

Physiological Stress of Farm Women during Threshing Operation- A Comparative Assessment for Empowering Farm Women

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ABSTRACT

Agriculture is an important unorganised sector where majority of the women labour force is engaged either in their own field or others field, and most of the activities women do in agriculture sector are tedious, time consuming, and drudgery prone and back-breaking. Out of various activities, threshing is one of the important post harvest operation of grains where women's involvement found mostly among small and marginal farming community. Present study on physiological stress of farm women was taken up to assess effectiveness of hold on paddle operated paddy thresher in terms of productivity and as drudgery reduction tools in comparison with manual threshing done by foot. Average working heart rate and energy expenditure of women in using hold on paddle operated paddy thresher is 131.1beats/min and 12.12 kj/min respectively which is observed 8.84 & 15.26 per cent less than manual threshing by using foot. Physiological cost of work reduced by 27.27 per cent with use of hold on paddle operated paddy thresher. Mean value of overall discomfort in response to musculo-skeletal problem and posture with hold on paddle operated paddy thresher found 7.6 in comparison to 14.1 in traditional method.

Key words: Farm women; Drudgery; Threshing; Energy expenditure; Physiological cost of work;

In India, women play a significant and crucial role in agricultural activities. 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). Various studies on women in agriculture point to the fact that women are generally employed in the operations which are either not mechanized or least mechanized and involve a lot of drudgery. Most of the activities are not only drudgerious but time consuming also. So a farm woman suffers a lot of drudgery while performing operations. Various tasks performed by women not only demand considerable time and energy but also sources of drudgery for rural women (Srinath K. *et. al*, 2010). The most drudgery prone activities experienced by women in various farm operations are sowing, harvesting, threshing, manuring, weeding and intercultural operations. During the activities they adapt

unnatural body posture due to which their physiological workload increases and also they faces many types of musco-skeletal problems as a result the efficiency of women to work decreases to a greater extent. In a study activities like weeding, cutting, uprooting, transplanting, removal of stalk and stubble, threshing were found to be maximum drudgery involved agricultural activities performed by women Oberoi & Singh (2001).

Threshing which is a major post harvest activity consume 25 per cent of the total energy utilised in paddy cultivation (Kathrived and Shivakumar-2003). Though in many states of India paddy threshing is completely mechanized, in Assam majority of rural farmers specially small and marginal farmer because of economic constrain still practice threshing with use of bullock, betting of paddy bundle on wooden or stone platform and threshing by using foot although it has low output, higher grain damage and involve more drudgery. Out

of these three practices involvement of women found mostly in betting of paddy bundle on wooden or stone platform and threshing by using foot. Therefore, need was felt to study effectiveness and ergonomic cost of ergonomically designed improved hold on paddle operated paddy thresher modified by Dept. of Engineering, AAU, Jorhat which is low cost and no requirement of power. To throw light on this a comparative study with threshing by using foot was taken with the following objectives:

- To assess the performance of hold on paddle operated paddy thresher with agricultural engineering interventions;
- To study ergonomic cost of hold on paddle operated paddy thresher in comparison with manual threshing by using foot.
- To determine perceived exertion by farm women with overall discomfort in both threshing practice.

METHODOLOGY

On Farm Trial (OFT) on hold on peddle operated paddy thresher for productivity, comfort ability and as drudgery reducing tools of farm women in comparing of traditional method of threshing by using foot were conducted in two districts of Assam namely- Kamrup and Tinsukia in the year 2014. For the purpose of the trial 10 nos. farm women from kamrup and 10 nos. of farm women from Tinsukia were selected.

Total 20. nos. of farm women as beneficiary of using hand hold peddle operated paddy thresher were selected. Another same numbers of farm women (i.e. 20 nos.) from same locality were taken as non beneficiary and doing threshing by using foot for comparing the assessment. Care has been taken to select the farm women who were healthy, non pregnant, non lactating and free from any serious health hazards and similar physical and physiological parameters. Apart from that selected farm women are involved in threshing operation for numbers of years. Thus total sample size of the study was 40 numbers comprising 20 beneficiaries and 20 non beneficiaries.

A specially structured Performa was used to record personal data and readings during the experiment. Prior appointments were fixed with the selected respondents (i.e. beneficiaries and non- beneficiaries). As per their

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convenience, visits were made and experiments were carried out. Readings were taken while the respondents performed the intended tasks. Respondents were encouraged to work in a natural way. Threshing performance was calculated in terms of time required for particular amount of output and cost of labour. Heart rate is one of the most accurate means of studying the energy expenditure while performing any activity. For assessing physiological parameters respondents were asked to perform the activity for 30 min. Later these readings were averaged to get mean values. Recovery heart rate was recorded for 5 mins. As it is considered that heart rate gets stable after 3-5th minute of the work. *Bhatt H.et al (2011), Singh A. et.al.(2010)* referred 5 min for recovery heart rate in conducting studies on ergonomic evaluations.

