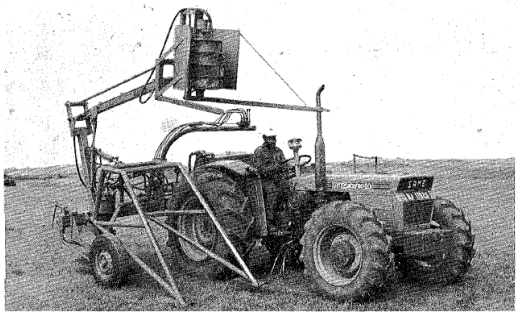
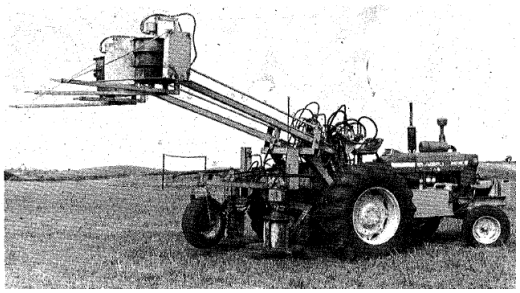
Mechanical Sugarcane Harvesting

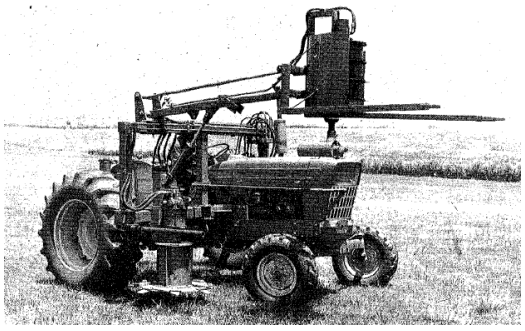
The increase in minimum labour wage as well as the lack of labour availability or inclination to cut cane has resulted in growers investigating on-farm mechanical equipment. In order for the equipment to be economically viable to the farm, growers must consider factors such as the cost of the equipment in relation to the operation and utilization of equipment, the limitations and suitability of the equipment, slope of the land, field access and other factors such as soil compaction and crop damage and harvesting losses.

Such investigations are not new to the industry. At SASRI we have reviews of many of the models that were developed when SASRI had a fully equipped workshop and team of design engineers, draughtsmen, technical artisans which looked primarily at the development of such harvesting machines over a period of time of about 20 years. Review paper 11 (1996), "the development of cane harvesting machinery and systems in SA" refers with over 18 different harvesting machines. During the 1970's and 1980's a subsidy scheme also existed for the development of on farm harvesting equipment. During this 11 year period no commercially successful machinery was ultimately adopted on a large scale that could meet the industry's mechanisation needs adequately at a cost to compete with manual harvesting systems. Many of the whole-stalk designs are compromised when the cane is lodged, or when green cane is to be harvested or field conditions are adverse. The SASRI info sheets 6.6 & 6.7 covers pros and cons of different equipment and also describes aspects that need to be considered before adopting mechanical harvesting. Here is some of the equipment developed and prototyped during that period:

- **Gobbler cane harvester (South Africa)**
  Mounted to the side of a tractor, this machine is designed to top and base cut cane, convey the cane stalks into a bin for accumulation to approximately 200kg capacity where after the cane was dropped into a loose bundle for mechanical loading.
  
- **SASEX cane cutter (100t/day) (South Africa)**
  This cutter is also mounted to the side of a 50kW or greater tractor and carried on the 3-point hitch for easy hitching or detaching. Various models were developed that could top and base cut and laid in a sausage windrow for manual stacking, bundling or windrowing.
  
- **Edgecombe cutter (200t/day) (South Africa)**
  Two rows of cane (of 1 to 1.5m row spacing) are topped and base cut into a sausage windrow. The cutter is able to straddle the rows being cut and can thus cut in any direction, open up a field or create fire breaks as required and can operate in burnt or green cane.



- **Midway cutter: (100t/day) (South Africa)**
  As the name suggests, the cutting mechanism is located mid-way between the front and rear tractor tyres. Cane is cut and directed underneath the tractor into a sausage. A topper is mounted in front of the tractor.



- **Bell cutter: (13t/hr to cut, top and load) (South Africa)**
  A Bell loader was fitted with two base-cutting components from the Edgecombe cutter. This resulted in 2 rows being cut per pass (The Bell loader operating in the reverse direction). Various topping mechanisms were tested, the final version being a compact side mounted sickle bar operated during loading operations. The sausage windrow formed required labour to manually assemble the cut sausage into neat bundles (of about 200kg) prior to the loading/topping operations.

