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# Mechanical Loading of Traditional cane Delivery Systems

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## Abstract

Cane area planted for each mill organized into regions according to the geographical distribution in respect to the mill location. Each region is divided into plots bounded by irrigation channel, drainage channel, and rod systems expanded in the agricultural area. Cane plots may be ten fedans or more owned by several farmers. Because of small holdings and variable management of each holding, cane planted in the same plot may not be of same Raton. Cane delivery schedules and consequently harvesting dates mainly depend on the Raton and date of last season harvesting. Therefore, fields to be harvested at the same date may not be at same cane plots and loader operation may have to be managed according to several variables.

Mechanical loading management was to specify wagons considered for mechanical loading during the day, specify the location of each wagon (store), determine the possibility to combine more than one wagon at the same store and number of wagons/store. Loader efficiency, loading duration percent of main vehicle/s load/s directly transported from the field were studied and analyzed for possible variables under which mechanical loading is accomplished and optimum values were determined. The results show that optimum number of wagon combined in the same store is 3 wagons at which loader efficiency $(L_E)$ was about 70% and field to store transport rate $(FST_R)$ was about 1.5 ton/h. Percent of total loads of all wagons that transported from fields while loading (total $Q_1\%$) may be maximized (35%) by combining 3 wagons at each store. Maximizing total $Q_1\%$ reduce quantities of cane delayed more 24 h and therefore reduce chances for deterioration. In case of railway wagons the value of $(Q_1\ \%)$ was 68%, 60%, 53% and 48% at field to store distances of 2, 3, 4, and 5 km for the loader working full operation day. The farmers may have chances for short time and consequently less $(Q_1\ \%)$ when the operation hours of the loader is less because of limited number of wagons loaded in the station.

## Introduction

Approximately quarter million Fedans of cane planted for sugar industry produce about 10 million tons of cane have to be delivered to cane mills within operation season (about four months). Delivery process activities performed according to schedules determine the date of harvesting and the main vehicle for cane transport to mill. Farmers have to load cane on the infield vehicles that transport cane to stores at the travel lines of the main vehicles provided by sugar mill. Cane has to be loaded again to the main vehicles, therefore 20 millions tons of cane required to be loaded on both of

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the infield vehicles and on the main vehicles. Type of infield equipment and field conditions may determine the possibility and efficiency of cane mechanical loading in fields. Therefore mechanical loading of cane is mainly applied in stores to load cane on the main transport vehicles.

Main system established for cane to mill delivery is the decauvelle slide lines and wagons. Other additional systems that transport limited cane quantities are railway wagons that transport cane production of fields near to the main railway line and ships that transport cane cross Nile. Such transport systems perform single trip per day and considered the traditional cane to mill delivery systems. These wagons act as storage bins in the mill yard to secure 24 hours of mill operation.

Grab loaders may be used to load cane on either decauvelle wagons or on rail way wagons. Cane mechanization companies in Aswan, Qena and Minia in addition to machinery service stations and cooperatives have been custom operate grab loaders for cane loading. Operating the loader inside fields meet several problems such as poor stability of the loader while moving across furrows, rapid wear of tires and low efficiency. Therefore the loaders are only operated for cane loading to the mai transport vehicles in the stores.

For mechanical loading of decauvelle wagons, special regulations has to be arranged to combine more than one wagon at the same store to facilitate operating the loader at high or moderate efficiency. More number of wagons combined at the same store create another problem represented in longer field to store distance and therefore lower field to store transport rate. On the other hand, the more the number of wagons in the store the longer the duration of loading and the greater the chance of transporting cane from the field for direct loading.

Cane transport stations are established at the main railway line where cane transported from fields to be loaded on railway wagons. Number of wagons often presented to the station to transport cane of several farmers at the same region. Actually number of wagons presented to be loaded in such station (according to harvesting schedule) may allow the loader for full day operation

Mechanical loading of cane under the prevailing conditions affected by many variables that may contradict each other. The current study conducted to analyze the effect operation conditions and variations on loader performance and the percentage of main vehicle load may be transported from the field while loading operation take place. The data was collected at 1998/99 and 99/2000 cane delivery seasons to evaluate mechanical loading of sugarcane and to test the loader fabricated by the Sugar and Integrated Industry Company. The activities was sponsored by Sugar Crops Counsel where the newly fabricated unit was tested at Kom Ombo and imported loaders belong to Aswan Mechanization Company were operated at Armant, and Edfo.

## Review of literature

Whitney and Cochran (1976) reported that Louisiana conditions require that sugar cane be cut ½ to 1 day ahead of the loader, burned and then transported to the mill. This type of harvesting system may be analyzed as two independent systems, a harvester and a transport system. Recent interest in the chopper harvester has accentuated the need for a model which could be used for sizing transport units and determining the appropriate number to be used. The objective of this analysis was to develop a model which would predict the delivery rate of cane to the mill for a single loader transport system and present it in graphical form to facilitate its use for field management.

