



FULL LENGTH ARTICLE

# An assessment of mechanical vs manual harvesting of the sugarcane in Sudan – The case of Sennar Sugar Factory



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**Abstract** The rehabilitation works carried out in the Sennar sugarcane factory in Sudan, improved the rates of milling accompanied by the horizontal and vertical expansions of the farm compelled Sennar factory to go for mechanical harvesting to solve the problem of labor shortage. The aim of this paper is to evaluate the current sugarcane manual and mechanical harvesting systems with regard to production efficiency, cost effectiveness, cane loading efficiency, infield losses, and the effect of trash (extraneous matter) in factory process. Different experiments were conducted to compare and contrast between the two harvesting systems. The results revealed that manual harvesting (8.98 SDG/ton) is more expensive than mechanical harvesting (4.9.5 SDG/ton); the wages for the cane cutting labor represent 74.14% of the total cutting cost, 46% of the total manual harvesting cost, and 18.9% of the total harvesting cost. Infield cane losses represent 4.72% and 4.22% of the actual yield for the manual harvesting and mechanical harvesting systems, respectively. Moreover, the results showed a significant difference between the two harvesting systems with regard to the cane weight/trailer (ton/trailer) and trash percent. On average the cane weight (ton/trailer) is 6.88 for manual harvesting and 10.12 for mechanical harvesting. The trash percent is only 3.66% for manually harvested cane while it reached 9.49 for the mechanically harvested cane. A 1% increase in trash will lead to decrease in sugar recovery by 0.1%. It could be recommended that Sennar Sugar Factory as well as other sugar factories in Sudan could go for increasing the mechanical harvesting

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system and reducing the manual harvesting to less than 10% of the total area. The specialized cane cutter labors should be employed in other agricultural operations during the off-season to insure their availability at the start of the season. A further research is needed to reduce the infield cane losses and trash percent and to determine their effect on cane quality and factory performance for the two harvesting systems.

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## 1. Introduction

Prior to the secession of the South Sudan, agriculture represents the main sector of the economy in Sudan. It contributes over 30% of the national gross product and more than 95% of the foreign trade (Bank of Sudan, 2010). In actual fact agriculture provides a living for more than 50% of the population. Future economic development is also based on agriculture, because out of 84 million hectares of cultivable land only 15% is under cultivation. According to Mohammed (2011) the secession of Southern Sudan has deprived the country of 25% of its total area, 24% of population, over 80% of its oil income. Moreover, it has separated with 75% of its vegetation cover and 30% of potential arable land. In addition, Sudan stands to tolerate at least 25% of its water resources. Economic situation precarious with the Darfur rebellions, the inception of Southern Kordofan's region civil strifes and the inflamed complaints in its Blue Nile region. That resulted besides deprivation of oil revenues and other potentials to increased cost of national security and expenditures on additional revenues to meet such funds for securing peace (Mohammed, 2011).

Under these adverse economic conditions, the sugar industry in Sudan is well established with proven track records on production efficiencies and technological advancements.

Since the establishment of the first sugar factory in 1962; the domestic sugar industry has sustained steady growth and expansion. In addition to progressing on the knowledge and expertise accumulated over its 50 years history, the Sudan sugar industry is also advancing amid global technological developments in the fields of bio-energy: cogeneration and ethanol (Federal Ministry of Agriculture, 2010).

Sugar is considered as one of the major strategic commodities in the country, sugar production started for the first time in Gunied (1962–1963). Later other sugar factories came into operation at New-Halfa (1965–1966), North West Sennar (1976–1977), Assalaya (1980–1981), Kenana (1980–1981), and finally White Nile Sugar Company (2004). Table 1 shows the capacities of Sudanese Sugar Factories.

In the last ten years the Sudanese Sugar Company (SSC) had witnessed a steady increase in sugarcane and sugar pro-

duction. The horizontal and vertical expansion in sugar cane production accompanied by the good performance in the factories due to the rehabilitation work carried out during these years gave remarkable figures: (1) area under cane horizontally increased from 70,000 to 81,200 Faddan; (2) cane yield per Faddan increased from 29 to 44.6 tons; (3) the crushing capacity per day increased from 8876 tons per day to approximately 20,000 tons of cane per day; (4) the total sugar production increased from 175,000 to 327,000 tons of sugar per year and (5) factory time efficiency increased and the downtime i.e. time lost for the milling plant decreased from 40% to less than 15%.

All these points reflect the need to improve harvest practices such as cutting windrowing, loading and haulage to improve delivery of cane from fields to the factory at the right time.

Evidence and lessons from Latin America (Ella, 2012) brief illustrated and summarized the advantages and disadvantages of switching from manual to mechanized sugarcane harvesting in Brazil. The brief showed that pre-harvest burning of sugarcane leaves is a common practice that enables manual pickers to collect the crop quickly, suffering less personal injury. The burning process, however, has negative impacts on the environment, on human health and on the potential energy value of the plant. On the other hand mechanization eliminates the need for burning, speeding up the collection process, eliminating harmful emissions from smoke, reducing crop wastage and thus increasing productivity in terms of energy generation. Electricity generated from sugarcane biomass can also be sold to the grid, increasing both producers' income and the national energy supply.

Table 2 indicates clearly the effect of the rehabilitation work and the renewal of the equipment carried out in Sennar by Sudanese Sugar Company from year 1993 onwards and till now the follow up is going on which leads to improvement year after year.

This improvement in performance and the increase in the rate of crushing made the harvesting and transportation of sugarcane to the factory an important factor for the success of the season.

Sudanese Sugar Company in the last ten years incurred a high cost in harvesting to attract the labor, the price per unit

**Table 1** Capacity of Sudanese Sugar Factories.

Factory	Startup date	Design capacity ton sugar/year	Total area Faddan	Designed crushing capacity ton cane/day	Highest actual production (ton sugar/year)
Guneid	1962	60.000	40.000	4.000	94,171
New-Halfa	1964	75.000	40.000	5.000	87,759
Sennar	1976	110.000	38.000	6.500	92,038
Assalaya	1980	110.000	44.000	6.500	97,500
Kenana	1981	330.000	94.000	17.000	427,895

Source: – Sudanese Sugar Company Khartoum (2006) and Federal Ministry of Agriculture, Investment Development Agency (2010).

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