



Ergonomic evaluation of manual sunflower threshing bench on farm women of Subarnapur and Mayurbhanj district of Odisha

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ABSTRACT

Sunflower threshing is one of the tedious job and done by female workers. Manual method of sunflower threshing by hand is fatigue, consumes time and its output is also very low. Different manual sunflower threshers have been developed by different research centres as pedal operated, hand operated wire mesh type and perforated GI sheet type thresher. Keeping this in view KVK, Sonepur and Mayurbhanj-1 have undertaken FLD on sunflower threshing for threshing sunflower for drudgery reduction of farm women and compared its performance with traditional method of threshing by hand. Ten female subjects were selected from each district in the age group 25-45years. The mean value of working heart rate was observed to be 110 and 109 beats/min in wire mesh type threshing bench, whereas 112 and 115 beats/min was in traditional method of threshing in Subarnapur and Mayurbhanj district respectively. The output was observed to be maximum 7.71 and 11kg hr⁻¹ in wire mesh type threshing bench whereas 1.37 and 2.8 kg hr⁻¹ in traditional method of sunflower threshing for both the districts of Subarnapur and Mayurbhanj district. The energy expenditure in threshing by wire mesh type threshing bench and traditional method was 8.77, 8.61 kJ min⁻¹ and 9.08, 9.56 kJ min⁻¹ respectively in two districts. Cardiac cost of work was low in wire mesh type threshing bench than that of traditional method of threshing. Hence from drudgery aspect and output point of view wire mesh type sunflower threshing bench is better than that of traditional method of threshing of sunflower.

Keywords: Sunflower thresher, energy expenditure, output, cardiac cost, threshing efficiency

INTRODUCTION

Agriculture, the single largest production endeavour in India, contributing 25% of GDP, is increasingly becoming a female activity. Agriculture sector employs 4/5th of all economically active women in the country. It is estimated that women are responsible for 70 per cent of actual farm work and constitute upto 60 per cent of the farming population (Basu and Singh, 2004). Women play a significant and crucial role in agricultural development and allied fields, including in the main crop production, livestock production, horticulture, post harvest operations, agro/ social forestry, fisheries, etc. Cent per cent population

of farm women observed to be involved in sowing, transplanting, weeding, winnowing, drying, cleaning and dehusking (Badigar et al., 2006). The nature and extent of women's involvement in agriculture, no doubt, varies greatly from region to region (Roshan and Ashok, 2011). In some of the farm activities like processing and storage, women predominate so strongly that, men workers are numerically insignificant (Aggarwal, 2003). Studies on women in agriculture conducted in India and other developing and under developed countries all point to the conclusion that women contribute far more to the agricultural production

than has generally been acknowledged. It is generally that the available agricultural technologies are not women friendly as they are not designed taking into consideration the women's ergonomic measurements. There exists a gap between design engineers and farm planners and also the lack of women's access to articulate their needs. The result is that the women farmers have to carry out various field operations with the age-old hand tools or with their hands. The farm women are employed in the operations which are either not mechanized or least mechanized and involve a lot of drudgery (Singh et al., 2010). The posture adopted during these operations are not proper and lead to occupational health problems if not given due attention. The modern technology thus, if not given due consideration to upgrade the skill of women, it may harm them in long run rather than benefiting them (Singh et al., 2007). Sunflower crop (*Helianthus annuus L.*) was introduced to Indian agriculture during 1969 to bridge the demand-supply gap of edible oil in the nation within these 40 years it is designated as one of the most popular oilseed crop of the farming community (Nath et al., 2013). Oilseed crops occupy an important position in the agricultural economy of any country. Sunflower is one of the most important emerging oil seed crop grown in our state next to that of groundnut and mustard (Goel et al., 2010). The area of this crop in our state is 29,690 ha (Anonymous, 2013). It is also one of the important cash crops adopted by the farmers hence the area under this crop is increasing day by day. Threshing is one of the crop processing operation to separate the grains from the ear heads and prepare the grains for selling (Kakhandaki et al., 2012). The harvesting of the seeds of this crop is also done by the farm women. Due to non availability of suitable machinery for its harvest and post harvest operations, farm women are following the traditional methods. Previously due to unavailability of the suitable harvesting implements for sunflower thresher to the farm women, they do it by rubbing the cub with hand or with each other to thresh the seeds. The output of the traditional method of threshing is very low and also it depends upon the efficiency of the worker along with this it also increase the drudgery farm women also. Goel et al. (2009) worked on wire mesh type thresher and reported that highest threshing capacity

