

Ergonomic Evaluation of Farm Women during Maize Shelling

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ABSTRACT

Women in India play a predominant role in agriculture and food provisioning and subsistence agricultural activities. The role of women in agriculture ranges from managers to landless labourers. However, the extent of their involvement differs with the variation in agro-production system and land owning system of farm households but they provide crucial labour in farm operations. She does the most tedious and back-breaking tasks in agriculture, animal husbandry and homes. Various studies on women in agriculture point to the fact that women are generally employed in the operations which are either not mechanized or least mechanized and involve a lot of drudgery. Hence a study was conducted in Chhindwara district to minimize the drudgery of farm women in maize shelling. A tubular maize sheller was introduced and tested on farm women. The results show that the shelling efficiency of tubular maize sheller was 26kg/hr as compared to hand shelling by which they only could shell 13kg/hr. and about 43% saving in cardiac cost of workers per unit of output in comparison to the hand shelling.

Key words: Maize sheller; Drudgery reduction; Shelling efficiency; Cardiac cost of work;

Women in rural India play a major role in shaping the economy of the country. As per 2001 census women constitute about 40 per cent of the work force engaged in agriculture, their number being about 92 million. By 2012, this number is expected to cross 110 million and it would be about 45 per cent of total agricultural workers. These figures give an indication of the role of farm women in Indian agriculture (Singh *et al.*, 2007). The farm women perform almost each and every agricultural activities right from land preparation, sowing, harvesting and storage of agricultural produce. The nature and extent of participation of farm women in agricultural activities are affected by a host of factors, which include, regional variations in nature of work, socio-economic status of the farm families, family traditions, change in nature of activities due to mechanization, introduction of time and labour saving implements and variations in agro-climatic conditions (Gautam *et al.*, 2008). All the household and farm activities are not only drudgerious but time consuming also. So a farm woman suffers a lot of drudgery while performing farming operations and household activities. If eight hours of work is considered

as one man day, the Indian rural women work more than two man day's everyday both in home and farm together. During the activities they adapt unnatural body posture due to which their physiological workload increases and also they faces many types of musco-skeletal problems as a result the efficiency of women to work decreases to a greater extent. Various studies on women in agriculture point to the fact that women are generally employed in the operations which are either not mechanized or least mechanized and involve a lot of drudgery. The research showed that maize shelling manually is very exhausting and time consuming task and the fingers and palm of farm women injured during shelling which reduces the efficiency of farm women. Therefore, there is an urgent need to suggest them about possible tools or techniques to save time, increase efficiency and reduce the drudgery.

Hence a study was conducted in Chhindwara district to increase efficiency and reduce the drudgery of farm women in maize shelling. A tubular maize sheller was introduced and tested on farm women through the heart rate method. Heart rate is one of the most accurate

means of studying the energy expenditure while performing any activity. Generally heart rate is used as an ergonomic measure to evaluate the physiological or functional demands of work on the individual workers (Hasalkar *et al.*, 2004). From the physiological point of view, the job demand or work load refers to the demands placed on the cardio-respiratory system and is determined by the energy cost and cardiac cost of work (Chauhan, 1999). Based on above considerations, the present study was undertaken with the following objectives:

1. To minimize drudgery and increase the efficiency of the farm women in short spin of time.
2. To execute the ergonomic analysis of the activities performed by the women and to study the circulatory stress and physiological cost of agricultural activities.

METHODOLOGY

The study was carried out on 20 farm women of Chhindwara district involved in maize shelling activity aged between 25-45 years without having any physical deformity. The experiment was conducted in the month of Nov.-Dec. During the experiment various parameters viz., time profile and physiological stress were studied. Time was determined as spent time for shelling of 100 maize cobs by farm women. Approximately 13 kg weight of the 100 cobs was taken for both the treatments i.e. hand shelling and tubular maize sheller. The anthropometric rod and weighing balance were used to measure the physical characteristics like height and weight. Stop watch was used for recording the time. The heart rate was recorded by using the heart rate monitor. Based on the heart rate records the following parameters were calculated-

- * Average heart rate during rest and work.
- * The energy expenditure per minute was estimated from the heart rate with the help of formulae given by Varghese *et al.* (1994).
Energy expenditure (kj/min) = 0.159 x Average heart rate (beats/min) – 8.72
- * ΔHR (beats/min) = Average working heart rate – average heart rate during rest
- * Output (kg/hr) = weight of maize cob x duration / average time

