

## Efficacy of Improved Tools for Farm Women toward Drudgery Reduction and Efficiency Enhancement

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### ABSTRACT

Women constitute almost half of the work force engaged in agriculture. Many agricultural operations and household activities performed by women involve a lot of physical strain, which create serious health problems in the long run. Hence, a study was conducted to assess the efficiency of improved tools designed for farm women viz. tubular maize sheller, hanging type double screen grain cleaner (hanging sieve), groundnut decorticator, manual twin wheel hoe and serrated sickle over conventional one. Twenty farmwomen were selected for the study. Tubular maize sheller shelled maize cob 25.8kg/hr. Hanging sieve showed decreased cardiac cost of worker (8.41 beats/ kg) when compared with local sieve. Groundnut decorticator on output basis increased to the extent of 10 fold over hand shelling. Wheel hoe saved 40.9 per cent cardiac cost of worker and the weed intensity was also found to reduce by 33.8 per cent. 21 per cent of working efficiency increased by using serrated sickle. The results help them to choose appropriate tools during agricultural operations to save time, energy and reduce drudgery.

**Keywords:** Tubular maize sheller; Groundnut decorticator; Manual twin wheel hoe; Serrated sickle; Hanging type double screen grain cleaner.

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 (Pandey cited in Singh *et al.*, 2007). Women are playing a significant and crucial role in agricultural development and allied fields including crop production, livestock production, horticulture, post harvest operation, agro/social forestry, fisheries etc. There is a greater involvement of women under various agricultural operations along with house arrangement (Chayal *et al.*, 2010). Many of such activities are drudgery prone to varying degree. Even women suffer from different health problems which adversely affect their working efficiency and family welfare Chandra *et al.*, 2013). During the activity they become familiar with unhealthy physical posture, which increases their bodily workload and also they faces many types of musco-skeletal problems, resulting in decreased working efficiency of women to a great extent (Jyotsna *et al.*, 2005).

Drudgery is a term used to represent the dissatisfactory experiences that constrain work performance in any activity (Technical module, 2009). It can be reduced by women friendly farm tools and equipments with increased output. In fact, drudgery is termed for hard work, monotony, time consuming, use of traditional tools with inappropriate working posture in field (Sridhar *et al.*, 2015).

The tools/equipment available for different farming operation are earlier designed for men workers keeping in mind male dominancy in Indian agriculture environment and same was given to women despite of their suitability to work. However, women face different technological difficulties in operating these tools, thereby causing serious occupational health problems and ultimately reducing work efficiency. Most of the activities in which women has been involved includes sowing, transplanting, weeding, harvesting, threshing, and winnowing , are very drudgery prone.

The traditional tools used by women worker

involves operating in bending or squatting posture which causes drudgery and leads to serious health issue such as back pain, knee pain and sometime also causes injury to women operating it (*Khadatkar et al., 2004*).

Moreover, gender bias approach of technology transfer system is blocking the road to progress and prosperity of women in our country. There is a need to identify the drudgery prone tasks and available technologies, which can be transferred to reduce the drudgery and increasing efficiency, thereby, improving health and well being of women. More attention is needed in simple low cost drudgery relieving technologies, which are easily adaptable (*Kishtwaria et al., 2007*).

Studies have pointed out that farm activities that are time and labor intensive, monotonous, repetitive and more drudgery prone are generally performed by women. 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 (*Badiger et al., 2006b*). Improved productivity and health are expected benefits out of drudgery reduction programmes conducted through technology interventions. Therefore, there is need to select suitable technologies guided by identified drudgery experiences (*Mrunalini et al., 2010*).

The present study was conducted to assess the efficacy of improved tools over conventional one and compare the energy expenditure and physiological cost of work based on heart rate of women subjected to both improved and conventional technologies. 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 workers [*Hasalkar et al. (2004)*].

## METHODOLOGY

The study was conducted in Krishi Vigyan Kendras of Madhya Pradesh (22°43' N, 75°48' E, 567 m a.s.l.) during 2009-2014. Five tested technologies used for assessment were tubular maize sheller, hanging type double screen grain cleaner (hanging sieve), groundnut decorticator, manual twin wheel hoe and serrated sickle.

Twenty farm women aged between 25-45 years without having any physical deformity, whose body temperature and blood pressure are normal and those who are not suffering with any cardio-respiratory and chronic diseases were selected to assess and compare the impact of improved technologies over conventional one. During the experiment various parameters viz., time and activity profile, weeding efficiency and physiological stress were studied.

