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DEVELOPMENT OF A MECHANICAL DRY CORN PICKER UTILIZINGA BUCKET CONVEYOR

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ABSTRACT

In this study, a manually-operated mechanical dry corn picker utilizing bucket conveyor was designed and developed using locally available materials. This post-harvest device is aimed to help farmers in reducing labor, time and cost in collecting dry corn during solar drying, hence, improving the production efficiency. Evaluation of the acceptability of the device in terms of functionality, safety, structure and efficiency was shown to be acceptable as assessed by randomly selected respondents.

Keywords: mechanical corn picker, bucket conveyor, solar drying.

INTRODUCTION

Corn (*Zea mays* L.) is the second most important cereal crop in the Philippines. It is one of the staple foods of the country. Moreover, it is an important agricultural commodity in the Philippines because it supports the growth of other vital industries such as the manufacturing, livestock, and feed milling sectors. The latter is highly dependent on the corn industry where corn accounts to 60 percent to 70 percent of feed ingredients. Despite the increasing demand for corn, (white consumed as staple by around 12 million Filipinos and yellow wherein approximately 70 percent is used as feeds for livestock), overall production is low and inefficient(Bulalin *et al.*, 2015). Inefficiencies in the yellow corn industry are transformed into high price of feeds and therefore a higher than desired cost of production. Lack of economies of scale, low technology adoption, shrinking production areas, inadequate infrastructure support and government protective policies have contributed to the relatively high price of corn (PAKISAMA, policy paper).

One of the most contributing factors in the quality and price of corn is the post-harvest handling and management (Gerpacio *et al*., 2004; Logrono *et al*., 1996; Tanchuling, 2007; Subaba, 2011; DA/NABCOR, 2006).In the Philippines, solar drying still predominates postharvest drying practices. Majority of the farmers depend on solar drying by using multi-purpose drying pavements. There are several mechanical and solar energy-based dryers available (Magararu, 2010; Chua and Chou, 2003; Irtwange and Adebayo, 2009 Bena& Fuller, 2002), however, only few farmers through cooperatives that have access to mechanical dryers. For this reason huge losses happen during rainy season and in times where there is unusual high frequency of rainfall. The grains are handled, transported and stored in sacks which make it cumbersome and expensive to distribute the grain to feed millers (PAKISAMA, policy paper).

During solar drying, the usual manual practice among majority of the local farmers in collecting corn simply utilized the traditional device assembled from woods and plywoods as shown in Figure-1. This practice is time-consuming and labor-intensive, not to mention the high cost and low productivity process.

Aiming to address this concern, a mechanical device for picking/collector the corn during solar drying is conceptualized, designed and developed. This innovative device operates utilizing a bucket conveyor. The conveyor functions by rotating the gear with a simple push of the device.

Figure-1. Traditional way of collecting the corn during solar drying.

While it is moving, the bucket conveyor automatically picks and carries the corn up from the reservoir. The corn is directly unloaded into the attached sack located at the back portion of the device. The device is provided with four wheels and the handle is positioned relatively far from the rotating wheels. Moreover, since this device is manually operated and functions via the spur gear and sprocket mechanisms, it gives no pollution to the environment, making it environmental-friendly.

Owners of the solar dryers where this device has been tested for its performance have affirmed that this innovative device is a big answer in saving their labor cost and efficient time management.

It should be emphasized that this device can be used not only on dry corn but also on other dry agricultural products.

MATERIALS AND METHODS

Designing the mechanical device

Figure-2 shows the isometric view of mechanical dry corn picker using bucket conveyor. The idea of the device is based on the sprocket, chain and spur gear mechanisms. The materials used for spur gear (driver) is a 4140 steel while the driven part is a cold rolled steel (CRS). An ordinary pipe is used in the handle. The rollers, which are attached to the shafting, served as guide for the flat belt rotation. As the belt rotates, the buckets which are attached to the belt transfer the dry corn grains from the reservoir to the sack automatically. This action facilitates the sacking process with lesser effort on the part of the workers.

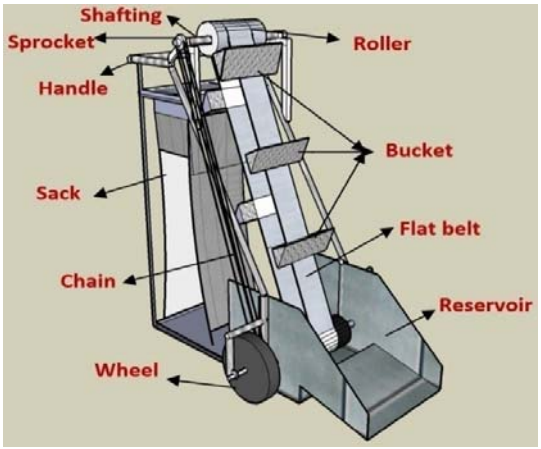

Figure-2. Isometric view of mechanical dry corn picker using bucket conveyor.

