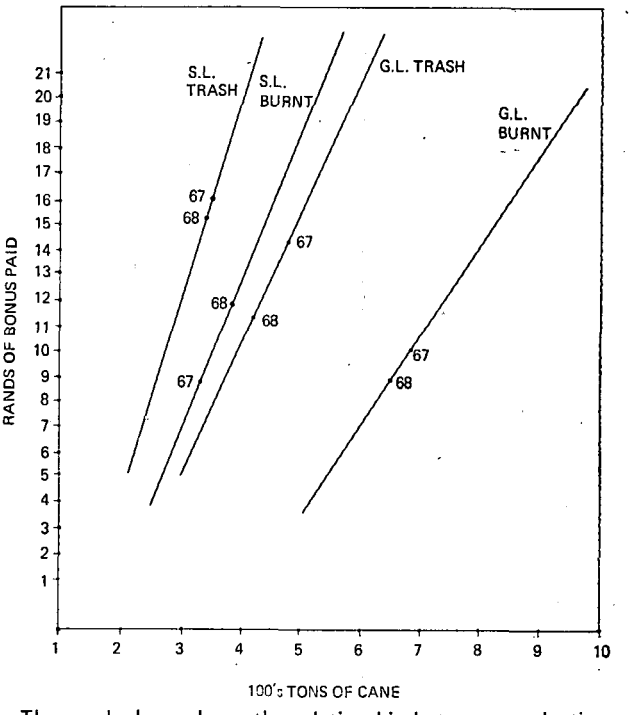
In other words the entire benefit to be gained from this method must be attributed to the reduction of labour requirements, not costs, and other operational conveniences.

Another important point is that under the Grab Loader system the cutters' remuneration is increased and this should assist in assuring their availability.

These figures are borne out by an exercise carried out by Ubombo Ranches Limited of Swaziland. The Ubombo Ranches' exercise, however, was a comparison of the costs of cutting by hand and mechanical stacking as opposed to manual stacking. In the Ubombo exercise an average of 368.59 tons of cane were stacked per day of 9.62 hours average. This gives an average rate of stacking of 38.32 tons per hours.

TABLE 2

Rands of bonus paid—per 100 tons cane cut.
S.L.=Sideloader. G.L.=Grabloader.



The graph above shows the relationship between production and bonus paid during the 1967/68 and 1968/69 seasons. It can be seen that the production for a given amount of bonus is greater in the case of the grab loader than in the case of the side loader. This bonus is shared by fewer cutters in the grab loader operation and so the bonus per head is, in fact, greater than with the conventional side loader systems.

The graph shows also the bonus system in operation at present favours trashed cane.

They found that the daily output per man was:

(a) *excluding ancillary labour:*
  (i) cutting only (for mechanical stacking — 10.22 tons
  (ii) cutting and hand stacking — 5.10 tons

(b) *including ancillaries:*
  (i) cutting only (for mechanical stacking) — 9.91 tons
  (ii) mechanical stacking only — 45.19 tons
  (iii) cutting only and mechanical stacking — 8.13 tons
  (iv) cutting and hand stacking — 4.68 tons

The cost per ton of cane at Ubombo Ranches was:

(i) cutting and mechanical stacking 36.67 cents

(ii) cutting and hand stacking 36.05 cents

These costs are made up as follows:

Cost Item	*Cutting and Mech. Stacking*	*Cutting and Hand Stacking*
Total labour	18.44c	23.38c
Mechanical costs	6.32c	—
Total direct costs	24.76c	23.38c
Indirect costs	11.91c	12.67c
(These include sundry expenses, consumables and general farm overheads)		
Total cost	36.67c	36.05c

Other field operations

(i) *Fields layout planning*

A most important aspect to be considered in the case of Grab Loaders is the preparation of the field and field drainage, so that the loader and the trailers can negotiate the terrain with the minimum difficulty. One of the major problems experienced at Tongaat with the introduction of the Crossman Loader was the damage done to the steering differential housings as a result of the tremendous stresses imposed on these components when negotiating drains. Attention to detail in respect of field preparation is most important.

(ii) *Trash blanket*

When using the Grab Loader system an additional operation is necessary after the loading operation has been completed, when the trash blanket system is used. This is to spread the trash back over the windrows.