Uichanco and Edilderto (1976) stated that cane loading is an arduous task which limits the productivity of manual harvesters. In the Philippines cane cutters can cut and load only one ton a day. The wider use of mechanical loaders in the sugar industry can be an intermediate step in improving harvesting efficiency, cane transport and mill unloading can definitely stand much improving. Trucks act as storage bins for 8 to 24 hours in many mills. Industry has to do some long range planning exercises before further investments are made in this area. It should seriously consider the harvesting system which will be employed in the next five to ten years as this will have a bearing on the transport and unloading systems.

Libunao (1978) reported that in the Philippins sugarcane is loaded manually in trucks or carts for in-field transport. Cane loaders carry on their shoulders about ten to twenty cane stalks, from the ground to the trucks, through a ladder or ramp placed on any side of the truck. Manual loading compliments sugarcane cleaning in the field which is also done manually. The variability of factors such as loader's rate sugarcane size, field conditions, time to load a truck and the volume of load are assumed to be constant. Other transport variables such as travel time from the field to the transloading station in the plantation, and to the mill, for a particular truck and state (i.e. loaded or empty) is a random variable. However, for simplicity of the model, average values were used. These activities depend on human factors, conditions and traffic. The model developed gives various items of information that can be used for decision-making.

Kepner et. al. (1980) stated that where as four-wheel wagons are generally preferred for field operations in the United States, two-wheel units are rather popular in England and some of the other European countries, particularly for general-purpose use on small farms. Two-wheel trailers are compact and more easily maneuvered than four-wheel units, and the loads can be distributed so as to add considerable weight to the tractor wheels for increased traction needed under muddy, hilly or other adverse conditions.

Blackburn. (1984) described the Bell self-loading trailer drawn by a wheeled tractor, designed and developed in South Africa. The trailer has a low platform carried on two wheels at the rear of which is a loading ramp, fitted with skids which can be moved into an upright position when not in use.

A winch, driven by the power-take-off shaft of the tractor, is mounted either on the tractor itself or on the front end of the trailer platform. Cane is cut manually and formed into heaps or bundles. When loading takes place the trailer is maneuver into position and its skids are dropped. A wire or chain attached to the winch is then passed around the bundle and draws it up the ramp into trailer Bell trailers are also used, with local modifications, in Trinidad and, since 1968, in the Philippines.

Yang & Wang (1993) evaluated the performance of mechanical loading of sugarcane and compared with the traditional manual loading on flat and slope lands under two different yielding conditions. On flat land with cane yield above 70 T/ha, manual cutting efficiency was 0.43 T/man/hr for cane loaded manually and was 0.5 T/man/hr for mechanically loaded cane in which the trash was separated from cane pile. The manual loading efficiency was 0.54 T/man/hr in comparison with 23.9 T/hr in mechanical loading. The trash content was about the same at 3% level in cane loaded by two methods. The payload per truck was 20% higher in manual stacking. On slope land with low yield, both cutting and loading efficiencies of two system reduced drastically. Results of economic analysis indicate that mechanical loading could save 35% of harvesting cost per ton cane and the system could replace 45% manpower required. Acquisition of several units of grab loader for further evaluation is recommended before the industry adopts the mechanical loading method.

Saif El-Yazal and Abdel-Mawla (1994) compared the cost of mechanical and traditional loading and transporting of sugar cane. The performance of the two mechanical systems was tested. The first was a 5 ton capacity self-loading trailer equipped with a loading boom and the second was the grab loader which loads the crop on a locally made trailers. The data show that traditional system using one camel and the required labors can load and transport 0.9 ton/h at a cost of 4.4£E/ton. The self-loading trailer transports 6.4 tons/h cost 4.3£E/ton. The locally made trailer transports 5.3 tons/hr from a field 0.5 km from the store location, when loaded by the grab type loader. The cost of loading the trailer in the field by the grab loader was around 1.8£E/ton for the loading operation only.

Dias et al (1994) evaluate vehicles used for road transportation of sugarcane and discussed the conditions and parameters affecting transport operation and compared the performance for efficient combinations. Transport planning and organization in the sugar industry must be based on the progress already made, so as to reach a degree of perfection that guarantees rapid and secure movement of the harvested cane at low cost.

Hanson et all (1998) stated that long delays between harvesting and milling of sugarcane leads to deterioration. The author developed a simulation model as an appropriate means of analysis conducted on an initial harvesting and transport model of a particular mill and the area supplying. And it was conducted that it was necessary to integrate this modele with a millyard model include limitations in transport availability, and model individual farms. This investigations led to greater clarity regarding to various process in the sugarcane harvesting and delivery systems. A survey of farms that supply the mill has to be conducted and the verified model has to be experimented with to determine methods of reducing delay.

Eggleston et all (1999) Explained that an industerial increase of their level of mechanization, lower cane quality is often observed with an increase in trash, however overall efficiency is normally improved and costs reduced. The authors conducted intensive studies on the problems of deterioration due to cane delay. The authors highlighted the problems caused by deterioration different processing stages and recommended to accelerate transport process to reduce delivery delay.

Abdel Mawla (2000) summarized that the duration from the time of cane harvesting to the time of unloading inside the mill may become critical. It has been recommended to deliver cane to the mill in short time because more delay in cane delivery may mean more losses in sugar production. Evaluation of cane delivery duration requires large amount of data concerning scheduling, equipment, labor activities and operation conditions of harvesting, loading and transporting.

