



Comparative evaluation of maize shellers for marginal farmers of Churachandpur district, Manipur

S. Roma Devi¹ • Laishram Kanta Singh^{2*} • Pramod Chandra Dihingia³ • Lydia Zimik² • Ingudam

Bhupenchandra⁴ • Hijam Jiten Singh⁵ • H. Dayananda Singh⁵

¹ICAR-KVK Churachandpur, ICAR Research Complex for NEH Region, Manipur Centre

²ICAR-KVK Imphal West, ICAR Research Complex for NEH Region, Manipur Centre

³Department of Agricultural Engineering and Technology, School of Engineering and Technology, Nagaland University

⁴ICAR-KVK Tamenglong, ICAR Research Complex for NEH Region, Manipur Centre

⁵ICAR Research Complex for NEH Region, Umroi Road, Umiam, Meghalaya

ARTICLE INFO

Article history:

Received: 06 July, 2021

Revision: 21 September, 2021

Accepted: 01 October, 2021

Key words: Handpicking, Octagonal Maize Sheller, Mounted Maize Sheller, Shelling Capacity, Shelling Efficiency and Breakage.

ABSTRACT

Shelling is a significant post-harvest technological activity that separates the kernels from the cobs for use as seed, fodder, and oil extraction, as well as to produce value-added goods and preserve end-product quality. The purpose of this article is to investigate the comparative assessment of maize shellers for marginal farmers in Churachandpur district, Manipur, as part of a frontline demonstration, in comparison to octagonal maize sheller, Mounted maize sheller and farmers' traditional method of handpicking by pressing maize with their fingers and thumbs. The demo involved 15 beneficiaries belonging to marginal socio economic status. The traditional handpicking can perform the capacity of maize shelling on an average of 6.15 kg/h, whereas Octagonal and Mounted Maize Sheller can perform 18.17 kg/h and 23.60kg/h respectively. The shelling efficiency is highest in Handpicking (100%), followed by Mounted Maize Sheller (98.27%) and Octagonal Maize Sheller (98.24%). On the contrary, breakage is highest in Octagonal Maize Sheller (0.64%), followed by Mounted Maize Sheller (0.60%) and Handpicking (0%). Overall, Mounted Maize Sheller can help much extent to maize farming community in reducing the drudgery of Churachandpur district, Manipur.

1. Introduction

Maize is one of the most important cereal crops, which are widespread in the world after wheat and rice. Global maize production is around 1147 million tonnes (<https://knoema.com>), while in India, it is 21.24 million tonnes (2016-17) (DAC 2019). In the NEH region, farmers grow mixed rice in mountainous *jhum* areas and in the mountains, which produces a meager yield. Given the economic returns, the maize-based cultivation system can be a valuable alternative crop to replace rice from the hills and center of the region and the change in the cultivated area. Maize production plays an essential role in food security and is used for various purposes, as well as for other cycle products in livestock. Maize is the critical cereal crop grown in Manipur after rice crop. Maize crop occupies in all the district of Manipur: Bishnupur (1610 ha), Chandel (3700 ha), Churachandpur (6220 ha), Imphal East (1230 ha), Imphal West (1260 ha),

Senapati (4750 ha), Tamenglong (2750 ha), and Ukhrul (2570 ha) during 2014-2015 (<http://manennis.nic.in>). Among the districts of Manipur, Churachandpur district has the largest area under maize cultivation.

The participation of agricultural women in agricultural activities is influenced by a variety of factors, including regional differences in the nature of work, socioeconomic status of agricultural households, family traditions, changes in the nature of activities due to mechanization, introduction of time and labor savings tools and changes in agro-climatic conditions. According to various researches on women in agriculture, women are often employed in operations that are either not mechanised or are just somewhat mechanised and entail a lot of work (Singh et al. 2007). Maize shelling is the removal of the maize kernels from the cob (Kumar and Begum 2014). Because the maize kernels are firmly bonded

*Corresponding author: kanta_lai@yahoo.co.in

to the hard cob when harvested, maize shelling is required after harvesting (Patil et al. 2014). Threshing or shelling is the most tedious and time-consuming job (.This separation is carried out by hand or by tubular maize sheller or by mounted maize sheller. The difficulty of the process depends on the varieties grown, the moisture content, and the degree of maturity of the grain. The main objective of the study is to assess the performance of maize shellers based on manual, octagonal/ tubular maize sheller and mounted maize sheller for the small farmers who tend to maize farming as a rural enterprise. Heart rate is commonly used as an ergonomic metric to assess the physiological or functional demands of work on individual workers (Hasalkar et al. 2004).

