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RESEARCH ARTICLE

ASSESSING THE IMPACT OF IMPROVED FARM TOOLS ON DRUDGERY REDUCTION AND OPERATIONAL EFFICIENCY OF FARM WOMEN IN GROUNDNUT PRODUCTION

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Abstract: The present study aimed to assess the impact of improved farm tools on drudgery reduction and operational efficiency of farm women engaged in groundnut cultivation. Demonstrations of a groundnut decorticator for pod dehulling and a hand wheel hoe one-lane weeder for weeding were conducted by Krishi Vigyan Kendra, Banasthali Vidyapith, in selected villages of Tonk district. The performance of these tools was compared with traditional practices involving manual dehulling by hand and mouth and weeding using *kudali*. The results revealed a significant reduction in time and energy expenditure while performing dehulling and weeding operations with improved tools. Farm women reported enhanced ease of operation, reduced physical strain, and improved work comfort compared to conventional methods. The total drudgery index of farm women was notably lower with the use of improved implements, indicating their effectiveness in reducing workload and enhancing operational efficiency. The study highlights the potential of gender-friendly farm tools in improving the occupational well-being of farm women in groundnut production.

Keywords: Groundnut, Drudgery, Farm women, Groundnut decorticator, Cono weeder

INTRODUCTION

Women constitute the backbone of Indian agriculture and play a pivotal role in sustaining farm productivity. Their participation spans almost all agricultural operations, including seed selection, sowing, intercultural operations, weeding, harvesting, processing, and storage. Several studies have reported that women contribute nearly 60–70 per cent of the total labour input in Indian agriculture, particularly in small and marginal farming systems (Kumar *et al.*, 2011; Nag and Nag, 2004). Despite their significant contribution, most farm operations performed by women continue to rely on traditional tools and manual methods, exposing them to excessive physical workload and occupational health hazards.

Farm women generally work for prolonged hours under unfavourable environmental conditions, adopting awkward and static postures that lead to fatigue, musculoskeletal disorders, and reduced work efficiency (Corlett and Bishop, 1976; Varghese *et al.*, 1994). Repetitive movements, continuous bending, squatting, and load carrying significantly increase physiological stress and perceived exertion among women workers (Nag and Nag, 2004). The lack of access to gender-friendly and ergonomically designed farm implements further aggravates drudgery and negatively affects women's health and productivity (Gite and Singh, 1997; Khadatkar *et al.*, 2015).

Groundnut production in India during 2024 was estimated at around 100–105 lakh tones**.** Major groundnut-producing states in India include Gujarat, Rajasthan, Madhya Pradesh, Tamil Nadu, and Andhra Pradesh**.** Groundnut crop provides livelihood security to millions of small and marginal farmers. Women play a dominant role in groundnut cultivation, particularly in pre-sowing and intercultural operations. One of the most tedious pre-sowing activities is manual dehulling of groundnut pods, which is predominantly carried out by farm women using hands or teeth. This traditional practice exposes women to mouth lesions, dental problems, hand injuries, and severe back and shoulder pain. Continuous engagement in such repetitive and forceful activities leads to cumulative trauma disorders and reduced operational efficiency (Gite and Agarwal, 2000; Sam and Kathirvel, 2008).

After sowing, weeding is considered one of the most labour-intensive and drudgery-prone operations in groundnut cultivation. Manual weeding requires continuous bending for long durations and is mostly performed using conventional tools such as *kudali*.

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This posture-intensive task results in excessive physical load, leading to lower back pain, muscular fatigue, and discomfort in the neck and shoulders among farm women (Varghese *et al.*, 1994; Nag and Nag, 2004). Studies have shown that prolonged bending during weeding significantly increases heart rate, energy expenditure, and perceived exertion, thereby reducing work efficiency and increasing time consumption (Sam and Kathirvel, 2008).

The problem of drudgery becomes more severe during peak agricultural seasons when labour scarcity compels women to work for longer hours, often without adequate rest. This adversely affects not only their health but also the overall productivity of farm operations (Kumar *et al.*, 2011; Yadav *et al.*, 2016). Researchers have emphasized that introduction of women-friendly, labour-saving implements can significantly reduce physical strain, improve posture, save time, and enhance work output (Gite and Agarwal, 2000; Mehta *et al.*, 2012).

