

Improving Efficiency and Reduction in Drudgery of Farm Women in Weeding Activity by Twin Wheel Hoe

Barkha Sharma¹, S.R.K. Singh², S. Gupta³, M.K. Shrivastava⁴ and Shilpi Verma⁵

1 & 4, Programme Assistant (Home science) & Programme Coordinator, KVK, Ratlam, 2. Sr. Scientist, ZPD, Zone VII, 3. Deputy Director Extension, RVSKVV, Gwalior, 5 S.M.S (Home science), KVK, Neemuch. M.P.

Corresponding author e-mail: singhsrk@yahoo.co.in

ABSTRACT

Indian farm women do many difficult tasks and weeding of the crop is among them. It is a main drudgery prone activity which is mostly performed by farm women and to solve this problem Krishi Vigyan Kendra Ratlam, as per its mandate conducted front line demonstration on "Improved twin wheel hoe" in soybean weeding. The basic objective of these demonstrations was to reduce drudgery with muscular stress and fatigue. The work efficiency of the farm women was distinctly increased by skilled use of "improved wheel hoe" developed by CIAE, Bhopal as is evident from the results of the demonstration. Thirty farm women were selected randomly for the study. The demonstration component included use of improved weeding implement (Twin Wheel Hoe), skill training and exposing advantages. The focus was to change the attitude, skill and knowledge towards recommended practices in the work. The women traditionally carried out weeding operation by using tools e.g. hand hoes or "khurpi" in squatting and bending position which decreases the work efficiency. In the recommended weeding practices, it was shown that the same amount of work could be done in almost half of the time and work efficiency was increased by 86.3%. Farm women adopted the improved technique as it had increased the efficiency to work, reduced the drudgery and helped in avoiding bending or squatting posture. It lessened the exertion and fatigue to make the farm women comfortable.

Key words: Drudgery; Ergonomics; Posture and Fatigue;

Weeding operation is a major problem for farm women. Majority of the farm women do weed control using hand tools like sickle, khurpi and so on. Therefore, timely weeding is very much essential for a good yield; this can only be achieved by using mechanical weeders which perform simultaneous job of weeding and hoeing and can reduce the time spent on weeding (man hours), cost of weeding and drudgery involved in manual weeding (Goel *et al*, 2008). Women in India play a major role in shaping the economy of the country. The women work force in agriculture and allied sectors is estimated to be around 92 million which amounts to 40 per cent of the total rural workers in the country (Singh *et al*, 2007).

As per Census 2011, women constitute 25.51% of the total workforce in the country. The percentage share of women as cultivators, agricultural labourers, workers in household industry and other workers stood at 24.92, 18.56,

2.95 & 47.20%, respectively. Women play pivotal role in agriculture – as female agricultural labour, as farmers, co-farmers, female family labours, as farm managers and farm entrepreneurs (Prakash *et.al.*, 2014).

Weed control is a major problem for farm women. Majority of the farm women do control weed using hand tools like sickle, khurpi and so on. Though, this method proves useful yet it demands labour and is full of drudgery. During these activities they adopt bending and squatting body posture due to which their physiological workload increases and also they face many types of musco-skeletal problems as a result of which the efficiency of women to work decreases to a great extent. Assessment of physiological parameters like heart rate, exhaustion and work output was done for this study.

Ergonomics is the scientific study of the relationship between man & his working environment that includes ambient conditions, tools, materials, methods of work

& organization of work. The performance of the weeder not only depends on the constructional features but also on the workers operating it. The performance of man – implement system may be poor, if ergonomic aspects are not given due attention. It may also cause clinical or anatomical disorders & will affect worker’s health. Proper attention to ergonomics aspects in design and operation will help in increasing the man implement system efficiency and also in safeguarding the workers’ health (*Gite, 1997*).

This research is aimed to reduce their drudgery and increase their working efficiency by introducing Twin Wheel Hoe. The farm women have to work with their hands and there is a lot of fatigue involved in it along with the occupational health hazards. The posture adopted during the operation is also not proper and leads to occupational health problems; Twin wheel hoe is lighter than the locally available implement. Women work faster with this implement. Comfortable working posture is an added advantage.

