

RESEARCH PAPER

# Ergonomic evaluation of hill farm women in paddy transplanting activity

NEENA VYAS\*, LAXMI DEVI AND JATINDER KISHTWARIA

Department of Family Resource Management, College of Home Science, C.S.K. Himachal Pradesh Krishi Vishvavidyalaya, PALAMPUR (H.P.) INDIA

## ABSTRACT

In almost all rice growing areas of Himachal Pradesh, women are responsible for sowing, transplanting, weeding etc. Majority of farm women are involved in household, agricultural and allied activities. Therefore, the main problems of rural farm women are long working hours of heavy work, low productivity and limited access to new technology. The transplanting activity performed by women has a strong bearing on their health. Hence, the present study was formulated with the objective to determine the ergonomic cost of paddy transplanting in existing working situations and to identify suitable technology to reduce the drudgery of work. Ergonomics evaluation of respondents were carried out in relation to physiological stresses viz., Heart rate, Energy expenditure, Grip strength and physical fatigue. Thirty (30) volunteer respondents selected for experimental work under present investigation. The readings were recorded while the selected respondents performed the paddy transplanting activity on existing working conditions for 30 minutes each. Results revealed that there was significant per cent increase in physiological stresses mainly in heart rate and energy expenditure before and during transplanting activity while working with traditional methods/tools. Campaigns were conducted to generate awareness on the use of manual transplanter, as it reduces time and energy of the respondents. Thus, after imparting training on improved technology that is manual transplanter majority of the selected respondents were willing to purchase the same. It can be concluded that the finding of the study can be useful to farm ladies to reduce their drudgery by using improved technologies.

**Key Words :** Transplanting, Drudgery, Physiological stresses, Energy expenditure

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Agriculture in India is the backbone of the country and is regarded as the largest sector of the country's economic activity. More than fifty per cent of the farm work is done by women in India (Dhillon *et al.*, 2007) Himachal Pradesh is located on a sloping terrain of the great Himalayan, with snow clad mountains, rolling hills and valleys. For more than a decade farming has been rated as one of the dangerous occupations. A considerable number of adverse health conditions, including musculoskeletal disorder are linked with agricultural work.

Women are the backbone of agricultural to workers, she does most tedious and back-breaking tasks in agriculture animal husbandry and homes. It is fact that the woman of hill rural areas contributes to agricultural work in addition to their domestic work. In almost are rice growing areas of Asia, men traditionally undertake activities such as land preparation, ploughing, irrigation and field levelling, on the other hand women are responsible for transplanting, weeding sowing and crop processing. Thus, the main problems of hill farm women are long working hours of heavy work,

\* Author for correspondence

Neena Vyas, Department of Agricultural Engineering, College of Agriculture, C.S.K. Himachal Pradesh Krishi Vishvavidyalaya, PALAMPUR (H.P.) INDIA

unfavourable climatic conditions, low productivity and less awareness of new improved technology. Longer working hours can result in exhaustion and a high risk of stress related diseases. Thus, it is necessary to analyze them in terms of physical stresses and their effects related to health problems. The transplanting activity performed by women has a strong bearing on their health. Rural women form the most important productive work force in agriculture sector of majority of the developing nations including India. Transplanting is an important activity performed by the rural hill farm women. Paddy is cultivated in 10 to 12 districts of the state except Kinnaur and Lahaul spiti. Kangra and Mandi districts account for 71.2 per cent of the area and 69.7 per cent of production (Singh, 2005).

### RESEARCH METHODOLOGY

The study was conducted in Villages of Bhawarna block in Kangra district of Himachal Pradesh because most of the women perform paddy transplantation activity in the selected area. Random sampling technique was used for selecting a total sample of 120 respondents for the study. For collecting the relevant data as per objectives of the study, an interview schedule was prepared comprised of three parts.

Various tools and techniques were used for taking measurements and reducing responses. Based on the results of survey experimental work was conducted on 30 volunteer respondents falling within the normal range of physiological parameters that is heart rate, energy expenditure and rated perceived exertion.

#### Recording of physiological parameters :

Heart rate before and after activity was recorded with the help of heart rate monitor. Before the start of each part of the selected activity, the resting heart rate of the respondent per minute for five minute was recorded. Then the heart rate at the interval of 30 minute was also recorded. Immediately after the completion of the activity, respondents were made to sit in relaxed position and recovery heart rate was recorded for 5 minutes at an interval of 1 minute each (or till the value reached resting value) with the help of heart rate monitor.

