THE INTEGRATION OF BULK HANDLING OF CANE AND A MANUAL HARVESTING SYSTEM AT ILLOVO

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ABSTRACT

The development of cane supplies to the Illovo factory had, over the years, resulted in a method of cane handling at the mill which did not allow for a high degree of efficiency in road fleet and mill operations. The cane growing and harvesting practices in South Africa are such at the present time that any new cane-handling method must take cognizance of the advantages and stability of the existing manual cane-cutting practices. The objective set by the Illovo management was to integrate the latest methods of handling cane in bulk and an essentially manual cane-cutting system. This was achieved by using a portable in-field weighbridge for recording cane-cutting productivity, and from there onwards using bulk transloading, off-loading and stockpiling methods. These developments have resulted in significant economic and labour-saving advantages.

Introduction

The harvesting of sugarcane in the South African sugar industry is still virtually entirely done by hand. It is indeed fortunate that an adequate supply of labour is presently available, as the steepness of terrain, and the need to harvest unburnt cane in order to use the trash as a mulch for soil and water conservation and weed control purposes, precludes the use of existing mechanical harvesters on most cane farms in the industry.

Rising wage rates, however, have necessitated a review of the materials handling problem with the view, wherever possible, to taking advantage of proven bulk handling methods, and yet retaining manual workers to perform the basic cutting operation. Success in this direction will offset rising cutting costs and prolong the manual cutting of sugarcane.

This paper concerns the integration of up-to-date bulk handling methods and an essentially manually orientated harvesting system.

Description and advantages of the existing manual harvesting system

Bartlett,[1] in 1962, described in detail the manual harvesting systems incorporating the self-loading trailers used in South Africa at that time. While progress has been made in mechanising the stacking of the cane after cutting into suitable stacks for eventual removal by self-loading trailers, or loading the cut cane directly into the transporting vehicle, the actual cutting procedure has remained virtually unchanged. The only exception is that where mechanical stackers and loaders are used, the manual worker cuts the cane only. This development has led to the "split harvesting system" on some farms where two separate harvesting crews are used, the first to do the cutting and the second to do the stacking of the cane. This has been done in anticipation of the eventual mechanisation of the stacking or loading operation, and because its implementation can also result in productivity increases.

Regardless of the system used, the essential ingredients needed to maintain a contented harvesting team have been retained, namely, a set daily task based on weight for a fixed daily wage, coupled with an incentive bonus scheme for extra work done. In addition, the separating of the actual cutting and stacking operations from the transport operation means that the field workers retain a large degree of independence as to

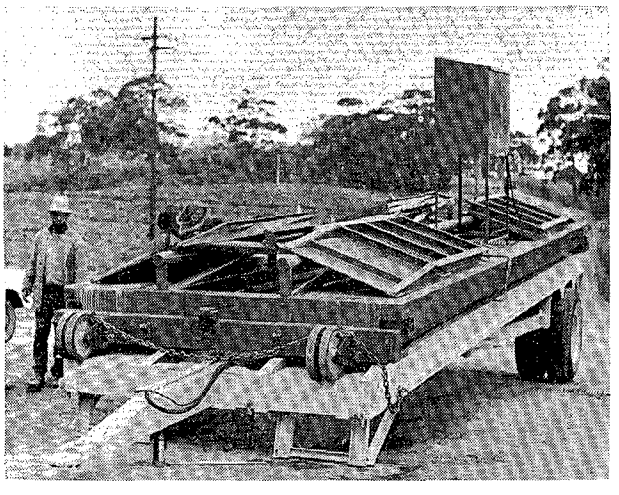

FIGURE 1 Portable weighbridge loaded on to its trailer ready for transporting to a new cutting area.

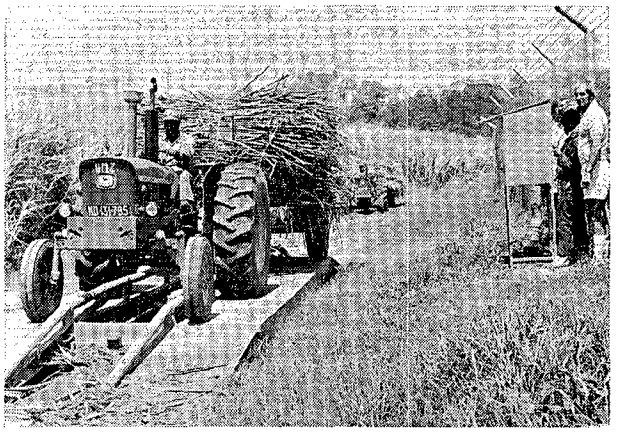

FIGURE 2 Each load of cane from the field is weighed on the portable weighbridge in order to obtain the stack weight for bonus purposes.

the rate at which they must work. The bonus scheme is so designed that fast work is repaid either in cash, if the length of working time is extended, or in leisure time, if the worker elects to complete his basic task only.

