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SRDC Grower Group Project Final Report

SRDC project number:	HGP002
Group name:	Design and build a moving wall on side tipping cane transporters
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Australian Government
Sugar Research and Development Corporation

Body of Report

Executive Summary:

With the finalisation of the New South Wales Sugar Milling Cooperative's Co-generation project, the transportation of whole of cane crop, with its 50% increase in bulk density, without losing the current efficiencies of two 33m^3 infield transporters or haul-outs loads to one 66m^3 road transport container and secure with a automated tarp was the aim. To maintain road transport efficiencies, the decision was made to introduce new 90m^3 aluminium transport containers with automatic tarping systems.

The logical harvest haul-out response was to follow suit and increase haul outs by the same percentage. Trial work done with the group's old haul-outs tipping whole cane crops, but this resulted in unloading difficulties as the leaf material held the load together instead of achieving a pouring action as is experienced with clean and burnt cane. The 8 tonne load remained in the haul-out basket causing it to become dangerously unstable as maximum tipping height was achieved, then the load would release in one uncontrolled mass. This resulted in cane spillage and very uneven loads which were unable to be tarped and greatly increased the chance of serious damage to equipment due to the unstable tipping process.

These issues would compound with the proposed larger 48m^3 12 tonne haul-outs. To address this, some type of device is needed to encourage the load to tip in a controlled manner, without spillage before causing instability in the haul-out bins and evenly enough for the automated tarping system to be utilised.

While constructing the larger tipping basket, the opportunity was taken to have a centre dividing wall included. This had two major benefits:

1) The majority of the load could be tipped in two lots, front and rear.
2) A device to assist unloading could be built and trialled in two stages.

A new 48m^3 haul-out was built with additional changes that could be trialled:

1) Tipping angel potential increased from 45% to 56%
2) Dividing wall separating haul-out bin in two, front and rear.
3) Metal sheeted sides instead of traditional mesh.
4) Tipping side wall design and construction to enable retro fitting of moving side wall.

A device we call a moving side wall was built and installed on the front half of the new haul-out. This was extensively trialled and a number of modifications made prior a second unit being fitted to the rear section. With the haul-outs ability to safely unload rather than tipping, further trials where carried out during November and December. The experiences and information gained covered not only unloading whole of cane crop from haul-out into road transport containers but also harvesting performance of whole cane, performance of the road transport system in such areas as load weights, tarping systems and discharge at the mill were monitored with a number of issues being identified, resulting in some changes being made and areas that need more work being identified.

Background:

The NSW sugar industry in late 60's early 70's not only moved into mechanical harvesting but also expanded, in many cases, into fragmented production areas. To overcome the limitations of rail access, the industry decided to introduce a road transport system using large single containers placed on a farm pad. It was soon established that the most efficient way to fill these was using side tipping transporters or haul-outs. Most of the NSW cane is grown on flood plains and this, combined with high rainfall, meant that compaction and floatation during wet harvests was a

limiting factor in pay load size, so three tipping with 8tonne haul-outs was standard. Advances in higher flotation ground equipment and load sharing hitches improved the ability of two tipping with 12tonne haul-outs, further improving efficiencies. However with these larger haul-outs loading road containers, more control in tipping cane was needed so things such as bin flaps, flipper rollers and levelling arms have been introduced. These where very effective in burnt or clean cane, however they had the opposite effect on whole cane loads. With all these unsolved challenges many considered the easiest option was to retain the size of the existing haul-outs and with whole cane harvests revert back to three tipping. However a few in Pacific Cane Harvesting group considered the social, economic and environmental price was too high.

Design work started on the larger haul-out option. The ridged structural integrity had to be retained as this had potential impact in two key areas; the onboard weighing system, critical to loading road transport and the tipping mechanism once the bin is elevated on the haul-out. Then the issue of unloading is where the SRDC funded moving sidewall became so important to the whole project as this was considered the highest risk part of the project and 32% of original costing of the total project. With SRDC commitment, Pacific Cane Harvesting members had the confidence and finance to proceed with the project.

This project has given the NSW industry the confidence that larger haul-outs are manageable and two more are under construction and both with the moving side wall.