Energy expenditure was estimated from the values of average heart rate during work by using formula given by Varghese *et al.* (1994).

$$\text{Energy expenditure (Kj/min)} \approx 0.159 \bar{I}$$

$$\text{Average heart rate } \frac{\text{beats}}{\text{min}} > 8.72$$

$$\text{Total cardiac cost of work (TCCW)} = \text{Cardiac cost of work (CCW)} + \text{Cardiac cost of recovery (CCR)}$$

where,

$$\text{CCW} = \text{AHR} \times \text{duration of activity}$$

$$\text{AHR} = \text{Average working heart rate} - \text{average resting heart rate}$$

rate

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

*Physiological cost of work (PCW) :*

$$\text{PCW} = \frac{\text{Total cardiac cost of work}}{\text{Total time of activity}}$$

#### Recording psycho physiological parameters :

*Rated perceived exertion :*

Rated perceived exertion is subjective expression of feeling of respondents towards light/heavy work being undertaken by them. It is based on the physical sensations a person experiences during physical activity, including increased heart rate, increased respiration or breathing rate, increased sweating, and muscle fatigue. Although this is a subjective measure, a person's exertion rating may provide a fairly good estimate of the actual heart rate during physical activity. In this study a modified 5-point scale of perceived exertion was developed by Varghese *et al.* (1996) was used to calculate mean scores of physical fatigue.

**Table A : Assigned score values for perceived exertion by respondents**

| Variables (perceived exertion) | Assigned score |
|--------------------------------|----------------|
| Very light                     | 5              |
| Light                          | 4              |
| Moderately heavy               | 3              |
| Heavy                          | 2              |
| Very heavy                     | 1              |

#### Recording of biomechanical parameters :

Body posture (Rapid Entire Body Assessment –REBA) REBA was developed by McAtamney and Higett in 1995. REBA has been developed to fill a perceived need for a practitioner's field tool, specifically designed to be sensitive to the type of unpredictable working postures found in health care and other service industries.

| REBA Score | Action  |
|------------|---|
| 2          | Negligible risk                                 |
| 2-3        | Low risk change may be needed                   |
| 4-7        | Medium risk, further investigation, change soon |
| 8-10       | High risk, investigate and implement            |
| 11+        | Very high risk, implements change               |

### RESULTS AND REMONSTRATION

Ergonomic evaluation of respondents in relation to physiological stresses, viz., heart rated responses, energy expenditure, grip strength and physical fatigue towards the existing working conditions of 30 volunteer respondents selected for experimental work under the present study. The

readings were recorded while the selected respondents performed the paddy transplanting activity on existing working conditions for 30 minutes each. Parameters such as heart rate, energy expenditure and grip strength of the respondents were measured before the start of activity that is when the respondents were in resting period and then during the activity and also after completion of activity.

**Cardio-vascular responses :**

Cardio-vascular responses such as hearts rate and energy expenditure with respect to working on existing working condition have been depicts in Table 1. It can be observed that at rest mean heart rate before working was 74 beats/ minutes which increases up to mean 96 beats/ minutes during the activity, indicating increase over base as 22 beats/ minutes. Thus, the per cent increase was 23 beats/ minutes. ‘t’ test was carried out to test the significant increased in hearts rate values between rest and during activity ‘t’ value (6.03\*) found significant.

Regarding energy expenditure, it is evident from the Table 1 that at resting position before working on existing working condition energy expenditure was found to be 4.42 (kj/min). whereas, during the activity it increased up to 7.33 (kj/min) indicating increase over base as 2.91 (kj/min). Thus, the per cent increase was 39.70 (kj/min). Further, ‘t’ test was carried out to test the significant increase in energy expenditure in existing working conditions. ‘t’ value was found to be 6.017861\* which was significant. The average temperature of the selected area while transplanting activity was 29°C and humidity was 80.5 per cent.

This finding is supported by Hasalkar *et al.* (2003). The average working hearts rate during weeding/

transplanting was observed to be 94 beats/min, and the average energy expenditure was 6.28 kcal/ min. The work output increased significantly while performing the weeding/ transplanting activity with the improved tool.

**Physiological stresses :**

Data enfolded in Table 2 shows that the total cardiac cost of work, physiological cost of work and physical fatigue of selected respondents while working.

It can be seen that while working average total cardiac cost of work was 635 beats/min, physiological cost of work was 20 beats/ min. Murali *et al.* (2007) found that working heart rate was significantly higher than resting heart rate of the selected household and farm activities.

**Effect on physical fatigue :**

Physical fatigue can be estimated by perceived exertion a person experiences during physical activity, including increased heart rate, increased respiration or breathing rate, increased sweating, and muscle fatigue. Although this is a subjective measure, a person’s exertion rating may provide a fairly good estimate of the actual heart rate during physical activity. The Varghese RPE (Rated Perceived Exertion, 1996) scale has been widely used to study physical fatigue. Table 2 shows that while working average physical fatigue was 1.767.