The anthropometric rod and weighing balance were used to measure the physical characteristics like height and weight. Stop watch was used to record the time. Weeding efficiency calculated by the formulae-

$$W = \frac{W1 - W2}{W1} \times 100$$

Where, W = Weeding efficiency, per cent

W1= Count of weeds between two rows before weeding.

W2= Count of weeds between two rows after weeding

The heart rate was recorded by using the heart rate monitor. Based on the heart rate records the following parameters were calculated-

- Average heart rate during rest and work.
- The energy expenditure per minute was estimated from the heart rate with the help of formulae (*Kwatra et al., 2010*)

Energy expenditure (kj/min) =

$$0.159 \times \text{HR (beats/min)} - 8.72$$

- HR (beats/min) = Average working heart rate – average heart rate during rest
- Output (kg/hr, sqm/hr)
- Cardiac cost of worker = “HR x duration / output

The results were statistically analyzed using test of significance (t-test at 5 per cent level of probability) and simple regression (r) (*Shnedecor et al., 1967*)

## RESULTS AND DISCUSSION

*Physical characteristics of the respondents:* Table 1 reveals that 20 respondents in the age group of 25 to 45 years were selected at random and Table 1 stated that average age was counted as 32.5 to 34.7 years. The basic body dimensions were measured an average was worked out as height (156.5 to 145.9 cm) and weight (48.2 to 50.1 kg) respectively.

It is clear from the Table 2 that during shelling of

**Table 1. Physical characteristics (Mean  $\pm$  S.D.) of selected respondents (N=20)**

Physical Characteristics	Maize Sheller	Hanging double screen Sieve	Groundnut Decorticator	Manual twin Wheel hoe	Serrated Sickle
Age (yrs)	34.5 $\pm$ 6.04	33.5 $\pm$ 6.64	33.0 $\pm$ 5.96	34.7 $\pm$ 5.47	32.5 $\pm$ 4.07
Height (cm)	151.4 $\pm$ 2.74	145.9 $\pm$ 8.51	147.7 $\pm$ 5.96	152.8 $\pm$ 6.62	156.5 $\pm$ 8.02
Weight (kg)	48.6 $\pm$ 4.40	48.9 $\pm$ 9.90	50.1 $\pm$ 4.83	48.2 $\pm$ 6.60	48.07 $\pm$ 8.47

**Table 2. Evaluation of performance data (Mean  $\pm$  S.D.) of different parameters of the farm women (N=20).**

Particulars	Maize Sheller		Hanging double screen Sieve		Groundnut Decorticator		Manual twin Wheel hoe		Serrated Sickle	
	1	2	3	4	5	6	7	8	9	10
Average working	86.7	92.5	101.3	100.3	88.0	106.0	93.3	101.5	103.3	110.0
	$\pm$ 4.38	$\pm$ 5.65	$\pm$ 5.03	$\pm$ 4.96	$\pm$ 4.09	$\pm$ 5.11	$\pm$ 6.03	$\pm$ 5.64	$\pm$ 5.75	$\pm$ 5.92
heart rate (beat/min)										
Average heart rate	81.9	86.9	83.3	80.0	79.0	78.6	78.3	81.3	80.0	86.50
	$\pm$ 3.91	$\pm$ 5.55	$\pm$ 4.27	$\pm$ 4.81	$\pm$ 2.62	$\pm$ 2.09	$\pm$ 3.60	$\pm$ 3.83	$\pm$ 3.67	$\pm$ 4.98
during rest (beat/min)										
“HR (beat/min)	4.8	5.6	18.0	20.3	9.0	27.4	15.0	20.2	23.3	23.50
	$\pm$ 0.95	$\pm$ 2.01	$\pm$ 4.70	$\pm$ 5.79	$\pm$ 2.68	$\pm$ 4.86	$\pm$ 4.99	$\pm$ 6.16	$\pm$ 4.33	$\pm$ 5.59
Output (kg/hr)	12.5	25.8	30.0	145.0	5.0	50.	-	-	-	-
	$\pm$ 0.95	$\pm$ 2.20	$\pm$ 3.64	$\pm$ 7.95	$\pm$ 0.50	0 $\pm$ 2.97	-	-	-	-
Area covered/	-	-	-	-	-	-	43.0	98.3	70.0	88.6
	-	-	-	-	-	-	$\pm$ 9.79	$\pm$ 18.21	$\pm$ 7.85	$\pm$ 5.42
Output (sqm/hr)										
Numbers of	-	-	-	-	-	-	-	-	39.0	50.0
	-	-	-	-	-	-	-	-	$\pm$ 2.50	$\pm$ 3.00
bundle harvested										
Cardiac cost	23.21	13.10	36.28	8.41	109.58	32.9	21.57	12.75	20.2	16.1
	$\pm$ 5.20	$\pm$ 4.72	$\pm$ 9.58	$\pm$ 2.40	$\pm$ 34.74	$\pm$ 5.89	$\pm$ 7.96	$\pm$ 4.21	$\pm$ 4.58	$\pm$ 4.36
(beat/kg)										
Saving in cardiac cost (%)	-	43.6	-	76.8	-	69.9	-	40.9	-	20.3