Assessment of Physiological Parameters: Based on the heart rate readings the following parameters were calculated.

- Average heart rate during rest, work and recovery period.

- The energy expenditure per minute was estimated from heart rate using the following formula ;
Energy Expenditure (kJ/min) = $0.159 \times \text{Av. Heart rate (bmin-1)} - 8.72$

- The Total Cardiac Cost of Work (TCCW) was estimated based on the cardiac cost of work and cardiac cost of recovery; $TCCW = CCW + CCR$

- $CCW = \nabla HR \cdot tA$

Where, CCW = Cardiac cost of work

∇HR = Mean working heart rate – Mean resting heart rate

tA = duration of activity

- $CCR = (AHR_{\text{recovery}} - AHR_{\text{rest}}) \cdot tR$

Where, CCR = Cardiac cost of recovery

AHR recovery = Average recovery HR

AHR rest = Average resting HR

tR = duration of recovery

- $PCW = TCCW/tA$

Where, PCW = physiological cost of work

For assessing overall discomfort level in both the practices i.e. using hold on peddle operated paddy thresher and traditional threshing practice by using foot, respondents were asked to put their opinion in 5 point

likert scale with 5 point for heavy pain/discomfort and 1 point for no pain /discomfort after completion of work. musculo- skeletal problem and posture related responses like- pain in shoulder, upper and lower back pain, wrist pain, Hand and finger pain, pain in lower and upper leg, irritation and pain in feet etc. were set in likert scale.

Data were collected through observation, personal interview and during field practices of the implements. Collected data were processed, tabulated, classified and analysed in terms of mean, percent score and ranks.

About hold on paddle operated paddy thresher: The hold on paddle operated paddy thresher consists of a cylinder with wooden/aluminium strips. The wire loops are embedded weided on these strips. The cylinder is given a rotary motion from the foot pedal through a power transmission system. The paddy bundles are threshed with hold method. The weight of the paddy thresher was about 40 kg and capacity was 35 kg/hr.

RESULTS AND DISCUSSION

Physical characteristics of respondents: Basic anthropometrics data of respondents in Table 1 revealed that mean age of selected farm women for threshing paddy bundle with foot is 35 years, with average height of 153cm and weight of 50.4 kg. and by using hold on paddle operated paddy thresher are 34 years with average height of. 152.3 cm and weight of 51.2 kg. respectively. Mean value of both the categories of respondents shows that anthropometrics data are almost equal

Table 1. Basic anthropometric data of respondents

Parameters	Beneficiaries		Non- beneficiaries	
	Range	Mean	Range	Mean
Age in years	34-40	34	35-40	35
Height (cm)	142-162	152.3	142-162	153
Weight in kg	45-55	51.2	43-56	50.4

Performance of hold on paddle operated paddy thresher: Performance of hold on paddle operated paddy thresher in terms of output and physiological stress of farm women were analysed in comparison with their traditional threshing using foot. Performance of threshing like time requirement and labour cost, Ergonomic parameters like- working heart rate, resting heart rate, energy expenditure, total cardiac cost of work and physiological cost of work were calculated to find out physiological stress in both the practices.

Threshing performance: Table 2 revealed that threshing time for 20 kg output in paddle operated paddy thresher is 200 per cent less than manual threshing. Less time requirement resulted more output in a day and saving of labour cost. The percent increase in per day output was 200 per cent for paddle operated paddy thresher. Improved technologies have significantly higher work output than the traditional method. For same quantity of output 2 days labour can be saved with paddle operated paddy thresher.