In some areas, cognizance is being paid to the condition of the cane to be harvested, and differential rates per ton of cane harvested are being paid according to yield, erectness of cane, and steepness of terrain. These, however, are merely a sophistication of the constituent elements of the harvesting system, rather than being major changes to the original concept.

In considering any possible advances in the methods and efficiency of cane harvesting and handling in South Africa, therefore, cognizance has had to be taken of the advantages and stability of the existing harvesting methods using manual labour.

Description and disadvantages of the former cane handling system at Illovo

The factory of the Illovo Sugar Estates Limited is located on the South Coast of Natal some 37 kilometres south of Durban. The company has two major cane-growing areas, namely, approximately 2 000 hectares each at Illovo and at Powerscourt, the latter being some 30 kilometres inland from the factory. These produce about 38% of the mill crush, the rest coming from 30 to 55 kilometres inland from private cane growers.

The miller-cum-planter's previous cane handling system consisted of tractor-drawn "Bell" self-loading trailers which operated in-field to lift and transport cane stacks weighing from 3 to 5 tons. These were then drawn from the field to strategically-located transshipment points where the bundles were self-off-loaded in the chain slings on to the ground. As the in-field transport only works during daylight hours, and the bulk transport vehicles used to haul the cane to the mill operate day and night, it follows that a stockpile of cane is built up at the transhipment points during the day.

FIGURE 3 After weighing, the stacks of cane are spilt free of chains in a windrow of stacks ready for transloading into Hilo trailers.

The bundles of cane were labelled with the date of cutting and the cutter's identification, and upon transshipping into the bulk Hilo type (chain net) vehicles, the weight of the bundle was recorded for bonus payment purposes. The equipment used for transhipping varied from the old-type "Zulu" crane, through the more up-to-date "Mobamech" hydraulic crane, to the more manoeuverable "Hyster" fork-lift crane which could be easily moved from one transhipment point to another, depending on the cane supply. This transshipping operation removed the chain slings from the bundle and the "bulk" or "loose" cane was transported to the mill where it was transloaded with a chain net off-loader into large rail cars for the final 400-metre trip to the mill carrier. The cane "stockpile" in these rail-cars totals only about 350 tons, while the mill crushing rate averages 110 tons per hour.

As stated earlier, the company only supplies 38% of the mill crush, the rest being supplied by private growers, the bulk of which comes from some 30 to 55 kilometres from the mill. The company, however, transports the growers' cane, the bulk being in Hilo-type road vehicles, which are off-loaded at the mill in the manner already described, and the rest on the estate-owned railway.

The rather awkward cane-handling facilities at the mill which existed prior to the recent alterations were

FIGURE 4 A tractor-mounted transloader is used to load the cane from the windrow of "Bell" stacks into the Hilo trailer.

the result of the Illovo Group's cane-growing expansion into the Natal Midlands and the eventual construction inland of the Group's Jaagbaan factory in the early 1960's to handle this cane.

Prior to the construction of the Jaagbaan mill, all the Midlands cane was railed to Illovo on the South African Railways, and this necessitated a large rail marshalling yard at the mill. The big expansion in the 1960's which led to the opening of the Jaagbaan mill, also led to present Illovo growers expanding their production beyond the capacity of the estate-owned railway line, hence the movement to road transportation of their cane.

Because of the extent of vital buildings close to the cane carrier which precluded the construction of a large road gantry in this area, the decision was taken to use "net-spillers" to tranship the road cane from Hilo trailers into railcars at a point close to the marshalling yard, and that these cars and the marshalling yard, would be used as the "stockpile" facility at the mill.

This resulted in what is now called the XR system, so named because the company purchased redundant South African Railway trucks (ex-S.A.R.) which were modified to have sloping floors and side doors, for easy and quick off-loading into the cane carrier.

While this system served admirably at the time, further expansion of cane supplies and the increasing movement toward road-delivered cane produced increasing problems in trying to guarantee continuous crushing. The "XRs" and the "Hilo spiller" became bottlenecks which often resulted in the road fleet incurring considerable down-time while waiting to be off-loaded. The timing of operations had to be extremely critical to ensure that the estate railway line traffic was cleared at the right time in order to enable timeous placement of trucks on the growers' sidings.

FIGURE 5 Hilo trailer being off-loaded and the "loose" or "bulk" cane being spilled on to the mill yard floor.