**Table 3. Correlation coefficient (N=20) computed between different variables and energy expenditure (kJ/s)**

Particulars	Maize Sheller		Hanging double screen Sieve		Groundnut Decorticator		Manual twin Wheel hoe		Serrated Sickle	
	1	2	3	4	5	6	7	8	9	10
Age (yrs)	-0.42	-0.16	0.08	-0.32	-0.21	-0.04	-0.06	0.30	0.28	-0.10
Height (cm)	-0.02	-0.15	-0.47 <sup>a</sup>	-0.13	-0.12	-0.22	0.21	0.12	0.1	-0.41
Weight (kg)	0.09	-0.19	-0.14	-0.11	-0.23	0.25	-0.09	-0.02	0.04	0.24
Time (min.)	0.07	0.12	0.19	0.13	0.16	0.08	0.14	0.09	0.13	0.10
Av. WHR (beats/min)	0.99 <sup>b</sup>	0.97 <sup>b</sup>	0.95 <sup>b</sup>	0.97 <sup>b</sup>	0.98 <sup>b</sup>	0.97 <sup>b</sup>	0.96 <sup>b</sup>	0.97 <sup>b</sup>	0.95 <sup>b</sup>	0.98 <sup>b</sup>
$\Delta$ HR (beats/min)	0.17	0.46 <sup>a</sup>	0.61 <sup>b</sup>	0.60 <sup>b</sup>	0.77 <sup>b</sup>	0.91 <sup>b</sup>	0.80 <sup>b</sup>	0.76 <sup>b</sup>	0.77 <sup>b</sup>	0.63 <sup>b</sup>
Output (m <sup>2</sup> /hr)	0.01	0.12	0.14	0.18	0.02	0.30	0.31	-0.29	-0.34	-0.14
Cardiac cost (beats/ m <sup>2</sup> )	0.10	0.45 <sup>a</sup>	0.52 <sup>a</sup>	0.58 <sup>b</sup>	0.69 <sup>b</sup>	0.84 <sup>b</sup>	0.56 <sup>a</sup>	0.79 <sup>b</sup>	0.82 <sup>b</sup>	0.57 <sup>a</sup>

<sup>a</sup> Significant at P=0.05, <sup>b</sup> Significant at P=0.01

1-Hand Shelling; 2-Maize Sheller; 3-Local Sieve; 4-Hanging Sieve; 5-Hand Shelling; 6-Groundnut decorticator; 7-Local Sickle; 8-Twin Wheel Hoe; 9-Local Sickle; 10-Serrated Sickle,

maize cobs, maize sheller saves more than half the time against the hand shelling and increases twice of working efficiency as the output recorded by tubular maize sheller was 25.8kg/hr as compared to hand shelling by which only 12.5kg/hr maize was shelled. During hand shelling, the average “HR was 4.8 beats/ min. while by maize sheller, it was recorded as 5.6 beats/ min. The cardiac cost of worker was 23.21 beats/ kg during manual shelling while 13.10 beats/ kg by maize seller. So the maize sheller saves 43.6 per cent cardiac cost of worker.

The use of hanging type double screen grain cleaner for cleaning or sieving of grains showed decreased cardiac cost of worker (8.41 beats/ kg) when compared with local sieve (36.28 beats/ kg). The work efficiency is measured in terms of output. The output with hanging type double screen grain cleaner increased 4-5 times as compared to local sieve. Significant increase (145.0 kg/hr) in work output was observed while using hanging sieve compared to usual method (30.0 kg/hr).