Twin wheel hoe is manually operated equipment for weeding and intercultural operations. It consists of twin wheels, frame, v-blade, v clamp and a handle. The cutting and uprooting of weeds in field is done through push and pull action. It is light weight, simple to operate which improves the work posture and also reduces the drudgery of the women workers. This is operated at optimum soil moisture condition and preferably after 20-25 day of sowing i.e., when the weeds are small i.e. 1 to 3 cm. in height for better weeding performance. (*Singh and Gite, 2007*). The present study was carried out with the following objectives:

- i. To study the performance of twin wheel hoe over traditional method.
- ii. To study the ergonomic parameters on twin wheel hoe to reduce drudgery.
- iii. To determine perceived exertion by farm women with overall discomfort rating (ODR).

METHODOLOGY

The study was carried out in the adopted village, Bhimakhedi of KVK Ratlam, Madhya Pradesh, India. Thirty farm women who had good experience at the control and operating traditional khurpi were selected randomly. They were healthy and had no physical ailment. The grading of health status of women was done on the basis of BMI. The BMI scores were interpreted as per

the classification given by *Garrow (1987)*.

Each respondent was tied the heart rate monitoring machine and was switched on to record the heart rate at every minute. In order to record the resting heart rate, five minutes rest was given. They were then asked to perform the activity for 30 minutes and heart rate was recorded at an interval of 1 minute each and than five minutes rest was given. The heart rate monitor was switched off and removed. The heart rate during rest and work were recorded while working with traditional as well as twin wheel hoe. Based on the heart rate records the following parameters were calculated-

- Average heart rate during rest and work.
- ΔHR (beats/min) = Average working heart rate (WHR) – Average heart rate during rest.
- For calculation of Energy Expenditure Rate from heart rate, the *Varghese (1994)* equation was used which is as follows.

$$EER (kj/min) = 0.159 \times HR (beats/min) - 8.72.$$

- Output = meter²/hour
- Overall discomfort rating (ODR) was taken on a 10 point psychophysical rating scale (0 = no discomfort, 10 = extreme discomfort) which is an adoption of *Corlett & Bishop (1976)* technique.

Classification of Workload: Workload of activity was categorized as per the following classification of workload (Table 1) in different occupations proposed by *Varghese et al (1994)*.

Physical work load	Physiological variables	
	Energy expenditure (KJ/Min)	Heart beats (beats/min)
Very light	Upto 5.0	Upto 90
Light	5.0-7.5	91-105
Moderate	7.6-10.0	106-120
Heavy	10.0-12.5	121-135
Very heavy	12.6-15.0	136-150
Extremely heavy	<15.0	Above 151

Overall discomfort rating (ODR): Overall discomfort rating (ODR) was used which was developed by *Corlett and Bishop (1976)* for the assessment of it. It consisted of a 70cm long graduated scale with its left marked as 0 and it’s and right ends 10 which are representing ‘no discomfort’ and ‘extreme discomfort’,

respectively. A sliding pointer was provided on the scale to mark the level of discomfort. At the end of each trial, subjects were asked to mark their overall discomfort rating on the scale. The overall discomfort ratings given by each of the thirty subjects were averaged to get the mean rating. Drudgery was operationalized as physical & mental strain, fatigue, monotony and hardship experience by farm women while doing weeding operations (Kumar *et.al.*, 2011).

RESULTS AND DISCUSSION

Physical characteristics of the respondents: Basic anthropometric data of the subjects have been presented in Table 2. As shown in the table, the mean age of the selected farm women was 34.0 years with the average height of 162.26 cm. and gross body weight was in the range of 45-78 kg. The mean body mass index was calculated to be 22.70 which meant that they were in the normal category.