- * Cardiac cost of worker per unit of output (beats/kg of maize) = $\Delta\text{HR} \times \text{duration} / \text{output}$

The results were statistically analyzed using test of significance (t-test at 5% level of probability) and simple regression (r) by the following method of x

RESULTS AND DISCUSSION

To evaluate the shelling through ergonomic point of view, 20 respondents in the age group of 25 to 45 years were selected at random and average age was counted as 34.5 years. The basic body dimensions were measured an average was worked out as height (151.4 cm) and weight (48.6 kg) respectively (Table 1).

Table 1. Physical characteristics of selected respondents (N=20)

Physical characteristics	Mean \pm S.D.
Age (yrs)	34.5 \pm 6.04
Height (cm)	151.4 \pm 2.74
Weight (kg)	48.6 \pm 4.40

Table 2. Evaluation of performance data of different parameters of the farm women while shelling (N=20).

Particulars	Mean values \pm S.D	
	Hand Shelling	Tubular Maize sheller
Number of workers required	1	1
Time spent to shell 100 cobs (min.)*	62.3 \pm 8.98	30.2 \pm 4.24
Average working heart rate (beats/min)	86.7 \pm 12.07	92.5 \pm 11.25
Average heart rate during rest (beats/min)	81.9 \pm 11.98	86.9 \pm 10.37
ΔHR (beats/min)	4.8 \pm 3.05	5.6 \pm 2.41
Output (kg/hr)	12.5 \pm 1.76	25.8 \pm 3.40
Cardiac cost (beats/kg)	23.04 \pm 12.03	13.02 \pm 5.67
Saving in cardiac cost/kg (%)	-	43

*wt. of 100 cobs is equal to 13 kg. for both the treatments

Table 2 revealed that hand shelling required 62.3 minute to shell the maize while maize sheller required only 30.2 minute. So it is clear from the table that maize sheller saves more than half the time against the hand shelling and increases twice of working efficiency as the output recorded by tubular maize sheller was 26kg/hr as compared to hand shelling by which only 13kg/hr maize was shelled. During hand shelling,

the average Δ HR was 4.8 beats/ min. while by maize sheller it was recorded as 5.6 beats/ min. The cardiac cost of worker was 23.04 beats/ kg during manual

shelling while 13.02 beats/ kg by maize seller. So the maize sheller saves 43 per cent cardiac cost of worker per unit of output.

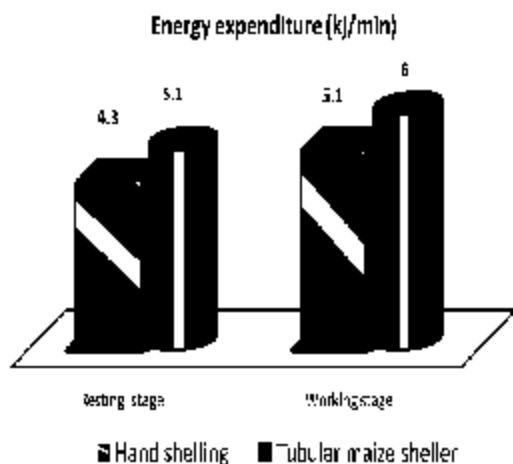


Fig 1: Comparison of energy expenditure of farm women between hand shelling and maize sheller.

Table 3. Correlation coefficient computed between different variables and energy expenditure. (N=20)

Particulars	Energy expenditure (kj/min.)	
	Hand Shelling	Tubular Maize sheller
Age (yrs)	-0.42*	-0.16
Height (cm)	-0.02	-0.15
Weight (kg)	0.09	-0.19
Time (min.)	0.07	-0.07
Average working heart rate (beats/min)	0.99**	0.99**
Δ HR (beats/min)	0.17	0.46*
Output (kg/hr)	0.01	0.12
Cardiac cost (beats/kg)	0.10	0.44*

*Significant at P=0.05,

** Significant at P=0.01

The average heart rate difference between working and resting stages (Δ HR) were found more variant by using tubular maize sheller, it is an accountable for energy expenditure during the course of shelling by maize sheller and calculated as 5.1 kJ/min and 6.0 kJ/min as resting and working stages, respectively, while it was found less in case of hand selling i.e., 4.3 kJ/min during resting and 5.1 kJ/min at working phase (Fig. 1).

