

## Ergonomic Assessment of Vegetable Harvesting Technologies for Farm Women

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### INTRODUCTION

The present study entitled "Ergonomic Assessment of Vegetable Harvesting Technologies for Farm women" was carried out with the objectives to assess the physiological cost of work, musculoskeletal disorders, and occupational health hazards and accidents faced by farm women while performing brinjal and okra harvesting in traditional and improved method. The use of mittens and cotton picking apron, developed by AICRP College of Home Science, MKV Parbhani was considered as an improved method.

The result showed that use of mittens and apron reduced physiological stress of the farm women in harvesting of brinjal (16.63%) and okra (16%). The work output was increased significantly while performing harvesting of brinjal and okra with improved method. It was found that there was increase in pace of work by 19.96 and 21.87 per cent in case of brinjal and okra harvesting respectively when performed by improved method. Similarly, area covered under vegetable harvesting was increased when performed by improved method by 19.08 and 24.89 per cent in case of brinjal and okra harvesting respectively. There was significant relief from muscular pain, grip fatigue, drudgery experienced, difficulty perception and workload. Thus, it can be concluded that use of mittens and apron was beneficial and we should motivate more and more women to use these technologies for reducing their drudgery in vegetable harvesting.

Farm women have anatomical and physiological differences that may place them risk for farm injuries (Engber, 1993). The use of conventional tool and method for the work of harvesting add further to their drudgeries. When a person does any physical work, he/she use muscle power (energy and skeletal tissues) to do so. During the muscular activity one's physiological responses i.e. energy expenditure and heart rate increases. This increase in physiological responses is related to the type, intensity and duration of work and thus sets limits to the performances of heavy work. Therefore, measurement of effort and physiological responses are important for designing work method. Nag and Chatterjee (1981) suggested that the work levels for 8 hr activities for men and women should not exceed beyond 35 and 28 per cent of one's aerobic capacity. There are several studies that reveal or show that women participate in several activities of the vegetable harvesting but there is hardly any literature that shows the physiological workload and biomechanical stress of women while performing vegetable harvesting activity. Quirina *et al.* (2008) had reported the skin problems among farm workers in North Carolina, such as pimples, or acne, rash, including skin sunburn, itching and insect bite. They suggested to using the personal protective equipment and change in work practices. To increase the productivity of the women's work, there is a greater need for the ergonomic analysis of the activities performed by women and to study the circulatory stress and the physiological cost of vegetable harvesting activity (Hasalkar *et al.* 2004).

### MATERIALS AND METHODS

The present study was carried out in selected villages of Parbhani district namely mirkhel, signapur,

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pimpri and Naukhed of Marathwada region in Maharashtra state. A random sample of 30 farm women ranged between the age group of 25 - 40 yr who were involved in vegetable harvesting since 5 years was selected for the study. The selected farm women were healthy and without any physical deformities and illness. The data regarding heart rate (resting, working and recovery), perceived exertion, energy expenditure, were recorded by using pretested questionnaire. Vegetable harvesting accessories / tools i.e. Brinjal and okra mittens and apron developed by ACRIP, Family Resource Management, College of Home-Science, M.K.V Parbhani were used as new technologies, the brinjal and okra harvesting was considered to know the difference between conventional and improved method (Plate no.1).