Table 2. Physical characteristics of the respondents (N=30)

Physical characteristics	Range	Mean
Age in years	23-45	34.0
Height (cm)	145-182	162.26
Gross weight (kg.)	45-78	60.0
Body Mass Index	19.36-27.53	22.70

Workload : As discussed earlier, the classification of workload during the activity period was done on the basis of average heart rate and average energy expenditure. The activity was classified as heavy while using Twin wheel hoe as compared to moderate while using traditional khurpi but the women were comfortable while working and they worked at a faster rate so twin wheel hoe happened a better implement. As evident from the data in Table 3 majority of the respondents (83%) were in normal category with regard to BMI Scores, 10 per cent of women had BMI Scores in obese grade I range and 7 per cent women were in the range of low weight normal category.

Physiological workload: Analysis of data (Table 4) indicates change in percentage of average working heart rate as well as energy expenditure with the use of twin wheel hoe. It was clearly depicted that twin wheel hoe has proved efficient on time and output parameters as it increases the output when compared with traditional

Table 3. Distribution of respondents as per BMI scores. (N=30)

BMI Scores	Interpretation	%
< 16.0	*CED grade III (severe)	-
16.0-17.0	*CED grade II (moderate)	-
17.0-18.5	*CED grade I (mild)	-
18.5-20	Low weight normal	7.0%
20.0-25.0	Normal	83%
25.5-30.0	Obese grade I	10%
> 30.5	Obese grade II	-

*CED = chronic energy deficiency

khurpi. The percentage change in average working heart rate was 16.44 per cent with the use of twin wheel hoe. Similar trend was observed for average energy expenditure also. The results presented in Table 4 depicted that improved technology has significantly higher work output than the traditional technology. The variation in heart rate and oxygen consumption for the weeder may be attributed to the design configurations of the weeder since all other parameters were controlled to be at constant level. (Thiyagarahan, *et. al.*, 2012).

Output: The results presented in Table 4 depicts the work output of the weeding activity with the traditional and improved technologies. Improved technologies have significantly higher work output than the traditional technology. Maximum increased work output was observed with twin wheel hoe weeder. The output capacity was higher using twin wheel hoe (112.3 m²/hr) as compared to only (60.3 m²/hr) with khurpi. Improved technologies have significantly higher work output than the traditional technology. The percentage increase in output was 86.3 per cent for twin wheel hoe. It means that work output was near about twice, as compared to traditional implement so working by twin wheel hoe is recommended. Hence, in this study an effort is made to introduce improved technologies for weeding activity for farm women so they can increase their efficiency, work output and reduce the drudgery while performing weeding activity.

Overall discomfort rating (ODR): Weeding of soybean is an activity where musculo-skeletal problems are very pronounced. The reason the activity is time taking and performed continuously for prolonged hours. The traditional method employs continuous sitting posture while weeding either with bare hands or using traditional kurpi.

Table 4. Change in heart rate, energy expenditure and output by use of twin wheel hoe over traditional khurpi (N=30)

Parameters	Khurpi	Twin wheel hoe	% change improved over existing
<i>Machine Parameters</i>			
Output, m ² /ha.	60.3	112.3	↑ 86.3
Weeding efficiency %	70.2	60.5	↓ 16.0
Stroke/min	51.4	41.5	↓ 23.8
<i>Ergonomic Parameters</i>			
Av. resting heart rate, b/min	82.7	86.4	↑ 4.47
Av. working heart rate, b/min	105.8	123.2	↑ 16.44
Δ AWHR over rest, b/min	23.0	36.8	↑ 60
Av. energy expenditure resting, KJ/min	4.4	4.9	↑ 11.36
Av. energy expenditure working, KJ/min	8.0	10.8	↑ 35
% increase in efficiency	-	-	↓ 86.3
Total cardiac cost of work (TCCW)	374.9	223.9	↓ 67.4
Physiological cost of work (PCW)	6.24	3.73	↓ 67.2

↑ indicates% increase ↓ indicates % decrease.

Musculo-skeletal problems: Musculo-skeletal problems and posture were evaluated by asking the respondents as to where they felt pain in their body after weeding with traditional and improved technology. Table 5 depicts that weeding with traditional tools in strenuous posture cause severe pain in shoulders, upper back, hands and fingers. The women perceived the task as heavy. On the contrary using improved weeding tool induced moderate to light discomfort/pain in shoulders, hands and arms. They were relieved from back pain and improved tool employed standing posture and eliminated continuous sitting posture as well as some movement is also employed while working on a twin wheel hoe. The rating of perceived exertion was also reported as moderate with use of twin wheel hoe.