In this context, ergonomic interventions in the form of improved agricultural tools assume great importance. Groundnut decorticators and hand wheel hoe weeders have been identified as potential drudgery-reducing technologies for farm women. These implements help in minimizing repetitive hand movements, reducing bending posture, lowering physiological workload, and improving operational efficiency (Rama Lakshmi *et al.*, 2009; Khadatkar *et al.*, 2015). Impact assessment of such technologies is essential to scientifically quantify their benefits in terms of time saving, reduction in physical load, postural comfort, and enhancement of work efficiency (Corlett and Bishop, 1976; Varghese *et al.*, 1994).

Therefore, the present study was undertaken based on demonstrations conducted by Krishi Vigyan Kendra, Banasthali Vidyapith, to assess the impact of a Groundnut Decorticator and Hand Wheel Hoe One-Lane Weeder on drudgery reduction and work efficiency of farm women engaged in groundnut cultivation. The study aims to generate empirical evidence on the ergonomic and productivity benefits of these tools, thereby supporting their wider adoption for improving the occupational well-being of farm women.

The research was designed with following objectives:

- To demonstrate Groundnut decorticator over traditional dehulling method
- To demonstrate Hand Wheel Hoe One Lane Weeder over traditional weeding method
- To assess output, manpower requirement and energy requirement in farm women
- To estimate drudgery index in farm women

MATERIALS AND METHODS

Selection criteria of farm women:

Thirty farm women were selected from three villages Sangrampura, Damodarpura and Motipura of Tonk district, Rajasthan. In the inclusion criteria, Farm women had good experience of groundnut dehulling by hands and manual weeding of groundnut crop with *Kudali.* They were all healthy and with no disease. Anthropometric parameters of farm women were assessed. BMI (Body Mass Index) of farm women was calculated from the formula weight (kg)/Height (meter^2) and classified it based on WHO standards.

Description of groundnut decorticator and Hand Wheel Hoe one lane Weeder:

For groundnut dehulling, Groundnut Decorticator was used which was developed by Tamil Nadu Agricultural University, Coimbatore with characteristics of Manually operated, Groundnut Decortication Efficiency- 25-30 kg/hour, Length-2 feet, width-1 feet, weight- 30 Kg. Groundnut decorticator is most suitable of medium sized groundnut pod. For weeding in groundnut crops, Hand Wheel Hoe one lane Weeder was used which was developed by Central Institute for Women in Agriculture, Bhubaneshwar. It works in the soil up to a depth of 5 cm in crop in groundnut, wheat and seasonal vegetables. Its length can be adjusted according to the height of the worker.

Demonstration ofgroundnut decorticator and Hand Wheel Hoe one lane Weeder:

Groundnut decorticator was demonstrated before sowing of Groundnut crop as the basis requirement is its dehulling. The demonstration was conducted at different time intervals of the day from nine AM to five PM. Dehulling by hands was also performed by farm women to find the difference with above demonstrated technology. When the crop was sown in the field, its weeding was the tedius task to be performed. Hand Wheel Hoe one lane Weeder was demonstrated for weeding in groundnut crop. First Weeding in groundnut as performed at 20-25 days of sowing and second Weeding was done at 35-40 days of sowing at different time intervals of the day from nine AM to five PM. To check the difference, weeding with *Kudali* was also performed by the farm women.

Output, Man power and physiological workload:

Output, Manpower required and physiological workload in farm women are the important parameters to assess efficiency of the equipments. Output of groundnut decorticator was assessed as dehulling in kg per hour while in weeding it was assessed as weeding in square meters per hour. Total manpower, time and drudgery index were assessed in both demonstrations in comparison to their traditional methods. Average heart rate of farm women during work and rest were assessed. On the basis of average heart rate at work and rest, physiological load was assessed and classified on the basis of classification given by Varghese, 1994 (Table 1).