(iii) *Infield transport*

The infield transport operation must form an integral part of the Grab Loader operation, and in order to make full economic use of the Grab Loader it is essential that sufficient tractor/trailer combinations are teamed up with the loader so as to keep the loader fully occupied and ideally there should be sufficient units so that as one pair of trailers is loaded and draws away the next pair should draw alongside the loader to be loaded. The complete cycle time to load the pair of trailers is approximately 7.7 minutes so that under ideal conditions 93 pairs of trailers can be loaded in a 12 hour day. The loaded capacity of the trailers varies from 2 to 5 tons depending on the kind of cane being handled. Under ideal conditions, therefore, the potential capacity of this loader should be 930 tons per 12 hour day or 77.5 tons per hour. The best production so far achieved using the Crossman Loader at Tongaat is 545 tons in a 9.31 hour day or 58.5 tons per hour. This indicates a theoretical utilisation factor of 75%. The average utilisation achieved falls far short of the ideal.

In Table 4 analysis of costs of harvesting and infield transport costs taken out on 12 fields on the estate confirm that the total labour cost of harvesting and infield transport, when using the Grab Loader and Side Loader systems, are almost identical The cost of infield transport labour, however, is very much greater in the case of the Grab Loader operations due generally to the very poor densities achieved in the basket trailers. Careful placing of the grab loads in these trailers is most important. It was found also that by fitting double acting cylinders on the hoist that it was possible, by pressing the load in the trailer, to increase the load per basket by 1,500 lb. or 3,000 lb. per trip.

More development work must be done in the field of infield transport work in conjunction with Grab Loaders.

TABLE 3

Grab Loader Production

Section	Average ton/day actually loading	Average hours operating /day	Tons/ hour	Best per day	% Time lost
Tongaat	270	10.23 mins.	25.9	481	6.3%
Klipfontein	260	11.03 mins.	23.5	390	5.3%
Inyaninga	287	9.31 mins.	30.0	545	8.6%
Average	272	10.2 mins.	26.3	—	6.7%

Trash versus burning

Table 1 shows the improvement in output per unit of labour when operating the Grab Loader system on burnt cane. The proportion of burnt cane, however, was very low and these figures could possibly be misleading.

When operating on burnt fields the Crossman Loader and the infield trailers showed a lesser ten-

TABLE 4

Results from 12 fields harvested on Tongaat, Klipfontein, Inyaninga (wages, rations only)

	Average T.C.A.	Harvesting Labour Only		Transport Labour Only	
Burnt CROSSMAN	27.6	3.95 tons/unit	20c/ton	18.2 tons/unit	4.6c/ton
Trash CROSSMAN	37.8	4.1 tons/unit	19c/ton	14.9 tons/unit	5.1c/ton
Burnt SIDE-LOADER	31.2	3.7 tons/unit	22c/ton	26.5 tons/unit	2.8c/ton
Trash SIDE-LOADER	35.4	3.3 tons/unit	24c/ton	30.4 tons/unit	2.7c/ton

dency to slide than when operating on the trash blanket in trashed fields, and cycle times were generally better when operating on burnt cane due to this factor.

Better weights generally are achieved with burnt cane and the cost of infield transport is therefore slightly lower.

Factors limiting production

1. Experience and skill of driver.
2. Terrain — slopes, drains, etc.
3. Field layout — short rows.
4. Length of stick and, naturally, cane quality.
5. Mechanical efficiency of loader.
6. Organisation of operation — sufficient trailer units. Training and efficiency of labour in handling the chains.
7. Availability of chains.
8. Delays at trans-shipping point.

Workshop: modifications and maintenance

The Crossman Loader used at Tongaat was built around a basic County Four tractor. The tractor was fitted with a Brockhouse Torque Converter. On this basic unit was mounted a 2-ton Hiab Hoist and in order to improve the stability of the machine, the wheels were extended to their maximum position and the rims altered to widen the track by a further 6 inches. A push/piler was mounted on the rear end of the tractor and the driver's seat re-positioned and reversed so that he faced the rear end and naturally it was necessary to change the steering arrangement.

Having used so many standard components on duties for which they were never designed, it was inevitable that weaknesses would show up and it was not long before failures in the slewing gear and in the boom of the hoist occurred. These failures were largely due to the very rough and uneven terrain which the machines were required to negotiate. These items were reinforced as failures occurred but, ultimately, it was necessary to redesign completely first of all the slewing mechanism, and finally the boom itself, so as to withstand the horizontal forces caused by operating on slopes.

As mentioned earlier, the steering differential housings gave considerable trouble and this problem was overcome by replacing the cast iron housing normally supplied with steel housings, which had to be specially cast.

Failure of the grab and grab components has been another source of breakdown, and modifications have been effected to the grabs. Although better, there is still room for improvement, and the design needs to be further modified.

The stop-start nature of the operation of the Grab Loader imposed severe stresses and strains on the torque converter, and breakdowns of this component caused the longest delays. These were often due to lack of availability of components.

