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Ergonomic evaluation of different improved grain cleaning tools with particular reference to safety and health of women: A rapid appraisal

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Abstract

A study was conducted to assess ergonomically the efficiency of improved post harvest technologies i.e., hanging type cleaner, grader, serrated sickle, wheel hoe, sugarcane stripper. Twenty farmwomen were selected to assess and compare the impact of improved technologies over one. The physiological cost of work and energy expenditure in terms of heart rate cardiac cost, time required, strokes, output were observed to be lower while performing selected activities with the improved technologies compared to the traditional one. The work output was also found higher with all of the improved technologies. The activity was performed with both the traditional method using as well as by using supra, local sickle, khurpee the improved tools. Results of the study showed that the average heart rate and energy expenditure of the women were reduced significantly while performing the activities with the use of improved tools manufactured by CIAE, Bhopal. The use of both the improved tools also leads to reduction in the muscular stresses. Further it was observed that work productivity with the improved tool i.e. serrated sickle, wheel hoe, sugarcane stripper Hanging sieve had significantly improved. It was therefore recommended that women should be motivated to use the improved tools for to minimize their health hazards and safety.

Keywords: ergonomic, grain cleaning tools, particular reference, health of women

Introduction

In India's Farm women play a significant role economy and their number, at present, is estimated at about 101 million. Though they play multifarious roles. The role of women in agriculture is very significant especially the post harvest and agro processing activities like the cleaning, drying, grinding, decortication. Cleaning of wheat grains is the most common farm activities performed by the women in every rural home. Farm women are involved mostly in drudgery prone activities which include transplanting, weeding, harvesting, threshing, grain cleaning etc. The tools/equipment available have been primarily developed for male workers and given for use to women workers which results in lower system efficiency and create health problems. Ergonomics as a science is defined to solve the problem and to help the farm women to work in better condition for which efforts of scientists are required. Ergonomics is branch of science that work for easing the task of farm women by equipment, knowledge and surroundings that will suit each worker (Rajendran and Reddy, 2013) [3]. Women have different ergonomical characteristics than men and therefore it is necessary to develop improved tools/equipment to suit their anthropometric and strength data. The tools/equipment once developed needs to be demonstrated, and the users have to be given proper training or their proper use. The Central Institute of Agricultural Engineering Bhopal in association with NRCWA subcentre and AICRPs located at SAUs has taken a lead in this direction and evaluated/refined/developed about 21 tools and equipment suitable for farm women. Effort have also been made to provide trainings and demonstrations to women extension functionaries and farm women on these tools and equipment. Making these tools available in rural areas is also very important and needs to be given due consideration. This paper touches all these aspects and suggestions have been given for development and promotion of women friendly tools and equipment with particular reference to safety and health.

Studies have pointed out that farm activities that are time and labour intensive, monotonous, repetitive and more drudgery prone are generally performed by women. Drudgery can be defined as physical & mental strain, fatigue, monotony and hardship experience by farm

women while doing weeding operations (Kumar *et al.*, 2011) [2]. Since all the operations are done manually, they cause considerable physical and mental fatigue and other health problems. The root cause of their sufferings is ignorance about improved technologies, age-old methods of doing the work, inappropriateness of the technology and attitudinal constraints such as innate conservatism and resistance to change. "Empowerment of Women in Agriculture" has been initiated with the objective to empower farm women technologically to reduce their drudgery (Badiger, 2006) [1].

Objectives

- To measure the average heart rate during work and during rest of women performing the selected activity with traditional method and with the use of improved tools.
- To measure the change in work output with the use of traditional and improved methods related to selected activity.
- To compare the cardiac cost of work, time required for cleaning, number of strokes/batch for sieving saving with traditional and improved method.
- To make the necessary recommendations to women to reduce their health hazards and drudgery while performing the grain cleaning activity.

Material and Method

Twenty five Farm women of Jabalpur District in the age group of 35 to 50 years with normal health without any major illness were selected for the study. The suitability of the women for the experiment was ascertained by measuring the body temperature, blood pressure, heart rate etc. Improved tools were compared with traditional practice. During the experiment various parameters viz. time profile, output, heart rate, work pulse, cardiac cost, saving in cardiac cost. Stop watch was used to record the time.

Performance Of the Activity

The selected subjects were given enough rest and their resting heart rate was measured with the help of Heart Rate Monitor. Then the subject was asked to perform the selected activity by traditional method for approx. 30 mins. and the heart rate of the subjects was measured for the entire activity. After the Hanging Sieve. Specifications completion of the task the recovery heart rate was again recorded till the subject came in the state of normal heart rate. The same procedure was repeated when the same women performed the activity with improved tools manufactured by CIAE, Bhopal.