Table 1. Classification of Workload

Physical work load	**Physiological variables**	
	Energy expenditure (KJ/Min)	Heart beats (Beats/min)
Very light	< 5.0	< 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	> 151

Varghese (1994)

Estimating drudgery index

Drudgery index is used to estimate drudgery level in farm women. There were certain rating scales that has been used to estimate drudgery index. These rating scales were based on physical/Manual load, Pastural discomfort and pain in body parts, repetitive work, physiologically stressful work, work demanding more time at task and work causing musculo skeletal disorder and pain. Each parameter of rating for drudgery estimation is given below:

Ratings on the basis of manual loads: Manual handling of loads includes the load exerted on body muscles to push, lift and carry the material. It also leads to a perception among women that work is heavy and demands muscular potential. Rating on manual loads operative: No loads-(1), Light loads-(2), Moderately heavy loads-(3), Heavy loads-(4), Very heavy loads-(5)

Rating on the basis of postural discomfort: Improper body postures c), Veryomfort and stress on skeletal and joints. Sitting on feet, bending and stooping are the common postures adopted by farm women performing agriculture tasks. Such working postures result in pains, body disorders, hazards, and low output efficiency. Ratings on postural discomfort related pain**:**No pain-(1), Mild pain-(2), Moderately painful-(3), Painful-(4), Very painful-(5)

Ratings on the basis of repetitive work: Repetitive work refers to the work that are performed with the same operation again. Such type of work needs same amount of strength or physical action and operations with similar length. Ratings on repetitive work: Repetitive less than 10 per cent of time-(1), Repetitive work 10-29%-(2), Repetitive work 30-49%-(3), Repetitive work 50-79%- (4), Repetitive work greater than 80%-(5)

Ratings on the basis of physical stress: when work needs forceful and rapid muscular movements, it exerts physical stress. Headache, muscle tension and fatigue are the main symptoms under this stress. Rating on physical stress: Very Light/ no exhaustion-(1), Light/mild exhaustion-(2), Moderately heavy/exhausting-(3), Heavy/exhausting-(4), Very heavy/very exhausting-(5)

Ratings on the basis of work demands more Time: Based on the time spent on task, time loads are perceived asVery less duration-(1) less duration-(2), moderate duration-(3), high duration-(4), Very high duration tasks-(5). In this eight hour/day is taken as high duration to consider the time load.

Ratings on the basis of Work causing Musculo skeletal disorders and pain: Prevalence of musculo skeletal disorders due to work situations, exposure to risk factors, incompatible postures, constrain workers and effect their output efficiency. Body disorder symptoms, pain ratings and pain frequency were considered suitable factors to assess musculo skeletal disorder.

Drudgery Index calculations:

It was calculated total Drudgery/150*100. Drudgery level categorization on the basis of drudgery index (Table 2).

Where

- Total drudgery = PL+P+RS+T+MSD+Phy.L
- ML=Manual load (25 points)
- P = Postural load (25 points)
- RS= Repetitive strain load (25 points)
- T= Time load (25 points)
- MSD= Musculo skeletal disorders (25 points)
- PhsL= Physiological load (25 points)

Table 2. Drudgery level categorization on the basis of drudgery index

Drudgery Index %	**Drudgery level**	**Expected heart rate**
< 10	Very low	Upto 90
10-20	Low	91-105
20-30	Moderate	106-120
40-50	Very high	121-135
>50	Extremely high	136-150

RESULTS AND DISCUSSION:

Physical characteristics of farm women: The anthropometric data of farm women have been presented in Table 3. The average age and height of the selected thirty farm women was 26 years and 160 cm respectively and the gross body weight was 52.4 kg. The average body mass index was 20.6 indicating that they were having normal body weight (Table 4).

