



## ORIGINAL RESEARCH PAPER

## Home Science

# WORKLOAD ASSESSMENT OF HARVESTING OF SUGARCANE IN SUGARCANE PRODUCTION SYSTEM

**KEY WORDS:** Heart Rate. Energy Expenditure. Total Cardiac Cost of Work. Physiological Cost of Work.

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## ABSTRACT

Sugarcane occupies an important position in agrarian economy of India, it is an important source of livelihood and income for the farmers. Heart rate is one of the accurate means to evaluate the physiological or functional demands of work on the worker. Hence the study was undertaken to know the workload of workers in harvesting activity. The results revealed that, the total cardiac cost of work while harvesting was 1261.5 beats and the physiological cost of work was 42.05 beats/min. The average working heart rate during Harvesting was observed to be 105.52 beats/min and the average energy expenditure was 8.06 kJ/min. Though harvesting was performed continuously from morning till evening in standing and bending position, majority of the workers perceived it as moderately heavy to heavy activity. The heart rate responses showed similar result as far as the classification of workload is considered.

## Introduction

Sugarcane occupies an important position in agrarian economy of India. About 6 million farmers and a large number of agricultural labourers are involved in cane cultivation. Besides, more than half a million skilled and semi skilled workers, mostly from rural areas are engaged in the sugar industry, the largest agro processing industry of India. Sugarcane being the major cash crop, it is an important source of livelihood and income for the farmers.

Harvesting is regarded as an activity that requires great physical exertion and is characterized by a high power consumption and high demands of the heart and lungs. Such activity is also characterized by repetitive movements of the arms, legs and trunk, load of cane bundles or weight.

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 worker (Burger, 1969). Rao (1987) evaluated workload in home and farm activities based on the pulse rate. Similarly Varghese et al. (1989) studied household activities and proposed job classification table based on heart rate and energy expenditure.

Tewari (1994) assessed the workload on fisher women and found it to vary between moderately heavy and heavy. From the physiological point of view, the job demand or workload refers to the demands placed on the cardio-respiratory system and is determined by the energy cost and cardiac cost of work. (Chauhan, 1999).

To increase the productivity of the farmers work, there is a greater need for the ergonomic analysis of the activities performed by them and to study the circulatory stress and the physiological cost of each agricultural activity. Then suggest possible solutions or techniques to increase the productivity. Hence this study was done with the following objective-

- To assess the workload of harvesting of sugarcane.

## Methodology

Forty healthy workers performing the harvesting activity regularly, not having any major illness were selected for the study. Physical characteristics like height and weight was measured by using the anthropometric rod and weighing balance respectively. The heart rate responses for every minute were recorded by using the heart rate monitor. Every respondent was tied the heart rate monitor and switched on to record the heart rate at every minute. Five minutes rest was given to record the resting heart rate. Then they were asked to do the harvesting activity for 30 minutes and then again five minutes rest was given. After a total time of 40 minutes the heart rate monitor was switched off and removed. Based on the heart rate records the following parameters were

calculated.

1. Average heart rate during rest, work and recovery period.
2. The energy expenditure per minute was estimated from heart rate using the following formula and the classification of work load was done as per Varghese et al (1994).

Energy Expenditure (kJ/min) = 0.159 x Average Heart rate (beats/min) – 8.72

3. The Total Cardiac Cost of Work (TCCW) was also estimated for the whole day based on the cardiac cost of work and cardiac cost of recovery.

Cardiac Cost of Work (CCW) = Increased Average heart rate x Duration of work

Increased Average heart rate during work = Average working heart rate – Average heart rate during Rest

Cardiac Cost of Recovery (CCR) = Increased average heart rate during recovery x Duration

Increased Average heart rate during recovery = Average Recovery heart rate – Average Resting Heart rate

The subjective judgement of respondents were taken to rate the perceived exertion soon after the harvesting activity on the five point scale, from very light -1 to very heavy -5 as given by Varghese et al. (1994).