## Materials and methods

Cane mechanization companies introduced and have been costume operate a grab loader type for mechanical cane loading. The loader trade name "Bell machine" which have been fabricated for cane loading in South Africa proved high efficiency for more than two decades of operation in Aswan mechanization company. To maintain continuous operation, the loader may be presented to a large temporary store where the cane of several dealers is ready to be loaded. Variable regulations have been arranged depending on the type of vehicles (decauvelle wagons or railway wagons) and other conditions.

### Mechanical loading of decauvelle wagons:

For mechanical loading of decauvelle wagons, loader operation is often organized as the following:

1- Farmers may plan for loader operation by fixing Raton and harvesting date of a complete cane plot. Since decauvelle slide line pass opposite to the fields of the cane plot, wagons and temporary stores will be near to each other (maximum 100 m). The loader operator loads the wagons one by one and may have to move up to 100m from wagon/store to another. Such arrangement may be difficult to be achieved unless a strong agricultural cooperative plane for fixing cane age and Raton in certain plot.

2- A set of decauvelle wagons may be presented in one store to facilitate reasonable efficiency of loader operation. Number of decauvelles may depend on the distance between fields and number of wagons assigned for each farmer. Number of combined vehicles may be up to 5 wagons at the same stores. The loader operator load the set of wagons at the same time and some farmers may have a chance to transport part of decauvelle load while loader operation depending upon the number of wagons in the store and the rank of the store.

## Loading railway wagons:

In case of the railway wagons, large stations are established where more than 10 wagons may be loaded at the same time. One or more of these wagons may be assigned to transport the cane of a farmer. The loader operator start loading the cane of each dealer on the wagons assigned. At the same time farmers continue transport cane from fields to complete their wagon/s load.

**Regulations for mechanical loading of single trip systems:**

1- Each farmer transport the cane from the field to be unloaded opposite to the wagon/s assigned.

2- Field to store transport vehicles to be used while mechanical loading are trailers pulled by 60 hp tractors (using camels or carts may not be effective).

3- Loader operator load all decauvelle wagons in a store then move to the next.

4- Enough space should be left between wagons waiting for loading in the store to facilitate wider space for cane and comfortable maneuver for the loader opposite to each wagon.

5- A quantity of cane enough for at least two operational hours should be ready in the store before the loader start operation.

6- The loader operator may load several wagons (i.e. wagons assigned to several farmers) at the same time considering that to load the cane of each farmer in the wagons assigned.

7- Each farmer should determine the quantity of cane could be transported during loading and transport the rest of the wagons load at the former day/s.

8- Average full operational day of the loader is 8 h.

**Criteria were determined for mechanical loading:**

**1- Loader rate:**

Loader rate affected by the grab capacity, cycle time and operation efficiency. Loader rate of loading vehicles simultaneously in the same store is given by:

$$L_R = \frac{60 \times L_{E1} \times G_C}{L_{CT} \times 1000} \qquad (1)$$

Where:

$L_R$ = Loader rate (ton/h).

$G_C$ = Average capacity of loader grab (kg)

$L_{CT}$ = Loader cycle time (min).

$L_{E1}$ = Loader efficiency of continuous operation at the same store (%).

**2- Operation efficiency:**

Loader efficiency $L_{E1}$ consider the losses time occur while loading vehicles simultaneously in the same store ($L_{E1}$ = losses time /total operation time of the store). The value of $L_{E1}$ represents the efficiency of continuous operation, which was constant for store loading. Loader transformation efficiency $L_{E2}$ only considers time losses while the loader move among stores ($L_{E2}$= time losses for loader transformation among stores/total operation time of the day). The value of $L_{E2}$ is variable according to store to store distance and number of stores among which the loader move during the operational day. Total efficiency of loader $L_E$ may be computed as the following:

$$L_E = L_{E1} * L_{E2} \qquad (2)$$

**3- Loading duration:**

Loading duration of vehicles waiting for mechanical loading at any store depend on the rank of the store and loader transformation efficiency as follow:

$$L_{DU} = \frac{V_{2L} \times V_N \times L_{E2} \times S_R}{L_R} \qquad (3)$$

Where:

$L_{DU}$ = Duration from the loader start operation till complete loading vehicles at certain store (h).

$V_{2L}$ = Store to mill vehicle load.

$V_N$ = Number of wagons to be loaded at the same store.

$L_{E2}$= Loader operation efficiency as a ratio of time losses for transformation among stores to the total operation time during the day.

$S_R$ = Store rank

Compensating $L_R$ from equation 1 and $L_E$ from equation 2 to equation 3. The following formula may be used to compute $L_{DU}$ at any store:

$$L_{DU} = \frac{1000 \times L_{CT}\ (V_{2L} \times V_{2N}) \times S_R}{60 \times G_C \times L_E} \qquad (4)$$

Where

$L_E$ = Total efficiency of loader operation.