2. Materials and Methods

2.1 Handpicking, Octagonal Maize Sheller and Mounted Maize Sheller

The study was conducted in the Churachandpur district of Manipur. Altogether 15 maize cultivated farmers' from seven villages were involved for the participatory demonstration of improved technology of Maize shelling in this study during 2015-2018 under ICAR-Krishi Vigyan Kendra (KVK) Churachandpur, Manipur. The selected farmers were from the maize growing beneficiaries of Front Line Demonstration under KVK Churachand, Manipur. Farmers were made aware of the distinctive features of different kinds of techniques of maize production and post-harvest management.

Handpicking is the most straightforward traditional system for peeling maize by pressing the thumbs on the maize kernels to separate them from the ears. Another simple and common method of shelling is to rub two ears of maize together (Fig. 1). However, these methods require a lot of labour. Tubular/octagonal hand maize sheller (Fin type) is used to shell dehusked maize cobs (Fig. 2). It is a simple, manually operated device to remove kernels from maize cobs. The sheller consists of four mild steel fins that are tapered along their length. Two holes are provided for riveting in each fin. The corners of the fins are rounded to avoid injury to the operator during the shelling operation. The cob is inserted into the sheller and repeatedly twisted forward and backward, or provided strokes in the clockwise and anticlockwise (<http://ecoursesonline.iasri.res.in/>).

Furthermore, mounted maize sheller has the same principle of tubular/octagonal hand maize sheller, but it has an additional feature of mounted stand and hand operating handle to move the sheller, as shown in Fig. 3.



Fig. 1. Maize shelling using Handpicking



Fig. 2. Maize shelling using Octagonal Hand Maize Sheller



Fig. 3. Maize shelling using Mounted Maize Sheller

2.2 Comparison of Handpicking, Octagonal Maize Sheller and Mounted Maize Sheller

Three methods, namely handpicking, octagonal maize sheller, and mounted maize sheller, were evaluated for the performances using 15 numbers of farm women having age between 20 to 40 years from 7 villages of Churchandpur district, Manipur during 2015-2018 period. The evaluation was conducted for 30 min duration, and shelling capacity, shelling efficiency, and breakage were evaluated.

2.3 Shelling Capacity

The weight of shelled maize from the cobs per unit time was calculated as shelling capacity.

2.4 Shelling Efficiency

The following formula calculates the shelling efficiency.

$$SE = \frac{SW}{TW} \times 100 \quad (1)$$

Where, SE= shelling efficiency (%), SW = weight of the shelled maize from the cobs (kg), and TW = total weight of the shelled maize from the cobs (kg).

2.5 Breakage

The following equation estimates breakage efficiency.

$$BE = \frac{BW}{SW} \times 100 \quad (2)$$

Where, BE= breakage efficiency (%), BW = weight of the broken shelled maize from the cobs (kg), and SW = weight of the shelled maize from the cobs (kg).

3. Results and Discussion

The traditional handpicking can perform the capacity of shelling of maize on an average of 6.15 kg/h and varying the capacity of shelling from 5.28 kg/h to 7.35 kg/h (Table 1). The standard deviation (SD) of shelling capacity is 0.58 kg/h, and the coefficient of variation (CV) is 9.43%.

Table 1. Performance of traditional shelling by their handpicking

Replications	Duration of Operation (min)	Shelling Capacity (kg/h)	Shelling Efficiency (%)	Breakage (%)
1	30	5.73	100.00	0.00
2	30	6.48	100.00	0.00
3	30	5.78	100.00	0.00
4	30	5.28	100.00	0.00
5	30	6.25	100.00	0.00
6	30	5.83	100.00	0.00
7	30	5.78	100.00	0.00
8	30	6.77	100.00	0.00
9	30	5.78	100.00	0.00
10	30	5.85	100.00	0.00
11	30	7.35	100.00	0.00
12	30	6.84	100.00	0.00
13	30	5.85	100.00	0.00
14	30	6.87	100.00	0.00
15	30	5.78	100.00	0.00
Average	30	6.15	100.00	0.00

Table 2. Performance of Octagonal Maize Sheller

Replications	Duration of Operation (min)	Shelling Capacity (kg/h)	Shelling Efficiency (%)	Breakage (%)
1	30	15.05	99.04	0.46
2	30	16.28	98.88	0.35
3	30	17.55	98.10	0.64
4	30	18.44	97.56	0.67
5	30	20.23	98.42	0.70
6	30	18.67	97.86	0.67
7	30	19.67	98.22	0.78
8	30	18.88	98.77	0.67
9	30	19.33	98.02	0.58
10	30	20.21	97.30	0.57
11	30	16.88	99.04	0.78
12	30	18.22	97.30	0.71
13	30	19.01	97.56	0.75
14	30	16.70	98.78	0.64
15	30	17.50	98.80	0.57
Average	30	18.17	98.24	0.64