Because of the distance the road cane had to be hauled, any delay of vehicles at the mill inevitably ended in a shortfall of cane some 6 to 8 hours later. Similarly, any delays on the long haul down the national highway through accidents, holiday traffic, roadworks, etc., added to the tight scheduling. It was a case of either "feast or famine", and in 1971 the whole problem was investigated with the view to improving the overall position.

It soon became clear that the single "spiller" Hilo off-loader was a vulnerable area, while the cane stockpile capacity of the XRs at about 350 tons was too small for the mill crushing rate and the long cane supply line.

It was found that the ideal situation would be to close down the XR system completely and replace it with a large cane yard and spiller tables. The cost of such a step, and the limited stockpile facility of the tables, however, was prohibitive, and other alternatives were investigated. The need for an alternative Hilo off-loader was obvious, but exactly how loose bulk cane could be stockpiled, in sufficient quantities, and separately for individual sucrose testing was a problem. The thought of increasing the number of XRs to provide additional stockpiling facilities was rejected because of the cost, and the fact that it perpetuated an undesirable system. The construction of a large overhead gantry to handle "bundled" cane was rejected because it would require the demolition of vital buildings close to the carrier, and would necessitate a retrograde step from bulk to bundled cane. In fact, the investigation was directed towards increasing rather than decreasing the bulk handling of cane.

The objective, therefore, was to eliminate the bottlenecks described, and increase the stockpile facility at

FIGURE 6 A caterpillar 950 loader fitted with a Cameco grab and cleaning rake is used to remove the cane from the off-loader wall and transfer it into the bulk stockpile.

the mill carrier to ensure continuity of crushing, and at the same time to expand further into the bulk handling of cane so as to secure the economic advantages therefrom. It should be pointed out that the cost of handling cane in bundles held together by chain slings, coupled with the problems arising from the management of large numbers of slings, over long distances, were further incentives to move towards the bulk handling of cane from the field to the factory.

Description and advantages of the new cane handling system at Illovo

As previously stated, the main objective of the investigation was to improve the continuity of cane flow to the mill carrier and that the advantages of the bulk handling of cane be retained and expanded. This, however, had to be done without making any major alterations to the existing manual harvesting methods.

The decision was taken to switch from the transshipment of bundles of cane at the transhipment points using cranes, to transloading bulk or loose cane using a tractor-mounted grab loader. This loose cane is placed at the transloading point by the in-field trailers which self off-load their bundles in a windrow of "loose" bundles of cane. This eliminated the necessity for chains and ensured a far more regular payload in the large Hilo-type vehicles. This change, however, created a further problem in that, by no longer using chains and cranes, the individual weights of each bundle brought from the field on the self-loading trailers, and held only by the winching rope, could not be determined, a vital requirement of the manual harvesting system. This problem was overcome by designing and constructing a portable hydraulic weighbridge on which the entire tractor and trailer unit would be weighed to determine the bundle weight for labour productivity and payment purposes. This weighbridge can be located wherever required; that is, either close to the field where cutting is taking place, or at a central point, possibly the transloading point, if cane is being received from a number of fields.

The machine used for the transloading operation was a standard in-field cane grab which had its "king-post" heightened in order to allow it to load one-ton bundles of cane into the high-sided "Hilo" trailers. The loader was mounted on a four-wheel drive agricultural tractor which gave it good stability and traction on adverse ground conditions. These advantages now allow transloading to take place at unprepared places (e.g. alongside a main cane road) rather than at large, level and hardened transhipping areas as was required for the operation of the usual transhipment crane.

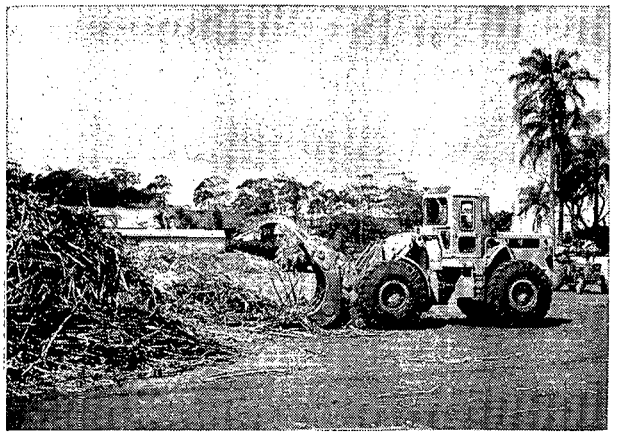

FIGURE 7 The grab of the loader is able to move 5 tons of cane at a time and is capable of feeding the mill at a rate of 200 tons per hour. The rake is seen ahead of the front tyres and is used to keep the concrete cane yard clean.