**Effect on muscular grip strength :**

Grip strength was determined to assess the muscular fatigue before, during and after the activity with the help of grip dynamometer. Data given in Table 3 reveals that the average muscular grip strength of left hand was 19.40 kg and that of the right hand was 21.87 kg. doing the

| Table 1 : Distribution of respondents according to their cardio-vascular responses while working on paddy transplanting |   |                             |                 |                    |                   |           |
|---|---|-----------------------------|-----------------|--------------------|-------------------|-----------|
| Sr. No.   | Parameters to measure cardiovascular responses (beats\mins) | Cardio-vascular responses   |                 |                    |                   | ‘t’ value |
|   |   | Existing working conditions |                 |                    |                   |           |
|   |   | At rest                     | During activity | Increase over base | Per cent increase |           |
| 1.  | Heart rate (beats\ mins)                                    | 74                          | 96              | 22                 | 23                | 6.03*     |
| 2.  | Energy expenditure(kj\min)                                  | 4.419                       | 7.334           | 2.915              | 39.7              | 6.017861* |

\* indicates of significance of values at P=0.05, respectively

| Table 2 : Distribution of respondents according to their physiological stress while working on existing working conditions |                             |
|--|-----------------------------|
| Parameters (physiological stress)  | Existing working conditions |
| Total cardiac cost of work (TCCW)-in beats   | 632 ± 228.31                |
| Physiological cost of work (PCW)- on beats   | 20 ± 8.32                   |
| Physical fatigue (based on RPE value)  | 1.767 ± 0.430183067         |

| Table 3 : Distribution of respondents according to their grip strength while working in the existing working conditions |                             |
|---|-----------------------------|
| Grip strength (kg)  | Mean muscular grip strength |
| Left hand   | 19.40 ± 11.74               |
| Right hand  | 21.87 ± 13.38               |

transplanting activity.

**Distribution of REBA score for existing working conditions:**

REBA was developed by McAtamney and Hignett in 1995. REBA has been developed as practitioner’s field ‘tool, specifically designed for the unpredictable working posture found in body. The ergonomic technique was used to evaluate respondents posture used while doing transplanting activity.

| REBA score | Action  |
|------------|---|
| 1          | Negligible risk                                 |
| 2-3        | Low risk change may be needed                   |
| 4-7        | Medium risk, further investigation, change soon |
| 8-10       | High risk, investigate and implement change     |
| 11+        | Very high risk, implements change.              |

The mean scores given in the Table 4 shows overall final REBA man score as 9.10 mean score for existing working condition. On comparing the score in the REBA score sheet, it was found that there was high risk in the working postures of the worker. Thus, change in posture soon was recommended. Khan and Siddique (2005) also concluded that the workers, who have to work for long hours in a particular posture should be advised to take couple of minutes rest after working for some time to reduce pressure on the spinal column. Similar work related to the present topic was also done by Kishtwaria *et al.* (2009); Kishtwara and Rana (2007); Kishtwaria *et al.* (2004); Kaur *et al.* (2007) and Dewangan *et al.* (2007).

**Table 4 : Distribution of REBA score for existing working conditions**

| Postures                        | Existing working conditions |
|---------------------------------|-----------------------------|
|                                 | Mean score                  |
| Final upper arm score           | 2.367                       |
| Final lower arm score           | 1.00                        |
| Final wrist score               | 3.00                        |
| Final wrist score and arm score | 4.73                        |
| Final neck score                | 3.00                        |
| Final trunk score               | 3.87                        |
| Final leg score                 | 2.87                        |
| Final neck, trunk and leg score | 7.7333                      |
| Final score                     | 9.10                        |

\*8-10 High risk investigate and change posture soon.

**Conclusion :**

Agriculture in India is the backbone of the county and is regarded as the target sector of the country’s economic

activity. Sowing / transplanting is one of the most costly and drudgery oriented operation in hills because traditional methods are employed for various tasks which are labour intensive and time consuming often get delayed due to non availability of labours in time.

Rural women contribute much of the labour for rice production and other agricultural activities. In Himachal Pradesh even now a day’s farm. Operations are being carried out manually causing drudgery to workers. Significant per cent increase was found in physiological stresses in heart rate and energy expenditure before and during transplanting activity while working with traditional method/ tools calculated mean REBA score was 9.10 for existing working condition and the score between 8-10 falls under high risk category .Hence, there is urgent need to change posture of the women while working in the study area.

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