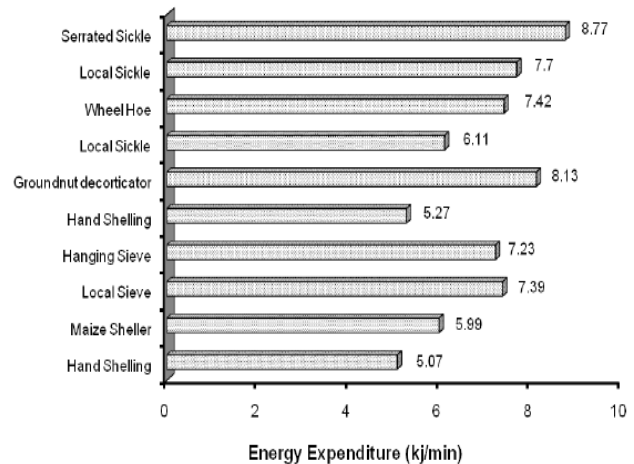
The results presented in Table 2 depict ergonomic assessment of improved groundnut decorticator technology. This technology on output basis increased to the extent of 10 fold over hand shelling. The average output is 50.0 kg/hr by use of decorticator and when compared to hand shelling of groundnuts it is 5.0 kg/hr. The groundnut decorticator saves almost 70 per cent cardiac cost of worker.

The study revealed that weeding with twin wheel hoe saves more than half the time against the sickle and increases twice of working efficiency as the output recorded by twin wheel hoe was 98.3 sqm/hr as compared to local sickle by which only 43.0 sqm/hr area was weeded. During weeding with wheel hoe, the average “HR was 20.2 beats/ min. while by sickle it was recorded as 15.0 beats/ min. The cardiac cost of worker was 21.57 beats/ sqm during weeding with sickle while 12.75 beats/ sqm by wheel hoe. So the wheel hoe saves 40.9 per cent cardiac cost of worker and the weed intensity was also found to reduce by 33.8 per cent.

21 per cent of working efficiency increased by using serrated sickle as one farm women harvested and bundled on average 50 bundles each by using serrated sickle while only 39 bundles each of wheat was harvested and bundled through local sickle in given time frame of 6 hours for wheat harvesting activity and 1.5 hours for bundling activity. Physiological stress revealed that output recorded by serrated sickle was 88.6 sqm/

hr as compared to Local sickle by which 70 sqm/hr areas harvested. During harvesting with local sickle, the average “HR was 23.3 beats/ min. while by serrated sickle it was recorded as 23.50 beats/ min. The cardiac cost of worker was 20.2 beats/ sqm by local sickle while 16.1 beats/ sqm by serrated sickle. So the serrated sickle saves 20.3 per cent cardiac cost of worker.

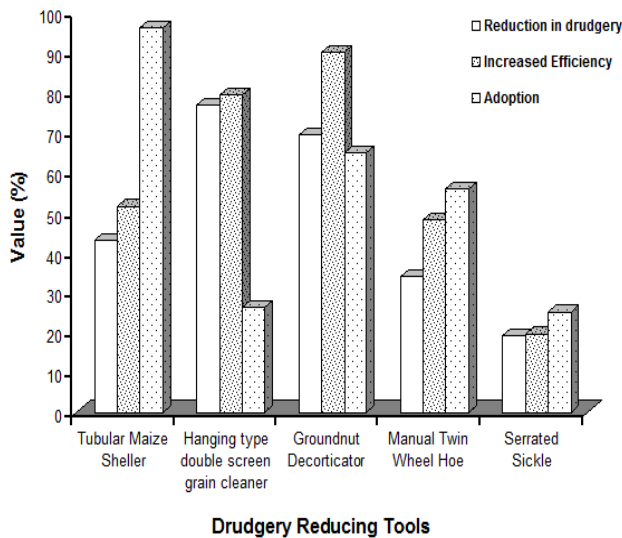
Figure 1 depicted energy expenditure during the course of work by improved tools and traditional practices. Heart rate and energy expenditure is closely related to each other. Increase in heart rate augmented the energy expenditure.