was observed with this as against traditional practices (7.71 kg hr⁻¹ and 1.37 kg hr⁻¹). and recommended for small and marginal farmers of the state. Hence in this research paper an attempt has been made by Krishi Vigyan Kendra, Sonepur and Mayurbhanj-1 to study the suitability of sunflower threshing bench (wire mesh type sunflower threshing) for the farm women of Subarnapur and Mayurbhanj district and to compare it with manual method of threshing by hand with a view to get them involved in the mechanical method of threshing.

MATERIALS AND METHODS

Selection of subject and field

This FLD was conducted at the farmer's field in village Bidurpalli of Ullunda block of Subarnapur district and in village Badsole and Badjode in Baripada block of Mayurbhanj district of the state Odisha by Krishi Vigyan Kendra, Sonepur and Mayurbhanj-1 respectively in Rabi, 2016-17 during the month of March and April. The moisture content of sunflower during threshing varied from 11% to 12% in Subarnapur district and 9 to 10.5% in Mayurbhanj district. The study was carried out on 10 farm women each from both the districts involved in sunflower threshing activity aged between 25-45 years with normal health. Traditional methods of threshing of sunflower in Subarnapur district was hand rubbing and in Mayurbhanj district it was done by rubbing two flowers with each other by hand.

Wire mesh type thresher

It consists of a square frame having each side of 600 mm and a height of 200 mm and is made up of 30 x 30 x 3 mm MS angle. Wire mesh with mesh size of 10 x 10 mm was welded with the main frame and served as the threshing surface (Fig. 1). The workers rub the cubs over the wire mesh and the seeds are dropped at the ground, which is collected later and cleaned manually.

Threshing of sunflower by wire mesh type sunflower threshing bench was compared with traditional method by hand. During the experiment various parameters such as output, threshing efficiency, working heart rate, resting heart rate, cardiac cost at work and average energy expenditure were studied. Stopwatch was used to record the time and Digital Heart rate monitor was used for measuring heart rate.

Following parameters were recorded during experiment for hand threshing and by sunflower threshing bench.

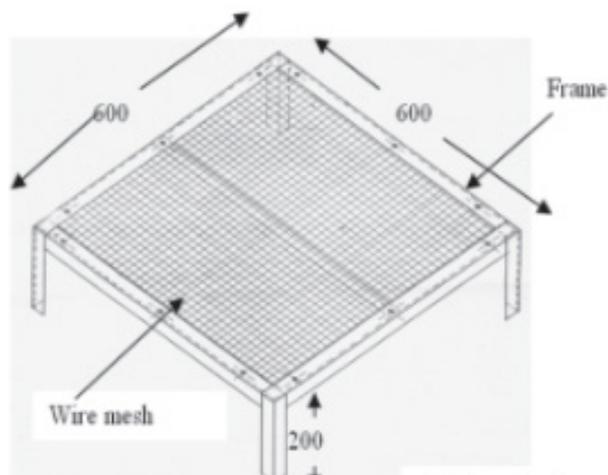


Fig. 1. Wire mesh type Sunflower thresher

Heart rate

Heart rate was recorded using a digital heart rate monitor. In the morning resting heart rate (RHR) of the respondent was recorded and after completion of the activity working heart rate (WHR) was recorded.