Aims:
Our aim was to develop the most efficient transport of whole of cane from the harvester to road transport bins.

Methodology:
From its conception, the success of this project was underlined by the commitment of SRDC, Pacific Cane Harvesting, Mclean Aquip and the NSW Sugar Milling Cooperative. The program was for McLean Aquip to modify one of Pacific Harvestings existing rolling chassis and mount on it a new 48m^3 side tipping bin, then with SRDC funding develop and install on the bin a moving side wall to over come problems in transporting and unloading whole of cane crop. Once the new unit was commissioned NSW Sugar milling cooperative would schedule transport and supply a new 90m^3 prototype aluminium road transport bin for trials and accommodate the resulting whole of crop product at the mill.

The trails cover a number of key areas:

1) Trail the load capacity of both haul-out and road transport bin this included trials with billet length and there impact in whole cane.
2) Transferring whole cane from larger haul-out with out moving side wall to road transport bin.
3) Commissioning and trialling moving side wall.
4) Design and specifications for moving side wall
5) Operating and assessing performance while maximising load in road transport bin and trialling tarping system.

Results and Outputs
In hindsight the time frame of this project was ambitious; information gathered was from loading the only road transport bin a total of 20 times, total of 450-500 tonnes of whole cane was trialled.

1) A: <u>Harvester</u>. Harvester used for trials was a 2004 Case 7700 with standard four blade differential chop with short and long chop options. Short chop slows down the last three sets of feed rollers making the harvester inefficient and contradicting feed train optimisation practice. However it did achieve shorter average billet length of 125mm-200mm. The preferred more efficient standard chop mode produced a consistent 200mm billet length. The limited data collected show a bulk density difference of 2-4% depending on cane variety, equating to $^1/_2$-1 tonne per road transport bin.

B: <u>Bin capacity.</u> Old ratoon crops which gave a greater trash or leaf to cane ratio and varieties BN81-1394, Concord and Q124 where used for the trial. All weight data was taken form the mill weigh bridge records. 4 of the 20 road bins were loaded with shorter billet length however the negative impact on the harvester for the small gains in bulk density improvement and the target weight of 22-23.5 tonnes was proven to be achievable with the longer billets, the standard chop mode was bench marked for further trials. The 48m^3 haul-out was able to accommodate 50% of the target road bin weight. The bulk density achieved by the haul-out was maintained or improved in the transfer operation to the road bin; two of all the loaded 48 m^3 fitted into the 90m^3 road bin.

2) <u>Transferring whole cane from 48m^3 to 90m^3 road transport bin without moving side wall.</u> This was a total disaster! Due to the packing effect on the whole cane load during loading and transporting resulted in the load hanging up in the elevated haul-out basket causing problems with placement in the road bin and trying to control this with the existing control flaps the load was over centre and very unstable placing extra strain on equipment. When the basket was tipped higher enough for the load to release it came as one huge mass and unacceptable spillage and uneven loads resulted.

3) <u>Commissioning and trialling moving side wall.</u> This was done in two stages with all the design improvements being able to be included in the second stage. Also having the haul-out with the moving side wall on the front half and conventual tipping configuration on the rear was excellent in demonstrating the effectiveness of the moving side wall. Some areas of the original design where changed and included in second stage.

a) Increased torque and decreased speed of operation needed, increased capacity of hydraulic drive motors.

b) Chains jumping off due top shaft flexing, addition support bearings added.

c) Bottom idler shafts bending, increased shaft and bearing size.

d) Tunnelling out effect on whole cane load making system ineffective, reduced the number of flights to four on each chain.

Once these changes where made the moving side wall operation was both very reliable and performed above expectations.

4) <u>Designs/ specifications for moving side wall. (</u>Drawings sent separately or attached due to file size when converted to word doc)

These drawings are part of patent application No 2005101047. Further information of drawings and specifications can be obtained from McLean Aquip ph 0266722148.

5) <u>Operation and assessment.</u> With both stages of the moving side wall operation trials on unloading technics and the loading and tarping of road bin where carried out.