Implication of the study: This study indicates that in order to ensure health, safety and well being and thereby improving the quality of work life and achieving higher productivity, it is essential that working implement must be designed ergonomically and should be women-friendly. The weeding efficiency of the Twin wheel hoe

Table 5. Mean value of overall discomfort rating (ODR), Responses on musculo-skeletal problems and perceived exertion experienced by respondents

Weeding method	ODR	MSP	RPE
Traditional khurpi	8.3	Severe pain in shoulders, upper back, hands and fingers	Heavy
Twin wheel hoe	4.1	Moderate to light pain in shoulder, hands and arms.	Moderate

ODR=Mean value of overall discomfort rating;

MSP=Musculo-skeletal problem;

RPE=Rating of perceived exertion;

was found satisfactory and it is easy to operate. It is women-friendly tool because it increases the work efficiency, reduces drudgery and provides comfortable working posture. It reduces the exertion and fatigue and women feel comfortable. They earn money by reducing the labour. Their social life improves and they feel happy in the society. By introducing such small tools, the work and work environment can be improved, physiological workload can be reduced in the weeding and the efficiency and work output can be improved significantly. Farm women should get help in getting loans to procure various tools and implements. There should be co-ordination between central/state departments and NGOs to promote these improved tools and implements. Hence, promoting such tools amongs the farm women engaged in the agricultural operation should be done at the priority.

CONCLUSION

In agriculture, weeding is one of the important labour intensive activity and adoption shows increase not only in, efficiency but in terms of money also by reducing labour engagement during weeding, productivity of worker is increased with the equipment than traditional method. The chances of injury are eliminated and provides safety to the worker, due to its better construction. Proper training to rural women on various improved implements should be provided so that they can operate these implements in a proper and safe way. Advertisements through media and other means. Practical demonstrations at various levels by departments related to agriculture should be done to educate farm women.

Paper received on : November 01, 2014

Accepted on : December 23, 2014

REFERENCES

- Corlett, E.N. and Bishop, R.P. (1976). A Technique for assessing postural discomfort, *Ergonomics*, **19** : 175-182.
- Garrow, J. (1987). Human Nutrition and Dietetics. Nutrition News 1991. National Institute of Nutrition, Hyderabad.
- Gite, L.P. and Singh, G. (1997). Ergonomics in Agricultural and Allied Activities in India. Central Institute of Agricultural Engineering, Bhopal, India. Technical Bulletin No. CIAE/97/70.
- Goel.A.K., Behera. B.K., Mohanty. S.K. and Nanda S.K. (2008). Development and Ergonomic Evaluation of Manually Operated Weeder for Dry land Crops. Agriculture Engineering International : the CIGR Ejournal. Manuscript PM 08 009. VOL.-X. September.
- Kumar Bharat P.P., Govinda, Gowda.V. and Khandekar, Neeta (2011). Time utilization pattern and drudgery of horticulture farmers. *International Journal of Engineering & Management Sciences*. **2**(2) : 93-96.
- Thiyagarahan, R., Kathirvel, K.K. and Jayashree, G.C. (2012). Ergonomical evaluation of two row finger type rotary weeding for paddy. *Journal of Agricultural Engineering and Technology (JAET)*, **20** (1).
- Prakash, N., Rishikanta Singh Kh., Punitha P, S.S.Roy, M.A.Ansari and S.V.Ngachan (2014). Gender Mainstreaming in Small Farm Production System. Souvenir: 7th National Extension Education Congress in ICAR Research Complex for NEH Region, Umiam, Meghalaya during 8-11 November , 2014
- Singh S.P., Gite L.P., Agarwal Nidhi and Majumdar J. (2007). Women friendly improved farm tools and equipment. Central Institute of Agricultural Engineering, Bhopal.
- Varghese, M. A., Saha, P. N., Atreya, N. (1994). A rapid appraisal of occupational workload from a modified scale of perceived exertion. *Ergonomics*, **37** : 485-491.