## RESULTS AND DISCUSSION

The mean age of the respondents selected for the study was 36.08 years with standard deviation  $\pm 7.86$ , height was 168.5cms with standard deviation  $\pm 5.10$  and weight was 58.06 kgs with std. deviation  $\pm 8.44$  (Table 1).

**Table 1: Physical characteristics of the subjects selected for ergonomic evaluation of Harvesting activity of sugarcane.**

**N=40**

S.No.	Physical characteristics	Mean $\pm$ S. D.
1	Age (yrs)	36.08 $\pm$ 7.86
2	Height (cm)	168.5 $\pm$ 5.10
3	Weight (kg)	58.06 $\pm$ 8.44

Prior to start of the activity the average resting heart rate recorded as 78.86 beats per minute, whereas while doing harvesting it was 105.52 beats per minute. After performance of the harvesting activity for a duration of 30 minutes the workers were given the rest for 5 minutes, the average recovery heart rate during recovery period was recorded as 94.25 beats per minute (Table

2). The average energy expenditure was 3.81 kj/min, 8.06 kj /min and 6.26 kj/min respectively during rest, harvesting and recovery. The peak heart rates recorded during rest, harvesting and recovery period were 82.4, 116.7 , and 111.9 beats per minute and the energy expenditure was 4.38 kj/min, 9.83 kj/min and 9.07 kj/min. respectively (Table-2).

Table 2: The average and peak heart rate and energy expenditure of the workers during Harvesting. N=40

Activity	Working heart rate(beats/min)		Energy expendi ture (kj/min)		Classification of workload	
	Average	Peak	Average	peak	Average	Peak
Rest	78.86	82.4	3.81	4.38	-	-
Harvesti ng	105.52	116.7	8.06	9.83	Moderat ely heavy	Moder ately heavy
Recovery	94.25	111.9	6.26	9.07	-	-

Table 3: Total cardiac cost of work, physiological cost of work and classification of work load of Harvesting activity.

Physiological Parameters	Harvesting activity
Total Cardiac Cost of Work (beats)	1261.5
Physiological cost of Work (beats/min)	42.05
Rate of Perceived Exertion (Moderately heavy to heavy)	3.95

Table 3 presents the Total Cardiac Cost Work, Physiological Cost of Work and the classification of workload of harvesting activity based on heart rate and energy expenditure. The calculation of Total Cardiac Cost of Work for harvesting of sugarcane activity was 1261.5 beats and the average Physiological Cost of Work during harvesting was 42.05 beats/min. As per the average and peak heart rate and energy expenditure the harvesting activity was classified as as moderately heavy activity. Based upon the above table it can be said that harvesting is physically demanding task performed by the workers for 8 hours per day with a rest in between for 1 hour.

Table-4 Tool used and Posture adopted in harvesting of sugarcane

Activity	Tool Used	Satisfied /Dissatisfied	Posture Adopted	Comfortable/un comfortable
Harvesting	Darati and Gadsa	Satisfied	Standing and bending	uncomfortable

Harvesting of sugarcane was done with the traditional tool- Darati and Harvesting was done in standing and bending position by the hand with the help of darati and gadsa. Posture was found uncomfortable.

CONCLUSION

Harvesting is one of the very important agricultural activity in sugarcane production system.

Though this activity is performed for 4-5 months in a year, continuously from morning till evening in standing and bending position workers perceived it as moderately heavy to heavy activity. The heart rate responses showed that the activity is a moderately heavy activity. Workers feel it as a drudgery prone activity because of its monotony in performance, continuous standing and bending posture and performing it for a longer period of time. Continuous standing and bending leads to accumulation of lactic acid thus adding to fatigue leading to pain /discomfort in the back and calf muscles /lower legs. Certain handy tips were suggested to the workers while they can taken up in between the activity which will delay the onset of fatigue by few hours.

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