The Octagonal Maize Sheller can perform average shelling capacity at 18.17 kg/h, and the standard deviation (SD) of shelling capacity is 1.5 kg/h, and the coefficient of variation (CV) is 8.25%. Moreover, average shelling efficiency is estimated at 98.24%, and shelling efficiency varies from 97.30 to 99.04%. The standard deviation (SD) of shelling efficiency is 0.63%, and the coefficient of variation (CV) is 0.64%. Further, the average breakage percent is calculated at 0.64, and breakage percent varies from 0.35 to 0.78%.The

standard deviation (SD) of breakage percent is 0.12%, and the coefficient of variation (CV) is 18.42%.The Performance of Octagonal Maize Sheller is given in Table 2.

The Mounted Maize Sheller can perform average shelling capacity at the rate of 23.60 kg/h, and the standard deviation (SD) of shelling capacity is 0.95 kg/h and coefficient of variation (CV) at 4.04%. The shelling capacity varies from 22.05 kg/h to 25.02 kg/h. Furthermore, average shelling efficiency is estimated at 98.27%, and shelling efficiency

varies from 97.05 to 99.05%. The standard deviation (SD) of shelling efficiency is 0.54%, and the coefficient of variation (CV) is 0.55%. Further, the average breakage percent is considered at 0.60, and breakage percent varies from 0.21 to 0.82%. The standard deviation (SD) of breakage percent is 0.18%, and the coefficient of variation (CV) is 30.06%. The Performance of Mounted Maize Sheller is given in Table 3.

The shelling capacity of maize is highest in Mounted Maize Sheller at 23.60 kg/h, followed by Octagonal Maize

Sheller (18.17 kg/h) and Handpicking (6.15 kg/h). Whereas, shelling efficiency is highest in Handpicking (100%), and followed by Mounted Maize Sheller (98.27%) and Octagonal Maize Sheller (98.24%). On the other hand, breakage is highest in Octagonal Maize Sheller (0.64%), followed by Mounted Maize Sheller (0.60%) and Handpicking (0%). The comparative evaluation of Handpicking, Octagonal Maize Sheller, and Mounted Maize Sheller is given in Fig. 4.

Table 3. Performance of Mounted Maize Sheller

Replications	Duration of Operation (min)	Shelling Capacity (kg/h)	Shelling Efficiency (%)	Breakage (%)
1	30	22.05	99.05	0.46
2	30	22.67	98.88	0.42
3	30	23.46	98.56	0.56
4	30	24.77	97.88	0.65
5	30	25.02	97.05	0.82
6	30	24.67	97.85	0.77
7	30	22.68	98.78	0.48
8	30	23.05	98.05	0.58
9	30	24.55	98.02	0.78
10	30	24.22	98.35	0.77
11	30	23.78	98.57	0.68
12	30	22.55	98.44	0.21
13	30	22.58	98.86	0.37
14	30	23.88	98.05	0.64
15	30	24.07	97.70	0.77
Average	30	23.60	98.27	0.60