- Ngwenya: This machine was developed as a green cane soldier type harvester which would cut, top, detrash and bundle between 200-300kg of green cane.

Internationally there has also been a lot of research and development to create small tractor mounted harvesting equipment. These include:
The Simon harvester (France) http://www.machines-simon.com

The INTA harvester is a prototype design being researched and developed in Argentina. It has been developed to cut and load whole stick green cane into an accompanying trailer. It is not yet commercially available.

The commercially available Hodge Series 2000 cane cutter (Australia):

When choosing a particular harvesting machine, the grower must evaluate its capabilities on the farm based on the circumstances under which it is used. SASRI *Information sheet 6.6: Mechanical sugarcane harvesting systems* highlights a wide range of equipment and provides details of the pros and cons of particular models. Some of the locally available mechanisation options include:-

- **Front mounted cutters (Various designs): (±30t/h to base cut and top)**
  An ISSCT paper by Boast, 1989, describes the development of an economical mechanical front mounted cane cutter typically for use in burnt cane operations. A single line of cane is cut and topped per pass and left in a linear 'sausage' windrow. Labour is typically required to merge multiple sausage windrows into transverse windrows suitable for mechanical loading operations. The paper provides details on labour requirements for the harvesting and loading operations associated with the system.

- **Orbach: (±20 to ±40t/h to base cut and top).**

This cane harvester is designed to base cut, top and bundle cane in the field. The tractor power requirement is about 50kW. The harvester is mounted onto the 3-point tractor linkage. The harvester has since been upgraded from the one shown and is rated at ±50t/h depending on field and operating conditions. A speed of ±5km/h is referenced. A tractor of ±70kW is required and 4wd is preferable especially on slopes.

A similar concept machine currently available to the industry is:

- **Vicro harvester: (±25t/h)**
  The Vicro harvester is mounted on the 3-point tractor linkage and cuts cane rows adjacent to the tractor. The harvester is designed to base cut, top and bundle cane in the field. A tractor of >60kW is required and 4wd is preferable.

- There are a few smaller sized harvesters that have been developed for sharper turning for small fields and improved infield manoeuvrability. These include the Austoft 4000 harvester (left) and the John Deere CH330 (3520W) harvester (right) developed primarily for the Indian sugarcane industry but potentially could be introduced into the South African industry. There is also a John Deere CH330 harvester being tested in the KZN midlands.

Chopper harvesters have however met most of the requirements of harvesting under a larger range of conditions, slopes, lodged cane, green cane, and topping requirements.Due to their high costs, mechanical harvesters require a large throughput to make them cost effective. The extraction vehicles that support the harvester also need to be taken into consideration. Mechanical harvesting systems also require infield

management to minimise field and stool damage due to the high level of infield traffic. The adoption of a fully-mechanised system thus requires careful planning from row spacing through to field extraction roads and routes. With high levels of infield traffic, growers are encouraged to implement better infield vehicle management practices such as controlled traffic. A SASRI information sheet detailing the aspects that must be considered before implementing mechanised systems is available (*Information sheet 6.7: Factors to consider when implementing mechanised cane harvesting).*
Where fully mechanised systems are unsuitable, semi-mechanical harvesting aids and equipment may then be an option. Below are a few examples:-

- **Brush Cutter (Not commercially available)**
  Research was done to develop a brush cutter for cane cutting. This became known as the Illovo cane cutter, details of which can be found in SASTA papers (Langton *et al.*, 2006) and (Lyne *et al.*, 2007)**.**

- **Cane Thumper (commercially available)**
  This is a walk behind, self-propelled semi-mechanical implement (Langton *et al.*, 2008)**.** This has a double-knife sickle bar principle with oscillating blades for base cutting of the cane. It is rated as being capable of harvesting 0.8 to 1 ha per day using 7 to 8 labourers under average conditions.

Source: ESM website: www.canethumper.co.za (Further technical specifications and reports are available on the website)

SASRI is also able to provide plans for some equipment such as cane cutter mechanisms, quick hitches, crane, Hot Water Treatment tanks etc. There are also a series of videos on local and international equipment options. In addition, growers may request an advisory economic analysis tailored to their farming operational needs to find out whether a mechanical aid is comparable or more cost effective than manual labour costs. For more information on these resources, please contact SASRI's Agricultural Research Engineer, Peter Tweddle (peter.tweddle@sugar.org.za) or your local Extension Specialist.