Energy expenditure rate

From the average values of heart rate energy expenditure was calculated with the help of formulae given by Varghese et al. (1994) which is as follows $EER (kJ \text{ min}^{-1}) = 0.159 \times HR (\text{beats min}^{-1}) - 8.72$

Where: EER = Energy Expenditure Rate (kJ min^{-1}); HR = Heart rate (beats/min)

Cardiac cost at work

Cardiac cost at work (beats) = Average heart rate (AHR) x Duration of activity

Where, AHR = Average working HR – Average resting HR (beats/min)

Output

Output (kg hr^{-1}) = weight of sunflower cob x duration/average time

Threshing efficiency

Threshing efficiency (η_{th}) (%) = $\frac{\text{Mass of threshing seeds (seed output)}}{\text{Total mass of seeds}} \times 100$

The detailed demonstration programme conducted at KVK, Subarnapur and Mayurbhanj is given in Fig. 2 to Fig. 5. The significance of difference in terms of their performance parameters and ergonomic parameters were compared by using paired 't' test.

RESULTS AND DISCUSSION

To evaluate the threshing through ergonomic point of view, 10 respondents each in the age group of 25 to 45 years were selected randomly from Subarnapur and Mayurbhanj district of Odisha and average age was counted respectively as 35.5 and 29.5 years. The basic body dimensions for both the districts were measured and averages were worked out as height (153.2 cm and 153 cm) and weight (51 and 49 kg) respectively (Table 1).

Table 1. Anthropometric dimensions of farm women involved in sunflower threshing (n=10)

Parameters	Mean	
	Subarnapur District	Mayurbhanj District
Age (year)	35.5	29.5
Height(cm)	153.2	153
Weight(kg)	51	49

Performance evaluation

As per comparison with traditional threshing of sunflower by hand with Sunflower threshing bench for both Subarnapur district and Mayurbhanj district the threshing efficiency was recorded as 96.1% and 96.5% by hand and 98.2% and 98.7% by sunflower threshing bench respectively.

During demonstration, data was collected to compare the performance of sunflower threshing bench and their traditional practices. The threshing efficiency of sunflower threshing bench was 98.2% and 98.7% as compared to their local practice of hand rubbing with threshing efficiency 96.1% and 96.5% respectively in both the district (Table 2), which causes significant losses to the farmers. Sunflower threshing bench also significantly saved 60 and 26.6 man-hour per q respectively in both the district as compared to traditional practices. The output of sunflower threshing bench was found to be 7.71 kg hr^{-1} while



Fig. 2. Threshing of sunflower by threshing bench in Subarnapur district



Fig. 3. Threshing of sunflower by threshing bench in Mayurbhanj district



Fig. 4. Traditional method of threshing of sunflower



Fig. 5. Output measurement

the output of threshing by rubbing with hand was only 1.37 kg hr^{-1} in Subarnapur district. Similarly the output of sunflower threshing bench was found to be 11 kg hr^{-1} and 2.8 kg hr^{-1} in traditional method in Mayurbhanj district, which is significant at both 5% and 1% level of significance. The difference of

output in traditional practices in two districts may be due to the fact that there are separate methods of threshing and in sunflower threshing bench the difference may be due to varied moisture content of flowers during threshing. Similar results were also obtained by Goel et al. (2009).

Table 2. Performance parameters while performing sunflower threshing with traditional and improved

Parameters	Subarnapur			Mayurbhanj		
	Hand threshing	Sunflower threshing bench	't' value	Hand threshing	Sunflower threshing bench	't' value
Threshing efficiency (%)	96.1	98.2	3.27*	96.5	98.7	6.12**
Labour required (Man-hour q^{-1})	72.9	12.9	46.99**	35.7	9.1	33.39**
Output (kg hr^{-1})	1.37	7.71	70.37**	2.8	11	81.67**

*Significant at 5 per cent level of significance **Significant at 1 per cent level of significance

Ergonomic evaluation

During execution of FLD, data was collected to compare the ergonomic performance of sunflower threshing bench and their traditional practices and given in Table 3. The average heart rate during resting period was found almost similar in case of sunflower threshing bench and their traditional practices such as 77, 76 beats/ min by using sunflower threshing bench where as 78 beats/min in traditional method of threshing respectively for both the districts.