Among various physical measurements of respondents exhibited significant negative correlation with energy expenditure (Table 3). Age of respondent showed significantly (P=0.05) negative relationship (r=0.42) with energy expenditure by shelling with hand and revealed that ageing effect working efficiency, while using maize sheller physical parameters is not directly responsible to effect working efficiency as is shown non significantly negative correlation with energy expenditure. Energy expenditure was increasing at right angles as increase of average working heart rate during the spin of shelling in both the cases as it exhibited significantly (P=0.01) positive correlation with hand shelling (r=0.99) and tubular maize sheller (r=0.99). Heart rate difference between working and resting period of respondent [Δ HR (r=0.46)] and cardiac cost (r=0.44) is also showed positive correlation (P=0.05) with energy expenditure and revealed that more energy was exhausted as rising of heart rate and cardiac cost also be found more at same point in energy expenditure while using tubular maize sheller for maize shelling.

Correlation coefficient computed amongst the

Table 4. Correlation coefficient computed amongst the variables of tubular maize sheller. (N=20)

Particulars	Age (yrs)	Wt (kg)	Time (min)	Av. WHR (beat/min.)	Δ HR (beats/min)	Cardiac cost (beats/kg)	Output (kg/hr)
Age (yrs)	1.00						
Weight (kg)	0.40	1.00					
Time (min.)	0.33	0.26	1.00				
Av. WHR (beats/min)	-0.17	-0.20	-0.07	1.00			
Δ HR (beats/min)	0.16	0.54**	-0.08	0.46*	1.00		
Cardiac cost (beats/kg)	0.29	0.59**	0.31	0.44*	0.92**	1.00	
Output (kg/hr)	-0.35	-0.17	0.98**	0.12	0.15	-0.23	1.00

*Significant at P=0.05,

** Significant at P=0.01

variables of tubular maize sheller is demonstrated in Table 4. Perusal analysis of data recorded is given the impression that the average weight of respondent showed significantly ($P=0.01$) positive relationship with ΔHR ($r=0.54$) and cardiac cost ($r=0.59$) and exhibited the working capacity affected through fluctuation of weight of worker. Output of work (Quantity of maize shelled) was depend upon the duration of work as it confirmed positive correlation ($P=0.01$) with time ($r=0.98$). Cardiac cost is also showed significant ($P=0.01$) positive association with average heart rate difference between working and resting period ($r=0.92$) during maize shelling with tubular maize sheller.

CONCLUSION

Manual shelling of maize 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. Hence maize sheller is best option for the women it saves not only the time but increases the efficiency of farm women twice and save about 43 per cent cardiac cost of worker per unit of output in comparison to the hand shelling. It eliminated the chances of injury to finger and is very comfortable hand-operated tool to shell maize from dehusked cobs. It is made up of mild steel pipe with four tapered fins riveted to its inner periphery. The best way to achieve the shelling is, held the maize sheller in left hand and cob held in right hand is inserted into it with forward and backward twist. The work efficiency with the use of this tool to shell maize is very high and efforts are very low.

REFERENCES

1. Chauhan, M.K. (1999). Workload and health problems in some occupational activities. Paper presented in Advanced Training Course in Ergonomics, at SNTD Women's University, Mumbai.
2. Gautam, U.S.; Khare, N.; Singh, Alka; Deva Kant (2008). *Technological module for farm women of Madhya Pradesh*. Published by Directorate of Extension Services, JNKVV, Jabalpur. 222 p.
3. Hasalkar, S.; Budihal, R.; Shivalli, R. and Biradar, N. (2004). Assessment of work load of weeding activity in crop production through heart rate. *J. Hum. Ecol.*, **14** (3): 165-167.
4. Singh, S.P.; Gite, L.P.; Agarwal, Nidhi and Majumder, J (2007). Technical bulletin No. CIAE /2007/128, Women friendly improved farm tools and equipment. Published by CIAE, Bhopal. 56 p.
5. Varghese, M.A.; Saha, P.N. and Atreya, N. (1994). A rapid appraisal of occupational workload from modified scale of perceived exertion. *Ergonomics*, **37** (3) : 485-491.