**4- Cane transported from the field while loading:**

Quantities of cane transported from fields to stores depend on field to store transport rate and $FST_R$, ratio of the number of $FST$ vehicles $(V_{1N})$ to the number of $SMT$ vehicles $(V_{2N})$ and loading duration $L_{DU}$. The part of a vehicle load transported while loading may be computed as follow:

$$Q_t\% = \left(\frac{FST_R \times (L_{DU} - 2)}{V_{2L}}\right)\left(\frac{V_{1N}}{V_{2N}}\right) \times 100 \qquad (6)$$

Principle variables and regulations arranged for mechanical loading of traditional delivery systems presented in Table 1.

Table (1) present the basic data of actual conditions of mechanical loading:

| Item | Decauvelle system | Railway system |
|---|---|---|
| $(V_{2N})$/store | up to 5 | up to 1 |
| Number of stores | depend on $(V_{2N})$/store | $L_{OH}$ = avg. 8 h/day |
| FST vehicles | tractor-trailer | $FST_{OH} = L_{OH}$ -2 |
| $V_{1N}/V_{2N}$ | up to 1/2 | |
| Loader op. hours ($L_{OH}$) | $L_{OH}$ = avg. 8 h/day | |
| Duration of FST for same day loading | $FST_{OH} = L_{OH}$ -2 | |

## Results and discussion

Some differences were experienced while mechanical loading of decauvelle wagons than that of railway wagons. Loader cycle time in case of a decauvelle was 1.2 min, efficiency of continuous operation 82% and loading rate 14 ton/h compared to 1 min, 85% and 18 ton/h respectively for the railway wagon. The average grab load was 350 kg either for loading decauvelle or railway wagons. Mechanical loading management and loader performance was different according to the transport system.

### Mechanical loading of decauvelle wagons:

Loading decauvelle wagons require manipulation of several variables to optimize loader efficiency as well as other contradicted variables. Mechanical loading management was to specify wagons considered for mechanical loading during the day, specify the location of each wagon (store), determine the possibility to combine more than one wagon at the same store and number of wagons/store. Figure (1 a) show that store to store distances were 200, 400, 600 and 1000 m when combining 2, 3, 4 and 5 decauvelle wagons at each store which explain that the more the number of wagons combined at the same store the longer the store to store distance. Corresponding field to store distances were 400, 600, 1200 and 2000 m. The Figure explains that more wagons combined in the store means multiply duplicated field to store distances. Number of wagons combined in the each store $(V_N)$ and field to store distance $FS_D$ are two variables contradicting each other. More $(V_N)$ mean higher total efficiency of the loader and more $FS_D$ means lower field to store transport rate ($FS_R$) and therefore lower percentage of cane transported from the field at the same day. Figure (1 b) show each of total loader efficiency $(L_E)$ and ($FS_R$) as related to number of wagons combined in each store. The Figure show that the two curves intersect at some point close 3 in respect to x axis on which the number of wagons is plotted. The point of intersection may be corresponding to the optimum number of wagons should be combined in the store at which optimum values of $L_E$ and $FS_R$ could be manipulated. At this particular point, field to store transport rate is approximately 1.5 ton/h and total efficiency of the loader is approximately 70%.

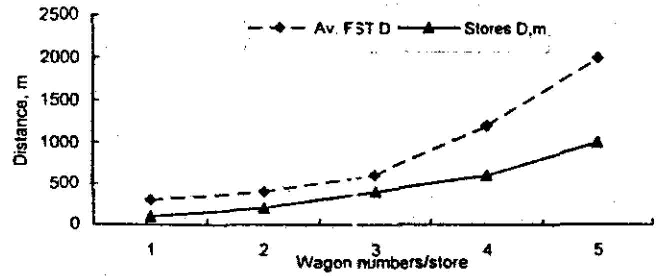


Fig. (1 a) Store to store and field to store distances vs wagons/store

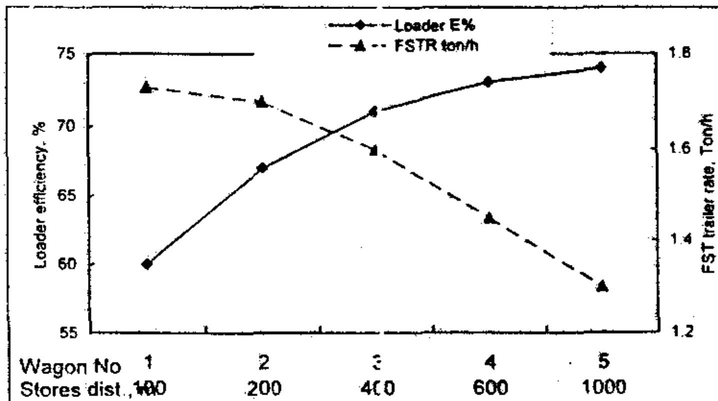


Fig (1 b) Loader efficiency and field to store transport rate

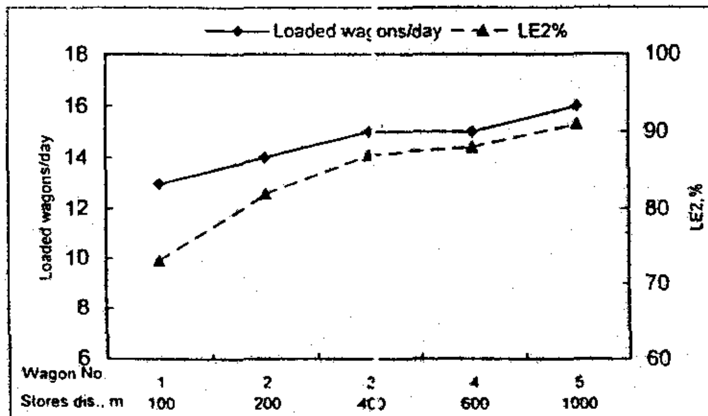


Fig (1 c) Number of wagons loaded and loader transformation efficiency (LE2 %)