The average working heart rate was observed as 110 and 112 beats/min in case of sunflower threshing bench and traditional method of threshing in Subarnapur district. There is no significant difference of average working heart rate between two methods of threshing. Whereas, in Mayurbhanj district it was 109 and 115 beats/ min respectively in case of sunflower threshing bench and traditional practices and found significant at both 5% and 1% level of significance. With the use sunflower threshing bench the farm women of both

Subarnapur and Mayurbhanj district found light rate of perceived exertion compared to traditional method.

The average energy expenditure by using sunflower threshing bench for threshing sunflower was found to be 9.08 kJ min⁻¹ while in traditional practice it was 8.77 kJ min⁻¹ in Subarnapur district. There is significant difference of average energy expenditure in Mayurbhanj district whereas it insignificant in Subarnapur district. The average energy expenditure was found to be 9.56 kJ min⁻¹ and 8.61 kJ min⁻¹ in case of sunflower threshing bench and traditional method respectively in Mayurbhanj district.

The cardiac cost of the farm women using sunflower threshing bench and in traditional practice was observed to be 990 and 1020 beats in Subarnapur district where there is no significant difference between two methods but there is significant difference of cardiac cost of the farm women between sunflower threshing bench and traditional practice in Mayurbhanj district and was found to be 990 and 1110 beats.

Table 3. Ergonomic parameters while performing sunflower threshing with traditional and improved technique

Parameters	Subarnapur		't' value	Mayurbhanj		't' value
	Hand threshing	Sunflower threshing bench		Hand threshing	Sunflower threshing bench	
Average Heart Rate during rest (beats/min)	78	77	1.02	78	76	1.84
Average working Heart Rate (beats/min)	112	110	1.53	115	109	6.06**
Average energy expenditure (kJ/min)	9.08	8.77	1.53	9.56	8.61	6.06**
Cardiac Cost(beats)	1020	990	0.55	1110	990	2.37*
Rate of perceived exertion	Moderately high	Light	-	Moderately high	Light	-

*Significant at 5 per cent level of significance **Significant at 1 per cent level of significance

Table 4 revealed that in traditional practice the percentage of respondents of both Subarnapur and Mayurbhanj district reported the occurrence of hand pain (70%,70%), shoulder pain (80%, 90%), backache pain(70%, 70%) and finger injury (90%, 80%) whereas during threshing through sunflower

threshing bench the occurrence of hand pain (10%, 20%), shoulder pain (20%,10%), backache pain (10%, 10%) and finger injury (0%, 10%) respectively. With the use of improved equipment farm women found light rate of perceived exertion as compared to traditional method.

Table 4. Comparisons health hazards in sunflower threshing bench and traditional

Health hazard	By hand				By sunflower threshing bench			
	Subarnapur		Mayurbhanj		Subarnapur		Mayurbhanj	
	Yes	No	Yes	No	Yes	No	Yes	No
Hand Pain	70	30	70	30	10	90	20	80
Shoulder Pain	80	20	90	10	20	80	10	90
Backache Pain	70	30	70	30	10	90	10	90
Finger injury	90	10	80	20	0	100	10	90

CONCLUSION

Manual threshing of sunflower by hand is a time-consuming and tedious operation. The heart rate responses showed that the activity is light. Though the activity is light, women feel it as a maximum drudgery prone activity because of its monotony in performance, continuous sitting and performing it for a longer period of time. It eliminated the chances of injury to finger and is very comfortable hand-operated tool to thresh sunflower. The work efficiency with the use of this tool to thresh the sunflower is very high and efforts are very low. Hence, it can be concluded that the wire mesh type sunflower threshing bench was found effective in reducing the drudgery of farm women. It was better in threshing efficiency and labour requirement than their traditional practice. It has also reduced the health hazards like hand pain, shoulder pain, backache and waist pain in majority of the respondents. Majority of the farm women perceived the sunflower threshing bench as 'most handy and convenient technology.

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