Using improved tool Hanging Type Cleaner

Specifications

Particulars	Hanging Type Cleaner	Sack Holder
Overall Dimensions (l x w x h), mm	1040 x 620 x 205	530 x 450 x 810
Weight, kg	17.1	10.3
Size of jute bag, mm	-	1120 x 680
Cost, Rest	4000	1500

Features

- Hanging sieve a batch type hand operated equipment to replace existing traditional practice of grain cleaning with natural wind or horizontal/vertical sieving to clean the grains.
- These separate impurities like stubbles, chaff, dirt and broken from wheat, Bengal gram, soybean and other cereals and pulse crops.
- These improved tools consist of the mainframe, scalper/grading screen, draper rod, handle, shutter etc., and is operated by hanging it on any elevated point with 4 ropes.
- A batch of 5-10 kg of grains is fed into the cleaner and it swings to and fro to sieve the batch
- Single woman can operate this in standing posture and desired work can be done with minimum of efforts and body fatigue.

Working Principles of equipment

- It is manually operated equipment for cleaning and grading of grain.
- It consists of main frame, grading screen, draper rod, rubber grip over handle, shutter etc.
- Four ropes are tied on the hooks provided on main frame of cleaner and hanged on any elevated points or hooks attached to the ceiling. It is operated in oscillating mode.

Result and Discussion

Formulae: Average heart rate, energy expenditure were calculated with the help of following formula

- Average heart rate during rest and work.
- ΔHR (beat/Min) = Average working heart rate - Average heart rate during rest.
- Output (Kg./hr.).
- Cardiac cost of work per unit of output (beats/Kg) = $\Delta HR \times$ duration of work/output.

Assessment of selected ergonomic parameters

Performance Data:

Table 1: Impact of improved tool over traditional tool for grain clearing activity

S. No.	Particulars	Traditional Practice (with supa)	Hanging Sieve (Double Screen grain cleaner)
1.	No. of Trials	05	05
2.	No. of Farm Women involved	20	20
3.	Grain used for experiment	Wheat	Wheat
4.	Quantity of seed fed per batch/Kg.	01 Kg.	10 Kg.
5.	Time required for cleaning/batch/min	06 min.	04 min.
6.	Number of strokes/batch for sieving.	32	13
7.	Output Kg/hour	10/Kg.	150/Kg.
8.	Average Heart Rate during rest beats/Min.	98.7 beats/min	88 beats/min.
9.	Average working Heart Rate beats/Min.	104 beats/min	93 beats/min.
10.	ΔHR	5.94 beats/min	5 beats/min.
11.	Cardiac cost of work per unit of output beats/Kg.	2.37 beats/Kg.	30 beats/Kg.
12.	Impact No. of farmers adopted %	-	40%

Analysis

Hanging Type Cleaner

The data enclosed in the table no. 1 it was that with traditional method of grain cleaning heart rate was 104.43 beats/min but with the use of improved tool (Hanging sieve) heart rate was reduced to 93 beats/min also proved that by using improved tools/technologies, the physiological workload get reduced to a great extent.

The work efficiency is measured in terms of output was significant increase (150 kg/h) in work output was observed while using improved technology compared to traditional method (10 kg/h) table-1.

Similar results are observed in case of energy expenditure and physiological cost of work. Thus, these technologies proved drudgery reducing, more efficient, advantageous in terms of increased out put thus time saving. The time saving with the use of improved method or improved tool was 04/batch/min with that of traditional method is 06/batch/min. for Indian Women. The cardiac cost of work is the total number of heart beats spent about the resting level in order to perform the work. The cardiac cost of recovery is the total no. of heart beats above the resting level occurring at the end of work and return to the pre activity state.

The same was perceived by the farm women. Hence, it may be concluded from the study that, most of the agricultural activities particularly they are post harvest activities commonly performed by farm women. Since all operations are performed manually they cause physical and mental fatigue and other health problems. Some of the schemes tried

to introduce many technologies, which have not reached the women at gross root level. But this study has made concerned efforts through continuous trainings, demonstrations at field level and created awareness and skill in the use of these technologies. Use of improved technologies i.e.. tubular maize sheller, ground nut decorticator, sugarcane stripper, serrated sickle, wheel hoe and hanging type cleaner, grader showed decrease in physiological cost of work and increased work out put compared to traditional method. Hence, beneficiaries of this study are changing their attitude, skill and knowledge which intern help to empower farm women technologically, and also socially and economically for improved quality of life.