Table 3. Selection criteria of farm women (N=30)

Physical characteristics	Range	Mean
Age (years)	18-45	26.0
Weight (kg)	145-175	160
Height (cm)	43-70	52.4
Body Mass Index	18-25	20.6

Table 4. Body Mass Index score of farm women (N=30)

BMI Score	Interpretation	BMI score of farm women (%)
< 18.5	Underweight	0
18.5-24.9	Normal	0
25-29.9	Overweight	100
> 30.0	Obese	0

(According to WHO Cutt off)

Man power, output and physiological workload:
Man power: After using groundnut decorticator for groundnut dehulling, 91.66% man power was saved over traditional dehulling. On the other hand, 35.71% manpower was saved in groundnut crop weeding by hand wheel hoe one lane weeder in comparison to its traditional weeding with *Kudali*. Saving man power in both demonstrations also saved money which would be spent on man power.
Output: by groundnut decorticator, 25 kg of groundnut per hour were decorticated while 2 kg/har were decorticated by hands. With this demonstrated technology, 1150 % output was increased. On the other hand, the output was increased 45.75% by hand wheel hoe one lane weeder.
Physiological workload: On the basis of heart rate and energy expenditure, the activity of dehulling was moderate while using groundnut decorticator and light with traditional dehulling but the farm women worked with comfort and they did not have to do both tasks for longer period of time which in turn saved farm women's energy as well (Table 5).

Groundnut dehulling by groundnut decorticator by farm women

Groundnut weeding by hand wheel hoe one lane weeder by farm women

Table 5. Man power, Output and Physiological workload

Parameter	Traditional dehulling	Dehulling by Groundnut decorticator	% change	Traditional weeding	Weeding by hand wheel hoe one lane weeder	% change
Man power required (No/ha)	6	0.5	↓ 91.66	14	9.0	↓ 35.71
Output (kg/hr)	2.0	25	↑ 1150	95.23 (m2/hr)	138.8 (m2/hr)	↑ 45.75
Av. Resting heart rate (beats/min)	72	72.1	↑ 0.13	73	73.5	↑ 0.68
Av. working heart rate (beats/min)	105	116	↑ 10.47	134	119	↓ 12.6
Av. Energy expenditure resting (kj/min)	5.14	5.15	↑ 0.19	5.21	5.25	↑ 0.7
Av. Energy expenditure working (kj/min)	7.5	9.66	↑ 28.8	12.40	9.91	↓ 25.12

Total Drudgery Index:

In traditional dehulling of groundnut the percentage of drudgery index was found to be 50 which indicated very high level of drudgery in farm women in manual dehulling of groundnut while on the other hand, using groundnut decorticator for groundnut dehulling the percentage of drudgery index was 26 showing moderate level of drudgery in farm women.

When drudgery level was estimated between wedding *Kudali* and weeding by hand wheel hoe one lane weeder in farm women, weeding of groundnut crop by *Kudali* had 86 percentage of drudgery index which indicated extremely high level of drudgery in farm women. While percentage of drudgery index was found to be 30 indicating moderate level of drudgery in farm women in Weeding by hand wheel hoe one weeder (Table 6).

Table 6. Total Drudgery Index

Parameter	Traditional dehulling	Dehulling by Droundnut decorticator	Traditional weeding	Weeding by hand wheel hoe one lane weeder
Manual load	10	10	20	10
Pastural discomfort	10	5	20	5
Repetitive work	20	5	20	5

Physiologically stressful work	5	10	25	10
Time demand	25	5	25	5
Musculo skeletal disorder	5	5	20	10
Total Drudgery	**75**	**40**	**130**	**45**
Total drudgery Index %	**50**	**26**	**86**	**30**

CONCLUSION

Groundnut dehulling and its weeding in crop stage are time consuming and tedious job. To minimize the efforts and reduce drudgery in farm women groundnut decorticator and Hand wheel hoe one lane weeder were demonstrated. In dehulling process of groundnut, 25 kg/hr of groundnut dehulling was found to be recorded by the use of groundnut decorticator in comparison with dehulling by hands that was recorded 2 kg/hr. In weeding of groundnut crop hand wheel hoe one lane weeder was found more effective and time saving as compared to *kudali*. Hand wheel hoe one lane weeder did its job of weeding in one hectare area with 35.71% man power saving in comparison to traditional weeding methods. Groundnut decorticator and Hand wheel hoe one lane weeder were found to be the most appropriate for groundnut crop to reduce drudgery. Hand wheel hoe one lane weeder was found to be most efficient in moist soil while groundnut decorticator was most suitable for medium size pod of groundnut. If they will be Battery operated then they will be more effective.

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