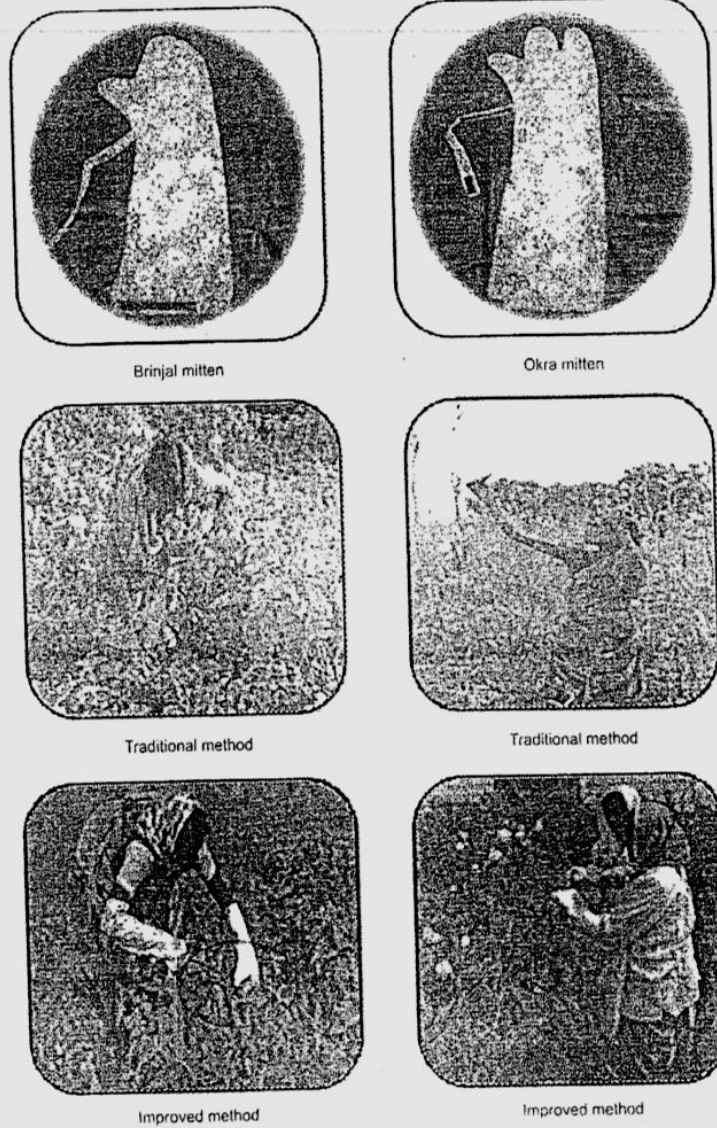


Plate 8.1: Traditional and Improved method of Brinjal and okra harvesting

### Determination of Physiological Cost of Work of Vegetable Harvesting

- **Average working heart rate (AWHR):** working heart rate was recorded with the help of heart rate monitor. Till the completion of work both in conventional and improved method.
- **Average peak heart rate (APHR):** peak heart rate was noted down while performing the activity.
- **Average and peak energy expenditure (Kj.m<sup>-1</sup>) (AEE and APEE):** It was calculated by using the formula:(Varghese *et al.* 1994)

$$\text{Energy expenditure (Kj.m}^{-1}\text{)} = 0.159 \times \text{heart rate (b.m}^{-1}\text{)} - 8.72$$

- **Total cardiac cost of work (TCCW) (b.m<sup>-1</sup>):** Total cardiac cost of work was calculated by using the following formula:

$$\text{TCCW} = \text{cardiac cost of work} + \text{cardiac cost of recovery.}$$

$$\text{Where, Cardiac cost of work} = (\text{Average working heart rate} - \text{Average resting heart rate} \times \text{duration})$$

$$\text{Cardiac cost of recovery} = (\text{Average recovery heart rate} - \text{Average resting heart rate} \times \text{duration})$$

Physiological cost of work (PCW) (beats): It was calculated by using the following formula:

$$\text{Physiological cost of work (PCW)} = \frac{\text{Total cardiac cost of work}}{\text{Total time of work}}$$

(Varghese *et al.* 1994)

## RESULTS AND DISCUSSION

### Physiological Workload While Performing the Brinjal Harvesting

Physiological workload while performing the brinjal harvesting by conventional and improved method i.e. by using specially designed mittens was carried out and results revealed that the average heart rate (101 b.min<sup>-1</sup>) and average peak heart rate (108 b.min<sup>-1</sup>) were noted highest in conventional method of brinjal harvesting activity than the improved method (98 and 104 b.min<sup>-1</sup>). On an average 3 b.min<sup>-1</sup> (2.97%) reduction was observed in working heart rate and 4 b.min<sup>-1</sup> (3.70%) reduction was observed in peak heart rate while working with improved tool i.e. mittens. The average energy expenditure (7.37 Kj m<sup>-1</sup>) and peak energy expenditure (8.40 Kj m<sup>-1</sup>) were noted higher in conventional method as compared to improved method i.e. 6.86 Kj m<sup>-1</sup> and 7.73 Kj m<sup>-1</sup> respectively. Hence 0.51 Kj m<sup>-1</sup> (6.91%) reduction was seen in average energy expenditure and 0.67 Kj m<sup>-1</sup> (7.90%) reduction was seen in average peak energy expenditure while working with using improved tool. Total cardiac cost of work and physiological cost of work found highest in case of conventional method. There was 14.56 per cent of reduction in total cardiac cost of work and 13.63 per cent of reduction in physiological cost of work while performing brinjal harvesting activity by using mittens. Statically the results were significant at 5% level.

Rate of perceived exertion indicated that conventional method of brinjal harvesting activity was perceived as very heavy by the farm women and it was felt moderately light when it was performed in improved method. Statically the results were significant at 1 % level.

Hence, it can be concluded that the heart rate of farm women was more while performing brinjal harvesting in conventional method compared to improved method. On an average there was 3.22 per cent of reduction in working heart rate and 3.88 per cent of reduction was observed in peak heart rate while working with improved method. Similarly, energy expenditure was reduced by 6.96 per cent and 7.90 per cent of reduction was observed in peak energy expenditure. Total cardiac cost of work reduced by 14.56 per cent and physiological cost of work was observed reduced by 14.63 per cent while performing brinjal harvesting activity. Energy expenditure was reduced by 6.96 per cent. Rate of perceived exertion indicated in brinjal harvesting activity as heavy in conventional method as it was felt light in improved method.