Another advantage of this method of transloading is that the manoeuvrability of the grab enables it to be quickly moved from one transloading zone to another, thereby serving a number of cutting areas. As such, a single transloader is able to replace more than one of the old type transhipment cranes if operated on a 24-hour basis.

The advantages of using a grab to transload loose, or bulk, cane instead of the normal transhipment crane transhipping bundles of cane held in chain slings, can be listed as follows:

1. There is no hold-up of in-field transport due to a shortage of chains.
2. There is an increase in the utilization of in-field tractor and trailer units.
3. There is a saving in the capital and maintenance costs associated with chain slings.
4. There is a large saving in labour formerly used to handle chains and re-stack spilt cane or broken bundles.
5. The use of a grab on bulk cane results in cleaner staging posts and less "trampled" cane.
6. The payloads of the Hilo trailers can be more evenly controlled.
7. The average payload of the Hilo trailers can be increased from an average of 9,2 tons using bundles, to the desired 14 tons.
8. The loader can be used to load direct into Hilos in the field, should field conditions be suitable, thereby eliminating the in-field transport operation.
9. The grab loader is far more mobile than the conventional crane, and can be easily and quickly moved from point to point.
10. As the loader is mounted on a conventional tractor and costs less to buy than cranes currently in use, yet can load at the same rate, it is felt that the cost of machine operation per ton of cane, will be reduced.

The system of handling cane described above was introduced at the company's Illovo sections during the 1973-74 season and has already justified the change.

The second part of the investigation was the problem of the "bottlenecks" at the mill. It was fortunate that the author visited Louisiana in 1971 at the time of the XIV ISSCT Congress, and was able to observe the bulk handling of cane in that State. It was there that the thought of using a large cane grab to handle and

stockpile "loose" cane in the Illovo mill yard first arose.

It was clear that a second chain-net off-loader was required in order to relieve the "bottleneck" at the existing spiller. It was decided that if an area could be found close to the mill carrier, and large enough on which to stockpile about 900 tons of "loose" or bulk cane, giving a total stockpiling facility of some 1 250 tons of cane, the second "bottleneck" would be relieved, viz. the limited (350-ton) stockpile facility of the XR rail cars. A further complicating factor, however, was that provision had to be made for keeping consignments from individual growers separate for sucrose testing purposes.

The investigation revealed that a suitable area could be cleared, and that the sampling problem could be overcome by stockpiling only the miller-cum-planter cane in the new bulk stockpiling area and treating it as being from a single consignee.

It was decided, therefore, to install a new weighbridge to weigh road vehicles, and a second cane spiller to off-load the Hilo, or chain-net, trailers whether they be large 40-foot road vehicles or 10-foot, mechanically loaded in-field trailers. A large concreted area covering approximately 0,3 of a hectare had to be constructed close to the mill carrier and a Caterpillar 950 loader fitted with a Cameco cane grab was purchased to stockpile the loose cane and feed the mill carrier. The cane in the yard is handled on a "first in, first out" basis to ensure the freshness of cane.

The new arrangement was commissioned in June 1973, and its advantages can be listed as follows:

1. All cane is handled in bulk, thereby removing the necessity for using chains.
2. In-field self-loading trailers operating from fields close to the mill can deliver cane direct to the mill, thereby eliminating the transloading operation.
3. The second spiller off-loader has resulted in a quicker off-loading of road vehicles, thereby reducing downtime.
4. Labour costs have been reduced.
5. The additional stockpile capacity has reduced the number and length of "no cane" mill stops.
6. The additional stockpile capacity has reduced the downtime of vehicles formerly caused by the XRs being full, either due to a mill breakdown, or due to rail traffic being given off-loading priority.

Conclusions

It had to be accepted that any improvements in cane handling due to using bulk handling techniques, had to take cognizance of the fact that manual cutting of cane would continue at Illovo for some years to come. The steps taken at Illovo have achieved this.

The incorporation of bulk transloading methods from in-field to road transport at Illovo's coastal estate, and the bulk handling and stockpiling of cane in the Illovo mill-yard, has resulted in definite economic and labour-saving advantages. While the bulk transloading of cane is presently limited to only one estate, and the bulk stockpiling at the mill is limited to only miller-cum-planter cane, it is felt that this can be expanded in the years to come. It will, however, be necessary to develop a new method of obtaining representative samples of individual consignments should the need arise to handle a number of consignees' cane in the bulk cane yard.

REFERENCE

1. Bartlett, G. S. (1962). The development of self-loading cane trailers, transhipment cranes and gantries. ISSCT Proc. 11 : 380-394.