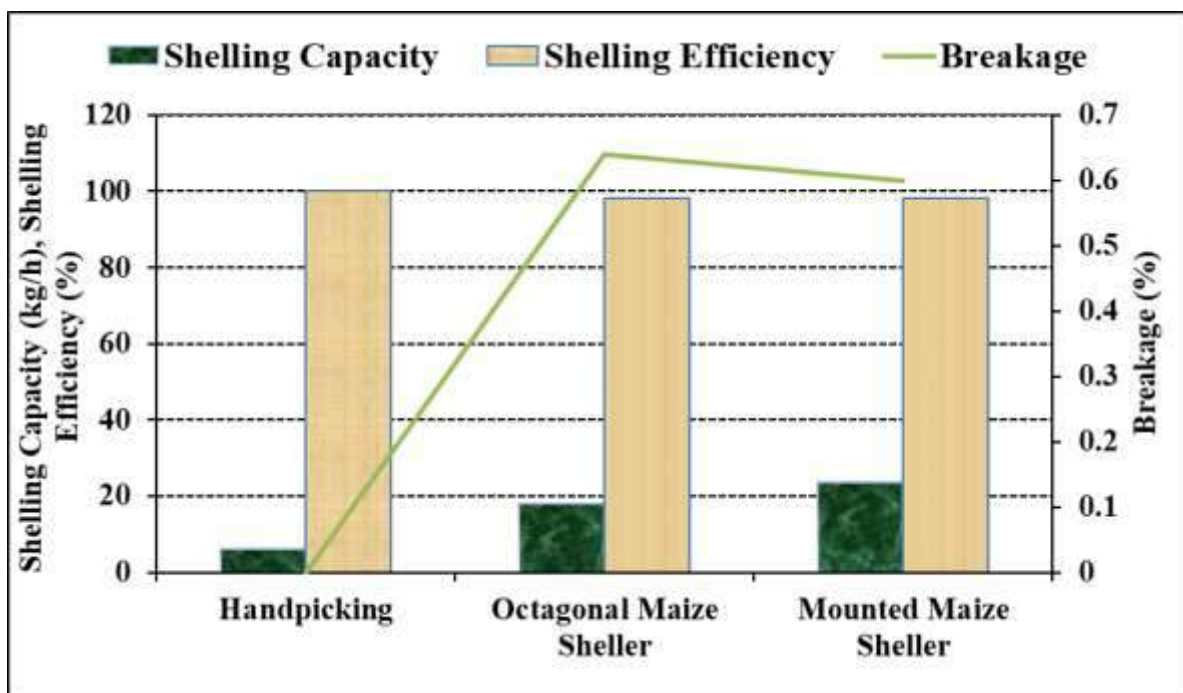


Fig 4. Comparative evaluation of Handpicking, Octagonal Maize Sheller and Mounted Maize Sheller

4. Conclusion

Although shelling efficiency and breakage is 100% and 0% respectively in the case of Handpicking, shelling capacity is very much inferior to both Octagonal Maize Sheller and Mounted Maize Sheller. Considering both shelling capacity and breakage, Mounted Maize Sheller has shown overall better performance than Handpicking and Octagonal Maize Sheller. Tubular sheller performs substantially better than manual shelling according to Chi-square testing (Pongen 2021). An ergonomic study of the manual maize sheller was conducted with the farmers as the subjects of the evaluation. The results revealed that the manual maize sheller better than the handpicking (Sarkar et al. 2021). The cost of Octagonal Maize Sheller is very low as compared to the cost of Mounted Maize Sheller. Still, Octagonal Maize Sheller is a popular maize shelling device commonly used in Manipur. On the contrary, Mounted Maize Sheller can help to much maize farming community in reducing the drudgery of Churachandpur in particular and Manipur in general. Adoption of Mounted Maize Sheller has higher shelling capacity as compared to Octagonal Maize Sheller and Handpicking. In view of increased shelling capacity and shelling efficiency the Mounted Maize Sheller was found more suitable and is recommended for maize shelling.

5. References

- DAC (2019) Annual Report (2018-19). Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India, Krishi Bhawan, New Delhi
- Hasalkar S, Budihal R, Shivalli R and Biradar N (2004) Assessment of work load of weeding activity in crop production through heart rate. *Journal of Human Ecology* 14 (3): 165-167
<http://ecoursesonline.iasri.res.in/mod/page/view.php?id=125404> (assessed on 07-04-2020).
- http://manenvis.nic.in/Database/Agriculture_2720.aspx (assessed on 06-04-2020).
- <https://knoema.com/atlas/World/topics/Agriculture/Crops-Production-Quantity-tonnes/Maize-production> (assessed on 06-04-2020).
- Kumar BA and Begum SH (2014) Design, development and performance evaluation of a hand operated maize sheller. *International Journal of Agricultural Engineering* 7(1): 194-197
- Patil SB, Chendake AD, Patil MA, Pawar SG, Salunkhe RV and Burkul SS (2014) Development and performance evaluation of pedal operated maize sheller. *Engineering and Technology in India* 5 (1&2): 32-37
- Pongen LY (2021) Study on performance evaluation of tubular maize sheller under frontline demonstration. *Current Topics in Agricultural Sciences* 2: 100–106., doi.org/10.9734/bpi/ctas/v2/13746D
- Sarkar B, Sundaram PK, Anurag AP, Kumar R, Kumar U, Rahman A and Aupadhyaya (2021) Ergonomic evaluation of hand operated maize sheller for reducing drudgery of farm women in Bihar. *Journal of AgriSearch* 8(1): 30-34
- Singh SP, Gite LP, Agarwal N and Majumder J (2007) Technical bulletin no. CIAE /2007/128, Women friendly improved farm tools and equipment. Published by CIAE, Bhopal, 56 p