Figure (1) Combining decauvelle wagons in one store, fild to store transport and loader operation efficiency

Total loader operation efficiency is a product of two multiplied efficiencies. The first is the efficiency of continuous loader operation $(L_{E1})$ computed as a percent of losses time occurred while loading vehicles simultaneously at the same store to the total time of loading all wagons in the store. The second efficiency computed considering the time lost in loader travelling among stores $(L_{E2})$ as a percent of total operation time in certain day. Results show that limited variation may occur in $L_{E1})$ due to variable loader operators or variable store conditions. Performance of various operators at different stores was determined and an average $L_{E1}$ value was computed to be 82%. Therefore the variation of total loader efficiency $L_E$ is due to the variation of $L_{E2}$. Figure (1 c) show the number of wagons loaded per day (approximately 8 operation hours) and $L_{E2}$ as affected wagon number/store. The more combined wagons in the store the higher $L_{E2}$ and the more the number of wagons loaded (average wagons load = 6.5 ton). Improving $L_E$ by combining more wagons at each store make it possible to loaded up to 16 wagons per day (8 operation hours). Loader transformation efficiency $L_{E2}$ increased from 73 % at single wagon/store to approximately 90% when combining 4 wagons/store or more which is the main reason in increasing the number of wagon loaded/day.

Since the loader load all wagons in the store simultaneously therefore the time of loading for each wagon is expanded to be equivalent to the time required to load all wagons in the store. And. loading duration of a wagon waiting for loading at any store depends upon the store rank in the process of mechanical loading. Figure (2 a) show loading duration of decauvelle wagons of single wagon/store or combined 2, 3, 4 and 5 wagons in each store. The Figure show that in case of one wagon/store the loader may move through 13 stores to load 13 wagons. The loader travel among 7, 5, 4 and 3 stores in case of 2, 3, 4 and 5 wagons are combined in each store respectively. Therefore loading duration depend upon the rank of the store where loading duration of wagon/s in the last store is equivalent to the total operation time. The loader operator may expand operation time more than 8 hours to complete loading all wagons in the last store.

Figure (2 b) shows the percentage of wagon/s load transported from the field at the same day. The farmers may have a chance to transport cane from fields to be loaded directly by the loader to the main vehicle in the store. The field to store direct transport chance is equivalent to the loading duration in hours minus two hours multiplied by field to store transport rate. Therefore if the average daily operation of the loader is 8 h, the maximum chance (at the store ranked last) is 6 h. For single wagon/store, the percent of wagon/s load directly transported from the field $(Q_1\%)$ was zero at the first three stores and increased from 6% at the store ranked 4 to 74% at the store ranked 13. The value of $Q_1\%$ was also zero at the first store then increased to 73% at the last store (rank 7) and 69% at the last store (rank 5) in case of 2 and three wagons combined at stores respectively.