In summary:

- Due the extra height of the road bin lack of visibility was experienced by the haul-out operator this was overcome with the instillation of two cameras and monitor in tractor cab.
- Elevating the haul-out tipping floor only to a horizontal position rather than the higher traditional tipping position and using the moving side wall to unload rather than tipping the

load, good control and placement of product was achieved. Spillage and haul-out instability problems were over come.

- Unloading times were started from the time the haul-out was positioned beside road bin and stopped when unloading was complete and haul-out started to move away. The first tip was the quickest as placement and spillage weren't as critical an average time of two minutes was achievable. The second took three and a half to four minutes.
- Even though the evenness of the load in the road bin was greatly improved with the moving side wall, the traditional levelling arm attached to the haul-out that wiped across the top of the loaded road bin to even or level the load reading it for tarping was not effective with whole cane. A number of static modification were tried all of which failed so each road bin trailed had to be manually levelled by hand! However maximum target loads of 22-23.5 tonne were achieved. The project group are confident that a hydraulic driven counter rotating spiked roller fitted to the levelling arm would achieve the levelling result required to operate automatic tarping system. However time limits meant this idea will have to developed and trailed during the 2006 harvest season.

Capacity Building:
The groups' capacity to carry out R&D was encouraged due to financial support form SRDC. The group was very focused on the mechanics of the task at hand during trials however recording data and photos was lacking. The project was reliant on the supply and availability equipment and resources from a number of areas therefore the groups outlined time frame for the project was to ambitious.

Outcomes:
Two of the three predicted benefits have been achieved.

- The benefit of maintaining the efficient two tip operation in the infield haulage of whole cane and its transfer safely without spillage while achieving targeted payloads has been achieved.
- However having the load ready for an automated taring system needs improving, a system is being worked and the group is confident but this as yet has not been achieved.
- The full benefit of the project will only be achieved with the success of levelling arm or device to ready the load for tarping.

Environmental Impact:
Being able the carry and manage larger loads without spillage, minimises the number of both infield and road trips resulting in less fuel, dust and noise.

Communication and Adoption of Outputs:
Adoption of project results have been dampened by the announcement in February 2006 by the NSWSMC that the collection of biomass for its cogeneration project would be postponed by twelve months has taken pressure off harvesting groups to change equipment for the 2006 season. However two more 48m^3 bins with moving side wall are under construction and with operate throughout 2006 season, Pacific cane harvesting will operate two in the Condong mill area the other will be in operation in the Broadwater area also other groups planning to make changes for the 2007 season based on moving to or maintaining the two tipping principal. Due to the successful transfer of whole cane product the need for better levelling is obvious, therefore the majority of harvesting groups in the Condong mill area have committed to working together in developing a haul-out attached levelling arm or device to prepare the loaded road bin for the mandatory tarping system. This is now seen by all to be the top priority in both two and three tipping scenarios. We felt to encourage Cane Grower and Cane Harvester magazines before this is sorted would be counterproductive it is expected this will happen during the 2006 harvest season. The bin was

featured in a NSW industry article titled Trash Matters which was sent to NSW growers. Pacific Cane Harvesting has hosted Qld grower group reps from the Burdekin, Proserpine and Sarina all of which viewed the bin and had the project explained. At each trial invitations were given to the Condong trash committee and harvester reps, on the 13 December 2006 a demonstration day was held for the Broadwater growers and harvester groups in which two road bins were loaded. A CD has been compiled of development and trials this has been very helpful in viewing whole-of-crop products behaviour while being unloaded. This CD will be made available to any interested party.

Recommendations:
With harvester rationalisation, extended harvesting hours, higher through put, capital cost of equipment and more grower owned cooperatives the in farm shed R&D and modifications are becoming more complex, difficult and expensive. Add the loss of Case (Austoft) off shore, and neither Case nor Cameco showing any interest in haulout equipment or harvester modifications and many traditional cane equipment manufactures are now servicing the more lucrative mining industry. It is increasingly more difficult to have harvesting and haulout equipment that meets the positive farming system changes and value adding we are seeing in the Australian sugar industry thanks impart to SRDC. More harvesting group funding should be an area seriously considered.

Publications: copy of Trash Matters, Development photos and final report attached in CD.