

## Ergonomic Evaluation of Improved Grain Cleaning Technologies - Comparative Study of Traditional and Improved Tools

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### ABSTRACT

This study was conducted to assess ergonomic efficiency of improved hanging type cleaner grader. Twenty farmwomen were selected to assess and compare the impact of improved technologies over traditional 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 Supa, 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 grain cleaning activity with the use of improved tool manufactured by CIAE, Bhopal. The use of both the improved tools also led to reduction in the muscular stresses. Further it was observed that work productivity with the improved tool Hanging sieve had significantly improved. It was therefore recommended that women should be motivated to use the improved tools for grain cleaning to minimize health hazards.

**Key words:** Ergonomic evaluation, having sieve, health hazards.

### INTRODUCTION

Farm women play a significant role in India's economy and their number, at present, is estimated at about 101 million. Though they play multifarious roles, farm women are employed mostly in drudgery-prone activities which includes transplanting, weeding, harvesting, threshing, grain cleaning etc. The tools/equipments available have been primarily developed for male workers and given for use to women workers which results in lower system efficiency and occupational health problems. Women have different ergonomical characteristics than men and therefore it is necessary to develop tools/equipments to suit their anthropometric and strength data. The tools/equipments once developed need to be demonstrated, and the users have to be given training for their proper use. The Central Institute of Agricultural Engineering, Bhopal in association with DRWA sub-centre 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. Efforts have also been made to provide training to women extension functionaries and farm women on these tools and equipments. Making these tools available in villages 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 equipments.

The role of women in agriculture is very significant especially the post harvest and agro processing activities like the cleaning, drying, grinding, decortications. Cleaning of wheat grains is the most common farm activities performed by the women in every rural home. Grain and chaff are separated using natural breeze or by creating artificial wind. While doing so, the women adopt many unnatural postures like bending, stretching of different body parts which lead to increase in cardiovascular stresses. Elisjistom and Nachemson (1970) also found that unnatural postures led to several musculo-skeletal problems. The tools/equipments available have been primarily developed for male farmers and women farmers have to use the same if required resulting in low work efficiency and many occupational health problems. So, there is a need to develop or improve the existing grain cleaning equipment according to the anthropometric needs of the women farmers to reduce their drudgery. Keeping in mind these views, an improved tool for cleaning of grains i.e hanging sieve was tested in order to see the impact on the reduction of stresses of women and to measure its impact on the increase of work output (Oberoi *et. al.*, 2005).

Studies have pointed out that farm activities that are time-and labour-intensive, monotonous, repetitive and more drudgery prone are generally performed by women.

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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 *et al.*, 2006). The present study was undertaken 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, measure the change in work output with the use of traditional and improved methods related to selected activity and compare the cardiac cost of work, time required for cleaning, number of strokes/batch for sieving saving with traditional and improved method.

### METHODOLOGY

Twenty farm women of Narsinghpur 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.* Cleaning and grading of grain with hanging sieve was compared with traditional practice Supa. During the experiment, value of various parameters *viz.* time profile, output, heart rate, work pulse, cardiac cost were recorded 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 approximately 30 minutes. 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.

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, (₹)	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

- 1) It is manually operated equipment for cleaning and grading of grain.
- 2) It consists of main frame, grading screen, draper rod, rubber grip over handle, shutter *etc.*
- 3) 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.

### RESULTS AND DISCUSSION

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

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

**Table 1: Comparative performance of the Supa and Hanging sieve**

Particulars	(Traditional Practice with Supa)	(Double Screen grain cleaner Hanging Sieve)
No. of Trials	05	05
No. of Farm Women involved	20	20
Crop	Wheat	Wheat
Output Kg./Hour	15 kg hour	150 kg hour.
ΔHR	5 beat min.	5.94 beats min.
No. of women farmers adopted (%)	-	40

Assessment of selected ergonomic parameters

**Table 2: Impact of improved tool over traditional tool for grain clearing activity**

Particulars	Traditional Practice (with supa)	Hanging Sieve (Double Screen grain cleaner)
Number of workers required	01	02
Grain used for experiment	Wheat	Wheat
Quantity of seed fed per batch/Kg.	01 Kg.	10 Kg.
Time required for cleaning/batch/min	06 min.	04 min.
Number of strokes/batch for sieving.	32	13
Output Kg/hour	10/Kg.	150/Kg.
Average Heart Rate beats/min.	103.40 beats/min	93 beats/min.
ΔHR	5.94 beats/min	5 beats/min.
Cardiac cost of work per unit of output beats/Kg.	30 beats/Kg.	2.37 beats/Kg.

It was observed that with traditional method of grain cleaning heart rate was 103.43 beats/min but with the use of improved tool (Hanging sieve) heart rate was reduced to 93 beats/min (Table 2). The results had conformity with the findings of Sandhu *et al.* (2001) who advocated that by using improved tools/technologies, the physiological workload get reduced to a great extent.

The work efficiency measured in terms of output was significantly high (150 kg/h) in work output was observed while using improved technology compared to traditional method (10 kg/h) (Table 2). Results were in line with the study conducted by Gupta *et al.* (2004).

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 output thus time taken. The time saving with the use of improved method was 04/batch/min against that of traditional method (06/batch/min). The energy expenditure was estimated by

using the formula proposed by Varghese *et al.* (1994) 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 (Saha, 1976).

Most of the agricultural activities particularly post harvest activities were 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 training, demonstrations at field level and created awareness and skill in the use of these technologies. Use of improved technologies viz. tubular maize sheller, ground nut decorticator, ground nut stripper 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 changed their attitude, skill and knowledge which in tern helped to empower farm women technologically, socially and economically for improved quality of life.

Hanging sieve saved almost half the time and increase working efficiency (saving 19 strokes/batch for sieving) and reduced drudgery of farm women over traditional practice. Comparison with traditional practice (Supa) found that Hanging sieve was easy in operation, caused no muscle strain, saved cardiac cost of worker, and required less energy expenditure causing fatigue.

## CONCLUSION

On the basis of the above-discussion, it may be concluded that improved tools decreased the health hazards and work-load and increased the efficiency of work. Besides, the quality of grain was also improved with the use of improved tool. Hence, there is need to promote such drudgery reducing technology for the overall health improvement of the farm women engaged in agriculture. This will lead to the empowerment of the farming community having a healthy mother and healthy family.

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