#### Work Output while Performing Harvesting of Brinjal with Conventional and Improved Method

Table. 8.1 indicate the work output measured in terms of work area covered under harvesting and pace of work *i.e.* weight of the vegetable harvested per unit of time. It was found that there was increase in pace of work by 19.96 per cent in case of brinjal harvesting when performed by improved method.

Similarly, area covered under vegetable harvesting was increased when performed by improved method by 19.08 per cent in case of brinjal harvesting respectively. Significant difference was noted between conventional and improved method when 't' test was applied.

#### Physiological Workload while Performing the Okra Harvesting

Physiological workload while performing the okra harvesting by conventional and improved method *i.e.* by using specially designed mittens and apron was carried out and results revealed that average heart rate ( $107 \text{ b} \cdot \text{min}^{-1}$ ) and average peak heart rate ( $113 \text{ b} \cdot \text{min}^{-1}$ ), were noted highest in conventional method of okra harvesting activity than the improved method ( $103 \text{ b} \cdot \text{min}^{-1}$  and  $109 \text{ b} \cdot \text{min}^{-1}$ ) respectively. On an average  $4 \text{ b} \cdot \text{min}^{-1}$  (3.73 %) of reduction was observed in working heart rate and  $4 \text{ b} \cdot \text{min}^{-1}$  (3.53 %) of reduction was observed in peak heart rate while working with improved tool *i.e.* mittens and cotton picking apron. The average energy expenditure ( $8.3 \text{ KJ m}^{-1}$ ) and peak energy expenditure ( $9.26 \text{ KJ m}^{-1}$ ) were noted higher in conventional method than improved method *i.e.*  $7.67 \text{ KJ m}^{-1}$  and  $8.61 \text{ KJ m}^{-1}$  respectively. Hence 7.59 per cent of reduction was seen in average energy expenditure and 7.01 per cent of reduction was seen in average peak energy expenditure while working with using improved tool. Total cardiac cost of work and physiological cost of work found highest in case of conventional method. There was 16.84 per cent of reduction in total cardiac cost of work and 16 per cent of reduction in physiological cost of work while performing okra harvesting activity by using mittens and cotton picking apron. Statically the results were significant at 5% level.

Rate of perceived exertion indicated that conventional method of okra harvesting activity was perceived as heavy by the farm women and it was felt light when it was performed in improved method. Statically the results were significant at 1 % level.

Hence, it can be concluded that the heart rate of farm women was more while performing okra harvesting in conventional method compared to improved method. On an average there was 3.73 per cent of reduction in working heart rate and 3.53 per cent of reduction was observed in peak heart rate while working with improved method. Similarly, Energy expenditure was reduced

by 7.59 per cent and 7.01 per cent of reduction was observed in peak energy expenditure. Total cardiac cost of work reduced by 16.84 per cent and physiological cost of work was observed to be reduced by 16 per cent while performing okra harvesting activity. Rate of perceived exertion indicated in okra harvesting activity as heavy in conventional method as it was felt light in improved method.

### Work Output while Performing Harvesting of Okra with Conventional and Improved Method

Table 8.2 indicate the work output measured in terms of work area covered under harvesting and pace of work i.e. weight of the vegetable harvested per unit of time. It was found that there was increase in pace of work by 21.87 per cent in case of okra harvesting respectively when performed by improved method. Similarly, area covered under vegetable harvesting was increased when performed by improved method by 24.89 per cent in case of okra harvesting respectively. Significant difference was noted between conventional and improved method when 't' test was applied. It can be concluded from the above data that work output was increased significantly while performing harvesting of okra and brinjal with improved method i.e. by using mittens and apron.

Table 8.1: Work output while performing harvesting of Brinjal with conventional and improved method

Pace of work(kg/0.3hr)			
Conventional (mean $\pm$ SD)	Improved (mean $\pm$ SD)	Percentage increased	't' test
3.27 $\pm$ 0.75	3.96 $\pm$ 0.75	19.96	2.6335**
Work area covered(sqmt/0.3 hr)			
Conventional (mean $\pm$ SD)	Improved (mean $\pm$ SD)	Percentage increased	't' test
18.86 $\pm$ 3.52	22.46 $\pm$ 6.59	19.08	1.875*

\*\* Significant at 1% level      \* Significant at 5% level

Table 8.2: Work output while performing harvesting of Okra with conventional and improved method

Pace of work(kg/0.3hr)			
Conventional (mean $\pm$ SD)	Improved (mean $\pm$ SD)	Percentage increased	't' test
3.20 $\pm$ 0.94	3.90 $\pm$ 0.98	21.87	2.000*
Work area covered(sqmt/0.3 hr)			
Conventional (mean $\pm$ SD)	Improved (mean $\pm$ SD)	Percentage increased	't' test
19 $\pm$ 3.60	23.73 $\pm$ 4.11	24.89	3.354**

\*\* Significant at 1% level      \* Significant at 5% level

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