Figure-3 shows the side view and the back side view of the device. It has a total height of 40.810 inches, width of 21 inches and a length of 29.577 inches. The diameter of the wheel is 8 inches so that it can easily rotate in a short distance. The materials used in this study are all locally available.

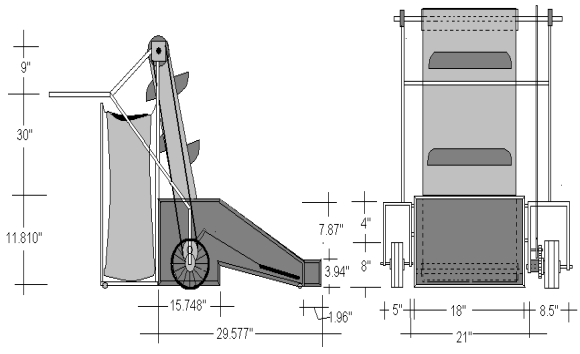

Figure-3. The side view and back side view of the device.

In Figure-4, the design of the flat belt and chain is shown. Five buckets are attached to the belt at 21 inches interval. The center length of the chain is 46.09 inches with 23 teeth for driver and 16 teeth for driven. Figure-5 shows the design of the spur gears (driven and driver) as attached to the shafting. The diameter of the spur gear (driver) is 2.75 inches with 31 teeth while the driven spur gear is 2.081 inches with 23 teeth. The sprocket that is attached to the driven spur gear is a recycled or secondary material.

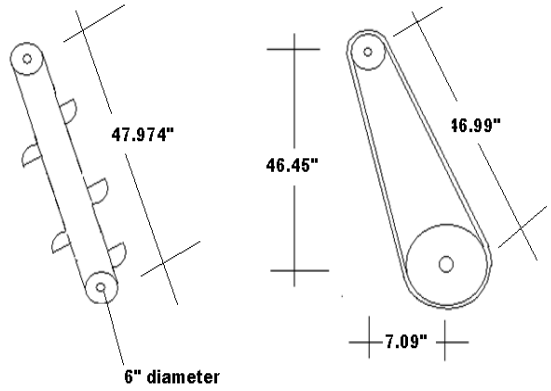

Figure-4. Design of flat belt and chain.

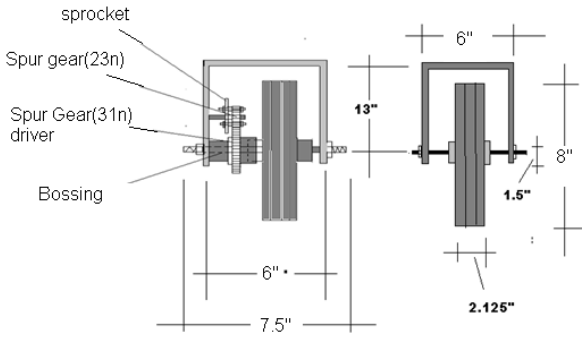

Figure-5. Design of the spur gear.

Prototype development

Based on the design, a prototype of the mechanical dry corn picker utilizing bucket conveyor is developed in the machine shop laboratory of the Mindanao University of Science and Technology. A lathe machine is used in forming a blank gear of accurate diameter. After which, a milling machine is utilized in obtaining the proper number of teeth and in dividing accurately the teeth of the spur gear. Welding machine is used for joining and assembling the parts. Other machine shop tools utilized are steel rule, hack saw, hammer, vice, box wrench and others.

Fine-tuning, testing and evaluation of the device

After the device is fabricated, testing is conducted at a local solar corn dryer. With the fabricated prototype, the average time consumed for one sack is filled-up with dry corn is evaluated and compared with the traditional

method of collecting the corn. Moreover, an evaluation on the acceptability of the device in terms of functionality, safety, structure and efficiency is likewise conducted. Respondents are randomly selected and are composed local corn farmers and workers, mechanical technician and students. The device is demonstrated to the respondents and afterwards, they are asked to answer the prepared instrument.

RESULTS AND DISCUSSIONS

The mechanical dry corn picker prototype

Figure-6 shows the actual photos of the mechanical dry corn picking device and its parts. In Figure-7, some photos on the actual utilization of the device in a solar dryer are shown. The photos demonstrated how the bucket conveyor carries the corn up over the roller and unloads the corn directly to the readily attached sack at the back of the device.

During testing, it is found out that utilizing the device; it takes an average time of 8 minutes to fill-up one sack of corn. This is in contrast with the traditional /manual way of collecting the corn which takes around 14 minutes. Hence, the increase in efficiency is almost doubled. In addition, the device worked well and is suited to the field, most of the owners of the fields/ dryers have said that the mechanical dry corn picker prototype has a great potential and is a big answer in saving labor cost and efficient time management.