Hydraulics are without doubt the item which has caused the largest percentage of machine downtime, and in Table 5 attached it will be seen that 26.5% of downtime has been due to hydraulics. The figure shown, however, includes failures of hydraulic components on the grab, push/piler, boom and slewing gear.

Pusher/piler breakdowns have resulted in a large proportion of downtime and here major modifications were necessary. The profile of the push/piler is very important in the successful operation of the machines. An analysis of the downtime on the Crossman Loader is given in Table 5 attached.

It is necessary, therefore, if maximum utilisation is to be obtained from these machines, to provide a first class scheduled servicing programme, and for the machine to be regularly checked for cracks, leaks, etc.

At Tongaat a 7-day milling programme has been worked and the Grab Loaders have very often also had to work on a 7-day cycle. The servicing problem was overcome by servicing the loaders in the evening, thereby making the machine available for maximum production.

A good garage maintenance service is essential if the cost of operating this type of machine is not to be burdened with bills from outside garages or engineering firms. There is not only the cost factor but mechanics must be available to effect prompt repairs if the utilisation, so necessary to make the machines an economic proposition, is to be achieved.

TABLE 5

Analysis of breakdown and stoppages Crossman loaders (hours)

	Tongaat	Klipfontein	Inyaninga	Average	Totals as %
Miscellaneous ..	8.0	26.5	—	14.8	8.6%
Engine	46.0	17.5	4.0	22.5	13.1%
Torque Converter ..	—	—	5.0	1.6	.9%
Steering and Diffs...	13.0	13.5	47.5	24.7	14.5%
Hydraulics	34.0	34.5	67.0	45.2	*(26.5%)
Grab	16.5	6.0	55.5	26.0	15.2%
Push/piler	18.5	7.0	5.5	10.3	6.0%
Boom	42.0	8.0	6.0	15.3	8.9%
Slew	4.0	4.0	15.0	7.6	4.4%
Electrical	7.5	—	—	2.5	1.4%
Total Hours	189.5	117.0	205.5	170.5	

* % of failures involving hydraulics.

Funkey Bell Loader

The Funkey Bell Loader was operated on the Wewe Sugar Estates last season. The design of the Bell Loader is most ingenious and completely original in concept. It has tremendous potential and will work on slopes which would previously have been considered quite impossible for a loader. Designed originally as a cane stacker the machine, in slightly modified form, performs the task of loading trailers admirably. It has not been possible, however, to get any reliable statistics on the performance of this machine and so these have not been included in this paper. The Bell Loader is basically an all hydraulic machine and suffered numerous breakdowns due to failure of the components of the hydraulic system. The reason for these failures is undoubtedly the tremendous pressure surges which are built up when the hydraulic motors are reversed from full ahead to full astern and under these conditions the pressure surges of 10,000 psi would not be at all surprising. Steps have been taken to rectify this fault and certain modifications have been carried out on the Wewe Bell Loader and this will be watched closely during the forthcoming season.

There is little doubt that the Bell is potentially an excellent machine and that it will be capable of operating on relatively steep slopes, although, admittedly, the production is very much reduced on the slopes.

Conclusion

The results achieved so far with Grab Loaders have been most encouraging particularly in respect of the terrain over which these machines have been proved capable of operating. As labour availability becomes more difficult and as the demands of labour grow so will the need to use Grab Loaders. The fact that production per unit labour is materially increased is important. On present levels of remuneration the Grab Loader shows no direct saving in the cost of cutting and loading cane, but since there is a saving in labour of between 36 and 50%, the saving would become more appreciable as wage rates increased.

The availability of a good maintenance service is essential in order to keep operating costs of these loaders to a minimum and to ensure their maximum availability for production.

An aspect of Grab Loader operation which has not been referred to in this paper is the skill of the operator. This is all important and I would like to pay tribute to the way these machines have been handled by the drivers at Tongaat. The African has proved himself to be a first class Grab Loader operator and any reasonably good tractor driver can be trained to operate these machines satisfactorily.

What of the future? Tongaat is tending to mark time, gain more experience in the operation of these loaders and at the same time keep abreast of the latest developments in this field, so that when it is necessary to introduce the Grab Loader system more extensively, it will be fully prepared. In the meantime the present Side Loader system used at Tongaat is serving the needs of the large mill-cum-planter estates very satisfactorily. This system is capable of operating on the most severe terrain and will continue to do so until such time as the availability or demands of labour make it necessary to change.

In the interim period, however, the long term process of field planning in preparation for the increased mechanisation which ultimately must come, must be constantly borne in mind and carried out progressively. Field layout planning is a long term project and in the author's opinion the time to start in this direction if indeed a start has not already been made, is now.