Hanging sieve saves almost half the time and increase working efficiency (saving 19 strokes/batch for sieving) reduces drudgery of farm women over traditional practice. Comparison with traditional practice (Supa) found that Hanging sieve was easy in operation, no muscle strain, save cardiac cost of worker, less energy expenditure causing fatigu The ideal work equipment should ensure health safety and wellbeing of the person. So it is essential that working equipment should be designed ergonomically and it should be user friendly. Hanging grain cleaner is ideal for work as it increase the work efficiency and reduce drudgery by avoiding bending and squatting posture. So farm women feel comfortable and they earn more money by reducing the labour engagement during cleaning of wheat. Money beings happiness in their families and their social life also improve. (Sharma, B,e.l 2018) [5].

Table 2: Improved tool Seratted sickle

Particulars	Local sickle	Improved sickle
Number of workers required	01	01
Strokes/min	37	33
Output m ² /h during wheat harvesting	149	158
Heart Rate during work beats/Min	129	119
Heart Rate during rest beats/Min.	95.5	90
ΔHR beats/min	33.5	29
Cardiac cost of work beats/ m ²	13.48	11.01

The data enclosed in the table no. 2 it was that with traditional method of harvesting of wheat heart rate was 129 beats/min but with the use of improved tool (Improved sickle) heart rate was reduced to 119 beats/min) also proved that by using improved tools/technologies, the physiological workload get reduced to a great extent.

The work efficiency is measured in terms of output was significant increase (158 kg/h) in work output was observed while using improved technology compared to traditional method (149 kg/h) table-2

Similar results are observed in case of energy expenditure and physiological cost of work. Thus, these technologies proved

drudgery reducing, more efficient, advantageous in terms of increased out put thus time saving. The time saving with the use of improved method was 33/ strokes//min with that of traditional method is 37/ strokes//min. The cardiac cost of work is the total number of heart beats spent about the resting level in order to perform the work. The cardiac cost of recovery is the total no. of heart beats above the resting level occurring at the end of work and return to the pre activity state). The cardiac cost of work is 13.48 beats/ m² with traditional method {local sickle} but with the use of improved tool (Improved sickle) cardiac cost was reduced to 11.01 beats/ m².

Improved tool wheel hoe

Particulars	Wheel hoe	Traditional method (Khurpee)
Number of workers required	01	01
Crop	soybean	soybean
Output m ² /h	145 m ² /h	35 m ² /h
Heart Rate during work beats/Min	118	127
Heart Rate during rest beats/Min.	100	99
Working width mm	200	45
Working depth mm	30	20
ΔHR beats/Min	07	19

The data enclosed in the table no. 3 it was that with traditional method of weeding of soybean heart rate was 127 beats/min but with the use of improved tool (Improved sickle) heart rate was reduced to 118 beats/min.

The work efficiency is measured in terms of output was significant increase 145 m²/h in work output was observed while using improved technology compared to traditional method 35 m²/h. Similar results are observed in case of Δ HHR beats/ means - Min Average working heart rate- Average heart rate during rest, it was that with traditional method (Khurpee) 19 beats/Min but with the use of improved tool (wheel hoe) heart rate was reduced to 07 beats/Min.

Improved tool sugarcane stripper

Particulars	Sugarcane Stripper	Local sickle
Number of workers required	01	01
Output ^{kg/h}	48	37
Heart Rate during work beats/Min	112	120

The data enclosed in the table no. 4 it was that with traditional method of stripping of sugarcane heart rate was 120 beats/min but with the use of improved tool (sugarcane stripper) heart rate was reduced to 112 beats/min.

The work efficiency is measured in terms of output was significant increase 48 ^{kg/h} in work output was observed while using improved technology compared to traditional method 37 ^{kg/h}.

Conclusion

Most of the post harvest activities performed by the farm womens, earlier all agricultural operations were performed manually. So they create mental and physical fatigue and also create many other health complications. The study introduced several technologies which have still not reached farm women. This study made many efforts through trainings, demonstrations, skill development programmes and other awareness activities among farm womens in their fields with the help of improved drudgery reduction tool like – double screen hanging type grain cleaner, serrated sickle wheel hoe and sugarcane stripper. The use of all improved tools were found to be of highly ergonomic design user friendly and was found to reduce drudgery.

It is concluded that improved tools decreases the safety and health hazards of women and work load and increases the efficiency of work.

Recommendations

From the results of the present study, it was observed that the improved tool manufactured by CIAE, Bhopal, helped in reducing the physiological parameters and also increased the production output to a great extent. Muscular stresses were also reduced with the improved tools. Farmers/ farm women are not always aware of the improvements they could make by using scientific and technological knowledge. Thus, the attention of farm women was directed towards the women friendly improved farm tools (Patel *et al.*, 2015) ^[4]. It is therefore recommended that the women should be motivated to use improved tool to prevent occupational health hazards and to achieve higher work productivity.

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