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Effect of maize sheller on efficiency and ergonomic parameters for farm women in hoshangabad district of Madhya Pradesh

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Abstract: Agriculture is the main source of employment for women in most of the developing countries. In rural areas about 60-70 percent of agriculture operations is not work efficient and leads to cause drudgery. All the post harvest activities are not only drudgeries but time consuming. Hence a study was conducted in Hoshangabad district of Madhya Pradesh to increase efficiency and reduced the drudgery of farm women in maize shelling by tubular maize sheller. The results indicate that the maize sheller shelled 28.4 kg/hr as compare to sickle 18.7 kg/hr with increase efficiency 34 % for maize crop.

Key Words: Maize sheller, Drudgery, Ergonomics, Health hazards

Introduction

Agriculture is of paramount importance in most developing countries because of both the large proportion of the population involved and the need to maintain national food production. Nearly half of the available human resources in India are women. It has been roughly estimated that women represent 50% of population and have contributed about 10% of income and own less than 1% of the world's property. 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).The extent of women contribution is aptly highlighted in a study that revealed that work day of women agriculture labour during season last for 15 hours and her male counterparts work for 7 to 8 hours (Mies, 1986). Within a region their involvement varies widely among different agro-ecological sub zones, farming systems, caste, classes and socio- economic status of families (Swaminathan, 1985). All the household and farm activities are not only drudgeries but time consuming also. During these activities farm women adopt unnatural body posture due to which their physical workload increases and also they faces many types of musculo-skeletal problems as a results the efficiency of women to work decreases to a greater extent. The maize or corn (*Zea mays L.*) are popular as a human food and animal feed. It is a source of a large number of products such as maize corn, corn starch, dairy feed, poultry feed, piggery, agro-industries.

Dehusking of maize cob after plucking from maize stalk is performed by human beings with hand (called dehusking) and grain removal from cob (called shelling) is also done traditionally. Hand and power operated maize sheller and maize threshers are commercially available but these equipment are not suitable for removing the grain from un-dehusked maize cobs. Thus, dehusking of cob is done manually. This activity is mostly performed by farm women. Traditionally, taking out grain from maize cobs are done either with use of fingers and hand, sickle, beating with sticks etc. Except beating with stick, farm women used to perform these activities. No hand operated maize dehusker-sheller was available for dehusking-shelling the un-dehusked maize cob (Singh, 2010). It is reported that farm women were not accustomed with cycling in the country (Singh, 2005), hence, a hand operated maize dehusker-shellerwas developed using ergonomic consideration (Singh *et al*., 2012) to provide options before small and hill farmers. The developed equipment needs to be evaluated ergonomically with farm women as they are involved in the process of dehusking-shelling of maize cobs. Physiological cost of operation is influenced by the health of operators, nutrition, basal metabolic rate and energy expended while working that can be indirectly measured by measuring oxygen consumption and heart rate. In general, person's subjective experience of a particular workload or rate of work is more closely related to heart rate than to oxygen consumption during the performance of work (Christensen, 1962). Pheasant (1991) have also concluded that the heart rate is a better index of the overall physiological demand of

work than energy expenditure and it has the additional advantage of being very much easier to measure in the field.

Hence a study was conducted in tribal block Kesla in Hoshangabad 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). With a view to generate information, a field experiment was conducted at farmer's fields in Hoshangabad district to increase efficiency and reduce the drudgery of farm women in Maize shelling to introduce Maize sheller.

Materials and Methods

The field experiments were conducted at the farmer's fields in village Morpani and Chandakiya during the year 2013-2014 in tribal block Kesla in Hoshangabad district of Madhya Pradesh.The study was carried out on 20 farm women of these villages involved in Maize shelling activity aged between 25-45 years with normal health, without any major illness were selected .The experiment was conducted during the month of December 2013-January 2014. Shelling with Maize sheller was compared with local sickle. During the experiment various parameters viz., time profile, shelling efficiency were studied. Stop watch was used to record the time. Following parameters were recorded during experiment for hand shelling and tubular maize shelling

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 and cardiac cost: From the average values of heart rate and energy expenditure was calculated with the help of formulae given by Varghese *et al.* (1994) which is as follows

EER (kj/min) = 0.159×HR (beats/min) - 8.72

Where: EER = Energy Expenditure Rate (kj/min); HR = Heart rate (beats/min)

From the values of change in heart rate (beats/min) and output (Kg/hr): The cardiac cost is calculated as

Δ heart rate (Beats/min) = Average working heart rate-average heart rate during rest

Output (kg/hr) = weight of maize cob x duration/average time

Physiological cardiac cost of worker / unit of outputs (beats/kg of maize) = Δ Heart rate x duration /output

After performing the activity: respondent were asked to rate the perceived exertion on a five point scale every time.

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 36.5 years. The basic body dimensions were measured an average was worked out as height (153.5 cm) and weight (51.2 kg) respectively (Table-1). As per comparison with traditional shelling of maize by local sickle and tubular maize sheller the shelling efficiency recorded 97% with only 2% grain damage as compare to their local practice by sickle *i.e.* 89% and 22% broken grain (Table-2). This can cause low market value as well as less storage period of grain. Local sickle shelled 18.7 kg/hour as compare to tubular maize sheller *i.e.* 28.4 kg/hour with increase efficiency 34 %. Pandey *et al.* (2013) also find similar results during shelling of maize through maize Sheller. The results presented in table-3 depict ergonomic assessment of improved maize shelling technology. The average working heart rate observed in traditional and improved method is 91 beats/min and 86.4 beats/min respectively. With the use of improved equipment farm women found light rate of perceived exertion compared to traditional method. Results are in line with the study conducted by Badiger *et al.* (2006).

Occurrence of health hazards in any farm practice affects the working efficiency and productivity of the performance. Table-4 reveals that in traditional practice the percentage of respondents reported the occurrence of hand pain (85%), shoulder pain (70%), backache pain(73.3%), waist pain (74) and finger injury (91%)

Table-1: Selected anthropometric dimensions of farm women involved in Maize shelling (n=20)

Parameters	Mean
Age (Yrs)	36.5
Height (cm)	153.5
Weight (Kg)	51.20

Table-2: Efficiency percentages of farm women during shelling of maize

Parameters	Hand Shelling	Tubular Maize shelling
Shelling Efficiency (%)	89	97
Labour required (man-hour/q)	05	03
Output (kg/h)	18.7	28.4
Efficiency (%) of farm women	-	34.1
Damage/ broken grain (%)	22	2

Table-3: Ergonomic parameters and perceived exertion rate while performing maize shelling with traditional and improved maize shelling

Physical parameters	Hand shelling traditional	Maize sheller
Average working Heart Rate (beats/min)	91.0	86.40
Average Heart Rate during rest (beats/min)	85.79	82.2
Ä Heart rate(beats/min)	5.21	4.2
Average energy expenditure (kj/min)	5.75	5.02
Av. physiological cost of work (beats/kg)	13.14	7.58
Rate of perceived exertion	Moderately heavy	Light

Table-4: Comparisons health hazards in tubular maizesheller and traditional sheller by sickle

Health hazards	Sickle (%)		Tubular maize sheller	
	Yes	No	Yes	No
Hand Pain	85	15	20	80
Shoulder Pain	70	30	6.6	93.3
Backache Pain	73.3	26.6	6.6	93.3
Waist Pain	74	26	10	90
Finger injury	91	9	10	90

whereas during shelling through octagonal shape maize sheller the occurrence of hand pain (20%), shoulder pain (6.6%), backache pain (6.6%), waist pain (10) and finger injury (10%) respectively.

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 siting 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 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.

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