CHAPTER V
SUMMERY AND CONCLUSION

Sugar is an important strategic commodity for all countries of the world. Sugar after wheat is of strategic importance in Europe, Africa, the Americas and Australia, while sugar is second only to rice for Asian countries.

The sugar industry depends primarily on the sugar cane crop, which is an important source of sugar production. Sugar cane yield is a profitable return, in addition to the possibility of loading some field crops on it, thus yielding an additional return to the farmer. It also provides food commodities imported by the state in free currencies. For the purposes of sucking and consumption of fresh juice and the manufacture of black honey in addition to many industries based on the remnants of sugar cane such as molasses, vinegar and alcohol pulp and wood pellets of Pajas in addition to secondary industries such as wax, yeast and dry yeast Beer, carbon dioxide, potassium sulphate, butanol, acetone, and alcohol oil, which is used in aromatic industries. In addition to benefiting from the field waste in the harvest season, using tops and green leaves in feeding livestock and burning the ambassador, the majority of insects and harmful diseases hidden in soil or intruders On the weeds Ashes from the fire contribute to the increase of soil fertility, and some of the leaves can be converted to organic fertilizer.

It was therefore necessary to pay full attention to sugary crops, especially sugar cane, to increase productivity and to bridge the gap between production and consumption by increasing the productivity of sugarcane. The main problem of sugar cane plantation is the harvesting process. The sugarcane harvesting season lasts for 5 months in Egypt, starting in December and ending in May.

The main purposed of the present study is to:

1. Design and manufacturing a sugar cane harvester suitable for small holdings in Egypt.

2. Reach the most appropriate operation factors of the machine in terms of the forward speed, knives velocity, number of knives and cutting height.
3. Test the machine at the Center of Experiments and Agricultural Research, Faculty of Agriculture, El-Minia University, Egypt.

To reach the main goal was:

1. Collecting researches in the field of mechanical harvesting of sugar cane and identifying the mechanisms of work of these machines, whether local or global.
2. Determine the required requirements of the material, bearings, knives, gears and the power transmission systems.
3. Perform the calculations, analysis of the forces affecting the various parts of the machine and select the appropriate materials to manufacture each part.
4. Implementation of the design after drawing the detailed drawing of each component and the assembly of the machine with complete specification for the manufacturing processes suggested.
5. Test the efficiency of machine performance in the field by studying the following variables:
    1. Forward speeds 3, 3.5, 4.5 and 5 km/h.
    2. Row spacing 70, 80 and 90 cm (Stalk diameters 2.5, 3and 3.5 cm).
    3. Cutting height at ground level, 2 and 4 cm.
    4. Number of knives 2 and 4.
    5. Knives velocity at constant speed ratio with the forward speed = 20:1.

The evaluation criteria of this harvesting unit were cutter head efficiency, field capacity, throughput capacity, power requirements and total operating costs.

Results of the experimental work could be summarized as follows:

1. Effect of forward speed: 1. For stalk diameter 2.63 cm, row spacing 71 cm, cutting height 0 cm with both (2 and 4) knives as shown in Tables (4-2) and (4-5) the proper forward speed of the harvester was approximately, 5 km/h. This forward speed gives maximum machine field capacity of (1.16 fed/h), through put capacity (42.9 ton/h) without stalks damage. Also, the average base cutter efficiency 100%, the cutting energy decreased up to (39.73 kW) and the total operating costs are 110.5 EGP/h (94.9 EGP/fed).

2. For stalk diameters (3.12 and 3.76 cm), row spacing (78.89 and 88.75 cm), cutting height 0 cm with both (2 and 4) knives as shown in Tables (4-2) and (4-5) the proper forward speed of the harvester was ranged from 4 to 4.5 km/h. This forward speed gives maximum machine field capacity of (1.18 and 1.30 fed/h), through put capacity (57.45 and 79.02 ton/h) without stalks damage. Also, the average base cutter efficiency 100%, the cutting energy decreased up to (42.78 and 46.88) kW and the total operating costs are (115.3 and 120 EGP/h) (98.5 and 92.3 EGP/fed) respectively.

2. Effect of row distance: It was found that increasing the row spacing from 71 to 88.75 cm had a direct effect on the field capacity, throughput capacity and total operating costs, the most economical row distance 88.75 cm at field capacity (1.32 fed / h, 78.49 t / h) And a decrease in total operating costs (105.05 EGP/ hr, 79.44 EGP/fed).

3. Effect of stalk diameter: The results showed that the stalk diameter was an important factor in the mechanical harvesting of sugar cane. It was found that at the stalk diameter 2.63 cm, the power requirements was 22.25 % less than stalk diameter 3.76 cm when the other factors stabilized, But it is necessary to work close to the soil surface in order to avoid bending the stalks before cutting.

4. Effect of cutting height: In general, it was found that the height of the cutting has a significant impact on the machine performance, especially in the base cutter efficiency where the cutting efficiency was 100% at the ground level and decrease by 9% at 4 cm. The cutting height also has another effect on the amount of loss during the harvesting process, where 1 cm leads to loss between 200 to 340 kg / cm per feddan depending on the row spacing. On the other hand, it was found that the row spacing have not effect on both the field capacity and the total operating costs.

5. Effect of number of knives: In general, The number of knives had a direct effect on the base cutter efficiency and did not effect any of the other performance paramters where it was the best performance of the machine when the number of knives is 4 and decreased when using only two knives. The number of knives had another effect on the stability of the machine during the operation and we found that the working with four knives was smooth operation free of vibrations and noise.

It can be concluded that the best operating conditions for harvesting sugar cane stalks to obtain the maximum machine performance are:

1. At row spacing = 88.75 cm, stalk diameter = 3.76 cm and cutting height at ground level the proper machine forward speed = 4.5 km/h, knives rotational speed = 1104.9 rpm, power requirements = 46.88 kW and field capacity = 1.3 fed/h
2. At row spacing = 78.89 cm, stalk diameter = 3.12 cm and cutting height at ground level the proper machine forward speed = 4.5 km/h, knives rotational speed = 1111.9 rpm, power requirements = 42.78 kW and field capacity = 1.16 fed/h
3. At row spacing = 71 cm, stalk diameter = 2.63 cm and cutting height at ground level the proper machine forward speed = 5 km/h, knives rotational speed = 1100.3 rpm, power requirements = 39.73 kW and field capacity = 1.16 fed/h

The main recommendations of this study could be concluded as follows:

1. Using four knives gave maximum working stability while using two knives lead to machine instability.

2. The sharpening angle of knives should be at down position to reduce wear and protect it from rocks in the soil.

3. The forward speed mustn't exceed 4.5 km/h incase lodging conditions of stalks.

4. Incase the stalk diameters are greater than 3 cm it is convenient to harvest at forward speed of 4.5 km/h to maintain the safety clutch in operation without slipping.

In general, it can be said that the sugar cane harvesters in Egypt may be non-existent so the purpose of this Thesis is to design and produce a prototype harvester suitable for work under the conditions of Egyptian agriculture. It was found that the performance of the machine is satisfactory for a prototype and has been registered as an invention with a number (-) and is suitable for commercial operation.