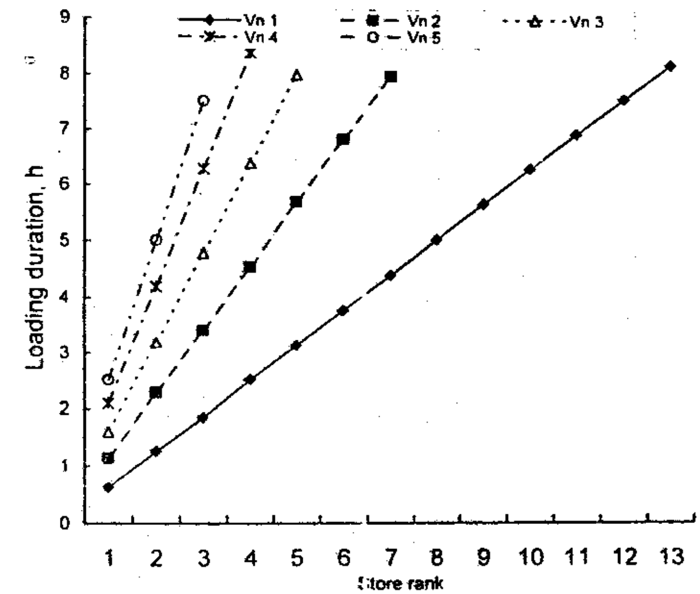


Fig (2 a) Loading duration vs decauvell wagons/store and store rank, h

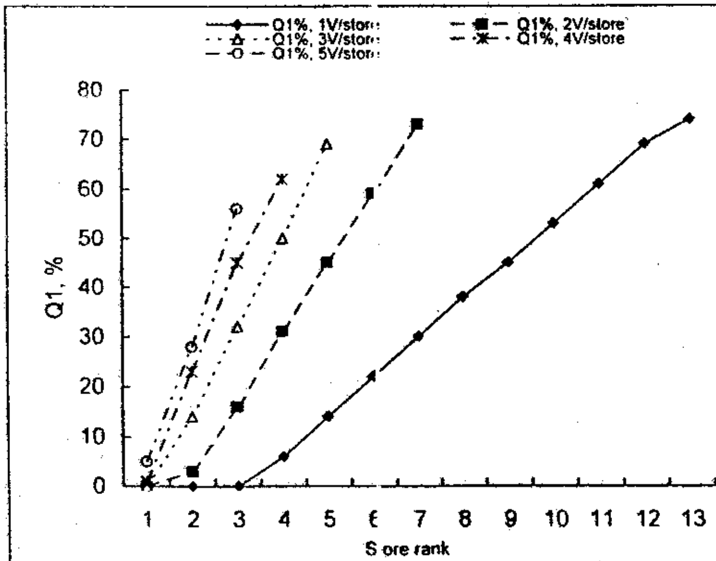


Fig (2 b) Cane transported from fields to decauvelle stores while loading (Q1%) vs store rank

Figure (2) Loading duration and quantities of cane transported directly from fields (Q1%)

Farmers may have the chance to transport $Q_l\%$ approximately 1%, 23%, 45% and 62% at stores ranked 1, 2, 3 and 4 (last store) respectively incase of 4 wagons/store. In case of 5 wagons/store, the value of $Q_l\%$ was 5%, 26% and 56% of the total wagons load of the stores ranked 1, 2 and 3 (last store) respectively.

The value of total $Q_l\%$ computed as general average of the percent of cane directly transported from fields to the total load of all wagons (loaded during the operational day) was 31.6% for single wagon/store. Total $Q_l\%$ was 32.4%, 35%, 33% and 29.7% for arrangements of 2, 3. 4 and 5 wagons/store respectively. The results explain that total $Q_l\%$ may be maximized by combining 3 wagons at each store. Maximizing total $Q_l\%$ reduce quantities of cane delayed more 24 h and therefore reduce chances for deterioration.

**Mechanical loading of railway wagons:**

Stations established for railway wagons are wide enough where large number of wagons are presented and loaded either by labors or by loader. Farmers transport cane from fields by tractor-trailers and to be unloaded opposite to wagons. Enough space is left between wagons to facilitate wide area for loader maneuver while loading. Railway cane loading stations established in certain regions and the loader suppose to work in the same station for full day or several days. Number of wagons to be loaded in any day may be variable according to delivery schedule. In most cases one wagon is assigned for each farmer where wagons are numbered by the mill administration. Since railway wagon capacity is large (average 12 ton) the farmer has to transport a part of the wagons load at former day/s. Actually the field to store distance in case of railway station may be as long as 5 km, therefore the farmer use tractor-trailer for cane field to store (at the station) transport. The number of field to store vehicles $(V_{1N})$ and store to mill vehicles $(V_{2N})$ mostly equal $(V_{1N}/V_{2N})=1$.

Loading duration is the time required to load all wagons in the station simultaneously. Consequently there is an equal chance for each farmer to transport a part of wagons load while loading. A quantity of cane enough for loader operation for at least two hours should be ready in the store before the loader start at the early morning. Therefore the time available for field to store transport is two hours less than loading duration. Figure (3 a ) show that loading duration linearly related to wagons number. The number of wagons wait for loading in the railway station often enough for the loader work for full day (8 operation hours). In some cases the number of railway wagons may be less because of schedule considerations or at the end of the season.

The minimum number of wagons found in the loading station while collecting the data was 8 wagons, which consumed about 5.3 h in case of mechanical loading and less wagon number may be expected. In contrast the loader operator may expand operation more than 8 hours to complete loading all wagons in the station. if A number of 12 railway wagons should be in the station. to maintain loader operation for full day (8 h). Therefore the time