Table 2. Comparisons of threshing output and ergonomic parameter between traditional threshing using foot and hold on paddle operated paddy thresher

Parameters	TTF	PO	%C
<i>Threshing output</i>			
Threshing Time for 20 kg paddy output	2.15 hr	0.45 min	200 ↑
Total output in 1 day (considering 8 working hours)	71.1kg	213.3kg	200 ↑
Saving of Labour cost over traditional threshing	-	2 days	-
<i>Ergonomic parameters</i>			
Av. working heart rate	142.7	131.1	8.84 ↓
Av.resting heart rate	83.9	84.6	0.8 ↑
Av. energy expenditure working (kj/min)	13.97	12.12	15.26 ↓
total energy expenditure for same quantity of output kl/min	1885.95	545.4	245.7 ↓
Total cardiac cost of work	1915.5	1505	27.27 ↓
Physiological cost of work	63.85	50.17	27.26 ↓

Note- ecreasing↓ increasing↑

TTF=Traditional threshing using foot, PO=Hold on paddle operated paddy thresher, %C=% change improved paddy thresher over traditional practice,

Ergonomic cost of work: Table 2 also depicts the ergonomic parameters of respondents to find out physiological stress in both hold on paddle operated paddy thresher and traditional threshing using foot. It is revealed from the Table that average working heart rate and energy expenditure is more with farm women doing threshing manually by using their foot. Mean resting heart rate found 84.6 and 83.9 beats/min of respondents with using paddle operated paddy thresher and manual threshing by using foot respectively which is very close to each other.

This may be because of similar sample selection procedure with similar anthropometric data. Average

working heart rate was recorded 131.1 beats/min with respondents using paddy thresher and 142.7 beats/min with respondents using foot for threshing, which is estimated 8.84 per cent decrease with the use of paddle thresher. Similar trend was observed in case of energy expenditure also. Energy expenditure value recorded 12.12kj/min with paddle thresher and 13.97kj/min with manual threshing. Based on energy expenditure value threshing with paddy thresher was categorised heavy work and threshing by using foot was categorised very heavy (Varghese *et al.* 1994).

Increase heart rate in threshing operation was compared to assess the extent of drudgery, as heart rate is a major parameter in quantification of drudgery (Astrand and Rodahl 1977). 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). The Total Cardiac Cost of Work (TCCW) was physiological cost of work (PCW) was found as 63.85 beats for manual thresher whereas 50.17 beats with the use of paddle operated paddy thresher. These findings can be concluded as physiological cost of farm women in using hold on paddy thresher is less with increase productivity and therefore labour saving. Less time consumption with hold on paddy thresher also help farm women to reduce boredom fatigue. Similar findings were found in a comparative study with manual beating of paddy that physiological responses and physiological cost of work reduced significantly in using paddy thresher by Kwatra S. *et al.*(2010).

Table 3. mean value of overall discomfort perceived by the respondents in terms of musculo-skeletal problem

Parameters	Threshing method	
	MT	PO
Mean value of overall discomfort in Responses on musculo-skeletal problem and posture	14.1	7.6
Rating on perceived exertion by respondents	heavy	moderate

MT=Manual threshing by using foot PO=Hold on paddle operated paddy thresher

Overall discomfort level: Musculo-skeletal problem and posture were identified to evaluate overall discomfort level of farm women as they usually feel pain in their body after manual threshing. In using both

improved hold on paddle operated paddy thresher and traditional threshing by using foot, discomfort was analysed by using 5 point Likert scale (Table 3).

After 30 min. of operation respondents were asked to put their opinion on responses like- pain in shoulder, upper and lower back pain, wrist pain, Hand and finger pain, waist pain, pain in lower and upper leg, irritation and pain in feet.

Table 3 depicts mean value of overall discomfort of above stated responses in both improved hold on paddle operated paddy thresher and traditional threshing. It was perceived from the analysis that threshing by using foot causes severe musculo- skeletal problems in waist pain, pain in lower and upper legs and irritation and pain in feet than using improved hold on paddle operated paddy thresher.

On the contrary, improved hold on paddle operated paddy thresher induced moderate to light or no pain/ discomfort in wrist, lower and upper legs and in feet. Similarly in other aspects like- pain in shoulder, upper back pain and hand and finger pain also respondents with threshing foot induced high to moderate than moderate to low in comparison with respondents using hold on paddle operated paddy thresher. Rating of perceived exertion was reported moderate in case of using hold on paddle operated paddy thresher for threshing. Respondents of hold on paddle operated paddy thresher user opined that discomfort level will be much less in case of double operator.

CONCLUSION

It is evident from the ergonomic evaluation of the above study that while performing the same activity with similar anthropometric character of respondents, average working heart rate, energy expenditure, TCCW and PCW found high with respondents doing threshing by using foot with less output than paddle operated thresher. Moreover overall discomfort in terms of musculo-skeletal problem and posture also found moderate. Introduction to improved hold on paddle operated paddy thresher technologies in agricultural operation adopted by farm women leading to the mechanisation, will reduce the drudgery and improve the efficiency. Hence empowering farm families about such tools and promotion in use through media, demonstration etc is at priority.

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