**Fig. 1. Energy expenditure of farm women between Local practice and improved tools.**

Figure 2 illustrated Impact of technology assessment of ergonomic practices in terms of drudgery reduction, efficiency enhancement and adoption. Maize Sheller saves 43% drudgery while hanging sieve, groundnut decorticator, manual twin wheel hoe and Serrated Sickles are reducing 77, 70, 34 and 20 per cent drudgery of farm women, saves more than half the time and increases 52, 79, 90, 48 and 21 per cent working efficiency of farm women. After technology demonstration, the adoption of Maize sheller is 96 per cent, hanging sieve is 26 per cent, groundnut decorticator is 65 per cent, manual twin wheel hoe is 56 per cent and serrated sickle is 25 per cent. Thus these improved technologies increases working efficiency with lesser fatigue.

Table 3 revealed that the various physical measurements of respondents exhibited non significant negative correlation with energy expenditure. Similarly, height of respondent showed significantly (P=0.05) negative relationship (r=0.47) with energy expenditure



**Drudgery Reducing Tools**  
**Fig. 2. Impact of technology assessment of ergonomic practices.**

by cleaning of grains with local sieve while using other tools physical parameters is not directly responsible to effect working efficiency. Energy expenditure was increasing at right angles as increase of average working heart rate during the work in all the cases as it exhibited significantly ( $P=0.01$ ) positive correlation with all the improved technologies and traditional practices. Heart rate difference between working and resting period of respondent  $\Delta HR$  and cardiac cost is also showed positive correlation ( $P=0.05$  and  $P=0.01$ ) with energy expenditure and revealed that more energy was exhausted as rising of heart rate.

In the present study, tubular maize sheller was found more efficient than hand shelling which is in agreement with the earlier reports of several scientists. Output was found greater by tubular maize sheller, results are in line with the study (Gupta et al., 2004).

Hanging type double screen grain cleaner was found with 4-5 times increased output as compared to local sieve. Similar result was also found with increased output when compared hanging type cleaner grader with conventional method [Badiger et al., 2006a).

The study showed that the Groundnut decorticator was recorded with increased output over hand shelling and the results of this study are in conformity of the study of Badiger, Hasalkar and Kavitha [Badiger et al., 2006a). According to them, this proved to be efficient in getting 3-4 times higher output compared to traditional method of decortication.

When twin wheel hoe was compared with local sickle saved 40.9 per cent cardiac cost of worker and the weed intensity was also found to reduce by 33.8 per cent. Similar study has also indicated increase in work output with saving in cardiac cost (Singh et al (2011). The introduction of improved technologies for weeding activity for the farm women increases their efficiency, work output and reduce the drudgery while performing weeding activity (Badiger et al., 2006a).

The improved sickle resulted in higher field capacity than simple sickle because of less pushing force required operating the sickle, which resulted in higher cutting speed and also found increased output with better harvesting efficiency and reduced drudgery by using serrated sickle (Mishra et al., 2013). Studies also found maximum output with improved sickle and reduction in total cardiac cost of worker with improved sickle over conventional sickle (Dilbaghi et al., 2008). The findings of the study are in conformity with scientists who revealed that drudgery reduction due to use of improved sickle was about 16.50 per cent as compared to local sickle. They also revealed that improved sickle requires less effort for cutting and reduce the drudgery in harvesting (Gite et al., 2000). The result of the study compared with improved and local sickle for paddy harvesting and stated that potential demand of improved sickle is more than 2.27 million in the country. This clearly indicated the potentiality of improved sickle in the country (Singh, SP, 2012).

Comparison of energy expenditure between Local practice and improved tools resulted in simultaneous increase in heart rate and energy expenditure. Results are in conformity with the study conducted by other scientists (Hasalkar et al., 2004).

In accordance with impact of technology assessment of ergonomic practices, other studies also stated that mechanization of certain tasks could decrease worker physical effort and fatigue and increase production (Nawi et al., 2012).

## CONCLUSION

Thus, these technologies proved drudgery reducing, more efficient, advantageous in terms of increased output thus time saving. The same was perceived by the farm women. Use of improved technologies viz. tubular maize Sheller, hanging type double screen grain cleaner, groundnut decorticator, manual twin wheel hoe

and serrated sickle showed decrease in physiological cost of work and increased work output compared to conventional method. Hence, there is a need to modification in usual technologies as well as beneficiaries change their attitude, skill and knowledge which intern help to empower farm women technologically, socially and economically for improved quality of life.

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