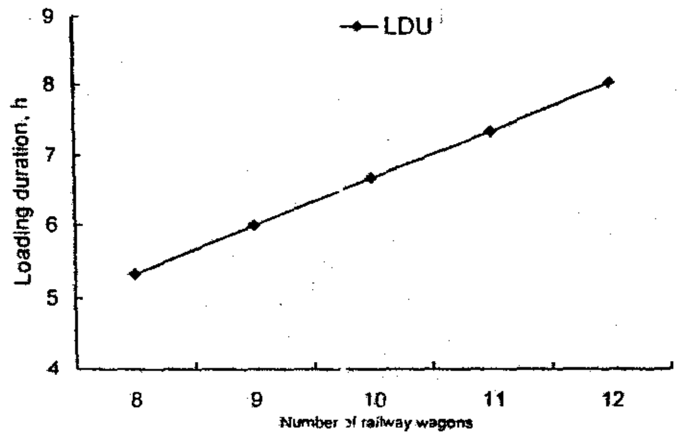

Fig (3 a) Loading duration of railway wagons vs number of wagons in the station

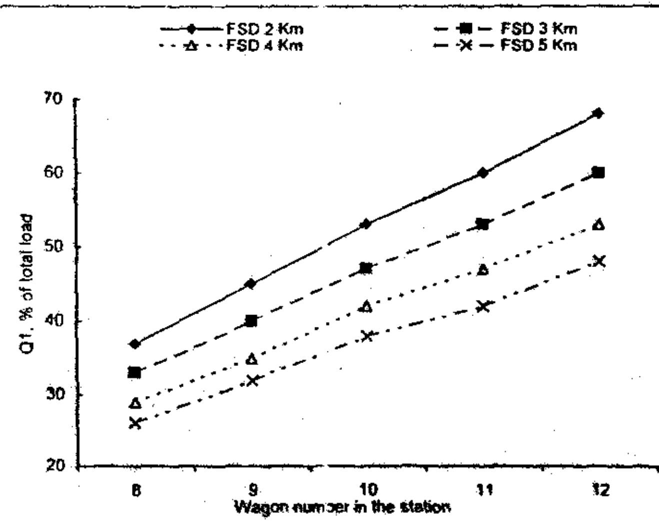

Fig (3 b) Cane transported from fields to railway stations vs number of wagons/station

Figure (3) Mechanical loading of railway wagons available for direct transport of cane from field to store while loading *($L_{DU}$ -2)* may ranged from less than 3.3 h to more than 6 h.

The percent of wagon/s load transported directly from the field *($Q_I$ %)* depend on loading duration $L_{DU}$ and field to store transport rate $FST_R$ (which is variable according to field to store distance). Figure (3 b) show *($Q_I$ %)* at variable number of wagons in the station (8-12 wagon) and variable field to store distances (2-5 km). The value of *($Q_I$ %)* was 68%, 60%, 53% and 48% at field to store distances of 2, 3, 4, and 5 km for the loader working full operation day. The farmers may have chances for short time and consequently less *($Q_I$ %)* when the operation hours of the loader is less because of limited number of wagons loaded in the station.

Therefore efficient management of cane area and delivery system may facilitate increasing mechanical loading productivity and control cane to mill delay. Planning to fix Raton of cane planted in the same plot or same area facilitate fixing delivery date of these areas where wagons available near to each other for higher loader productivity and efficiency.

## Conclusion

Loader efficiency, loading duration percent of main vehicle/s load/s directly transported from the field were studied and analyzed for possible variables under which mechanical loading is accomplished and optimum values were determined. The results of cane mechanical loading may be concluded as follow:

1- For mechanical loading of decauvelle wagons, special regulations has to be arranged to combine more than one wagon at the same store to facilitate operating the loader at high or moderate efficiency. More number of wagons combined at the same store create another problem represented in longer field to store distance and therefore lower field to store transport rate. On the other hand, the more the number of wagons in the store the longer the duration of loading and the greater the chance of transporting cane from the field for direct loading.

2- Decauvelle mechanical loading management was to specify wagons considered for mechanical loading during the day, specify the location of each wagon (store), determine the possibility to combine more than one wagon at the same store and number of wagons/store.

3- Optimum number of wagon combined in the same store is 3 wagons at which loader efficiency *($L_E$)* was about 70% and field to store transport rate *($FST_R$)* was about 1.5 ton/h. Percent of total loads of all wagons that transported from fields while loading (total *$Q_I$%)* may be maximized (35%) by combining 3 wagons at each store. Maximizing total *$Q_I$%* reduce quantities of cane delayed more 24 h and therefore reduce chances for deterioration.

4- In case of railway wagons the value of $(Q_l\ \%)$ was 68%, 60%, 53% and 48% at field to store distances of 2, 3, 4, and 5 km for the loader working full operation day. The farmers may have chances for short time and consequently less $(Q_l\ \%)$ when the operation hours of the loader is less because of limited number of wagons loaded in the station.

5- Efficient management of cane area and delivery system may facilitate increasing mechanical loading productivity and control cane to mill delay. Planning to fix Raton of cane planted in the same plot or same area facilitate fixing delivery date of these areas where transport wagons being near to each other for higher loader productivity and efficiency.

## References


Abdel-Mawla (2000) Analysis of cane delay of traditional delivery systems: Paper presented to the MSAE. Menofia Univ.:25-26 October 2000.

Hancsen, A. C. , A. J. Barnes and P. W. and L. Lyne (1998) An integrated approach to simulating sugarcane harvest-to-mill delivery systems. Paper presente at the 1998 ASAE: July 12-15, 1999.

Eggleston G., B Logonder, and C. Richard (2001) Effect of harvesting methods and storage time on sugarcane deterioration: Paper considered for ISST 2001.

Cochran, B. J. and Whitey, R. W. (1976). A technique for designing transports systems for sugar-cane, Agricultural Engineering. ISSCT; 2069 – 2079.

Diaz, L. D. Ramos, E. C. And Sanntiago, A. M. (1994). Cane transport: truck-hauled versus tractor-hauled trains. Sugar-cane. 1994,No. 5, 14-16; 7 ref.

Libunao, O.S. (1978). Modelling a sugar-cane transportation system for simulation in the philippines. ISSCT Vol(4) : 2081- 2092.

Uichanco, E. A. (1976) Mechanization and increased efficiency in sugar-cane production: An industry goal. AMA vlo. VII. No .4, Autumn 1976: 41- 44.