Acceptability of the device

An evaluation on the acceptability of the device in terms of functionality, safety, structure and efficiency is likewise conducted. Respondents are randomly selected and are composed local corn farmers and workers, mechanical technician and students. The device is demonstrated to the respondents and afterwards, the respondents are asked to answer the prepared instrument.

Figure-6. Actual photos of the mechanical dry corn picker and some of its parts: (a) isometric view, (b)bucket, roller, belt, and reservoir.

Figure-7. Actual photos on the utilization of the mechanical dry corn picker.

The results of the evaluation are summarized in Tables-1. From the table, the acceptability of the device in terms of functionality, safety, structure and efficiency have been shown to be acceptable as assessed by randomly selected respondents.

Table-1. Evaluation result at different predetermined criteria.

	Mean	Description
A. Functionality		
1.The corn picker device can pick the corn well.	2.9	Acceptable
2. The device is easy to use.	3.4	Acceptable
3.Use in high production runs.	3.4	Acceptable
Overall	3.23	Acceptable
B. Safety		
1. The device is safe to use.	3.20	Acceptable
2.The device is sharp edges free.	2.50	Slightly Acceptable
Overall	2.85	Acceptable
C. Structure		
1. The material of the device is based on the availability of local market.	3.4	Acceptable
2. The reservoir of the device is bolted properly.	3	Acceptable
3.The conveyor put it properly.	3.20	Acceptable
4.The sack of the device is easy to remove.	3.30	Acceptable
5.The handle of the device is welded properly.	2.80	Acceptable
Overall	3.14	Acceptable
D. Efficiency		
1.the device can pick the corn well than manual picking.	3.1	Acceptable
2.The device can minimize labor cost.	3.1	Acceptable
3.The device can make the time lesser than manual picking.	3.2	Acceptable
Overall	3.13	Acceptable

CONCLUSIONS

This study focused on the fabrication of a prototype of an innovative mechanical dry corn picker utilizing bucket conveyor. The functionality and efficiency of this proposed device has been evaluated and is observed to be more efficient than manual operation in gathering and collecting corn grains in the solar. Hence, the device aids in minimizing manpower and saving labor costs at the same time. It should be emphasized that this device can be used not only on dry corn but also on other dry agricultural products. It is further suggested to tap the assistance of the local government unit (LGU) for wider dissemination of this innovative technology to their respective farmers and cooperatives

REFERENCES

Bena B and Fuller RJ. 2002. Natural convection solar dryer with biomass back-up heater. Solar Energy. 72 (1): 75-83.

Bulalin S.P.,Llamelo N., Pattung A., Ocampo R., Bangyad S., Digma G., Corpuz P. 2015. Enhancing Corn Productivity through Application of Vermi Tea as Foliar Spray. Asia Pacific Journal of Multidisciplinary Research. 3(5), Part II.

Chua K.J. and Chou S.K. 2003. Low-cost drying methods for developing countries. Trends in Food Science and Technology. 14(12): 519-528.

DA/NABCOR. 2006. Paper presented during the Corn National Congress, Pangasinan.

Gerpacio R. V., J. D. Labios R. V. Labios and E. I. Diangkinay. 2004. Maize in the Philippines: Production Systems, Constraints, and Research Priorities. Mexico, D.F.: CIMMYT.

Irtwange S V. and AdebayoS. 2009. Development and performance of a laboratory-scale passive solar grain dryer

in a tropical environment. Journal of Agricultural Extension and Rural Development.1(2): 042-049.

Logrono M.L., Lopez E.L.and Alejandro F. 1996. Maize Seed Situation in the Philippines: a Country Report. Philippine Journal of Crop Science. 21(3) 61-70.

MagararuB G. 2015. BPRE offers environment-friendly furnaces for mechanical drying; Philippine Center for Postharvest Development and Mechanization (Phil Mech), Department of Agriculture, 7/30/2010. Online. Accessed: http://www.philmech.gov.ph/?page=news& action=details&code01=FB10070002.

Philippine Council for Agriculture, Forestry and natural Resources Research and Development (PCARRD). 2006. Corn Industry Profile. Available from www.PCARRD.dost.gov.ph.

Strengthening the Philippine Corn Industry amid Intensifying Agricultural Trade Liberalization; Policy paper, Pambansang Kilusanng Mga Samahang Magsasaka (PAKISAMA), Inc. Accessed July 26,2011.*www.* pakisama.com/downloads/.../policy%20paper%20on%20corn.pdf.

Subaba G. M. 2015.The Philippines' Rising Corn Giant, Philippine Center for Postharvest Development and Mechanization (PHilMech), Department of Agriculture, 3/1/2011. Online. Accessed: http://www.philmech.gov.ph/?page=news&action=details &code01=FT11030001.

Tanchuling Hazel. 2007. Issues and Prospects of the Philippine Corn Industry. Rice Watch and Action Network.