Yang, S. J. and Wang, C. H. (1993). Performance evaluation of mechanical loading of sugar-cane in Fiji. Taiwan Sugar Vol.3;27-29.

Blackburn. F. (1984). Reaping and transport. Sugar-cane. Chapter 9;161-288.

Saif El-yazal. N. and Abdel-Mowla, H. A. (1994). Cane loading and transporting in Egypt. INT. Sugar JNI., 1994, Vol. 96. NO. 1150E.; 424-426.

Kepner. R. A. R. Bainer and E. L. Barger. (1980). Prenciples of Farm Machinery. A. V. I. Pub. Co. , Inc., Westport , Connecticut, U. S. A. pp.527.

# التحميل الآلي لوسائل نقل القصب التقليدية

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يزرع قصب السكر في حوالى ربع مليون فدان وينتج الفدان في المتوسط أربعون طناً وتنقل معظم تلك الكميات عن طريق وسائل النقل التقليدية المتمثلة في خطوط الديكوفيل كوسيلة نقل رئيسية لتوريد القصب لمصانع السكر في جنوب مصر بالإضافة إلى محطات الشحن على عربات السكة الحديد التي تقوم بقل القصب من المناطق المتاخمة لخط السكة الحديد الرئيسي بالصعيد . وبذلك فإن كميات القصب المنقول تصل إلى حولى ١٠,٠٠٠,٠٠٠ طن يجرى تحميلها على وسائل النقل التي تنقلها من الحقول إلى مخازن مؤقتة عند خطوط حركة معدات النقل الرئيسية ثم يعاد تحميلها مرة أخرى على تلك الوسائل التي تنقلها للمصانع. وحيث أن معدات النقل من الحقول (الجمال والكارو والمقطورات المجرورة بالجرارات) لا يناسبها التحميل الآلي بالإضافة إلى مشكلات تشغيل اللودر في الحقول المتمثلة في تدنى كفاءة التحميل وسرعة إستهلاك العجلات الكاوتش وغيرها فقد إقتصرت جهود نشر التحميل الآلي على تشغيل اللوادر في شحن المعدات الرئيسية.

وقد إهتمت شركات الميكنة التي أنشأتها وزارة الزراعة بأسوان وقنا والأقصر بتمويل من مجلس المحاصيل السكرية بميكنة شحن القصب لكونها عملية تحتاج إلى قدرة مكثفة وإجرائها بالعمالة يعتبر عملية مجهده ومستغرقة للوقت مما يكرس أسباب تأخيرا توريد القصب الذي يعتبر بدوره السبب الرئيسي لتدهور نسبة السكر ويقلل من القيمة التصنيعية للعصير . وقد إستوردت تلك الشركات أحد أنواع اللوادر الكباشة المصممة خصيصاً لتناسب شحن القصب والتي تنتجها إحدى الشركات العالمية بمصانعها بجزيرة موريشيس بجنوب أفريقيا (خاصة شركة أسوان للميكنة التي إستوردت ٧٠ وحدة منها في الثمانينات) . وقد لاقى تشغيل تلك الآلات صعوبات تؤدى إلى نقص كفاءتها نظراً لبعثرة عربات الديكوفيل المفروض تحميلها في اليوم الواحد والذي تقتضيه برامج التخصيصة التي توضع على أسس تتعلق بعمر القصب وتاريخ حصاده في الموسم السابق . بالرغم من أن محاولات تجميع العربات في مخزن واحد تصتدم بإزدياد مسافات نقل القصب من الحقول لتلك المخازن مما يؤدى إلى مضاعفة الوقت والجهد المطلوب في عمليات نقل القصب من الحقول إلى مكان المخزن المجمع وربما يشكل ذلك عاملاً حرجاً في تأخر توريد القصب . وقد أجرى هذا البحث لتحليل العوامل المؤثرة على كفاءة الشحن الآلي في مخازن شحن عربات الديكوفيل ومحطات شحن القصب في عربات السكة الحديد والنسبة المؤية من حمولة تلك العربات التي يمكن نقلها من الحقول في ذات يوم الشحن .

وقد أظهرت نتائج الدراسة أنه يمكن الموائمة بين كفاءة تشغيل اللودر وسرعة النقل من الحقل بتجميع عربات الديكوفيل بعدد ثلاث عربات في المخزن الواحد حيث يمكن عندها تحقيق كفاءة تشغيل للودر في حدود ٧٠% ويكون معدل النقل من الحقل للمخزن في حدود ١,٥ طن/الساعة . كما أنه عند تلك الظروف تكون النسبة المؤية من حمولة العربات المنقوله من الحقول في ذات يوم الشحن قيمة عظمى تكافىء ٣٥% . كما أنه في حالة شحن عربات السكة الحديد فإن نسبة القصب المنقول في ذات اليوم تبلغ ٦٨% ، ٦٠% ، ٥٣% و ٤٨% في حالة نقل القصب من حقول على بعد ٢ ، ٣ ، ٤ و ٥ كم على الترتيب واللودر يعمل في ذات محطة الشحن يوم عمل كامل (متوسط ٨ ساعات تشغيل) .

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