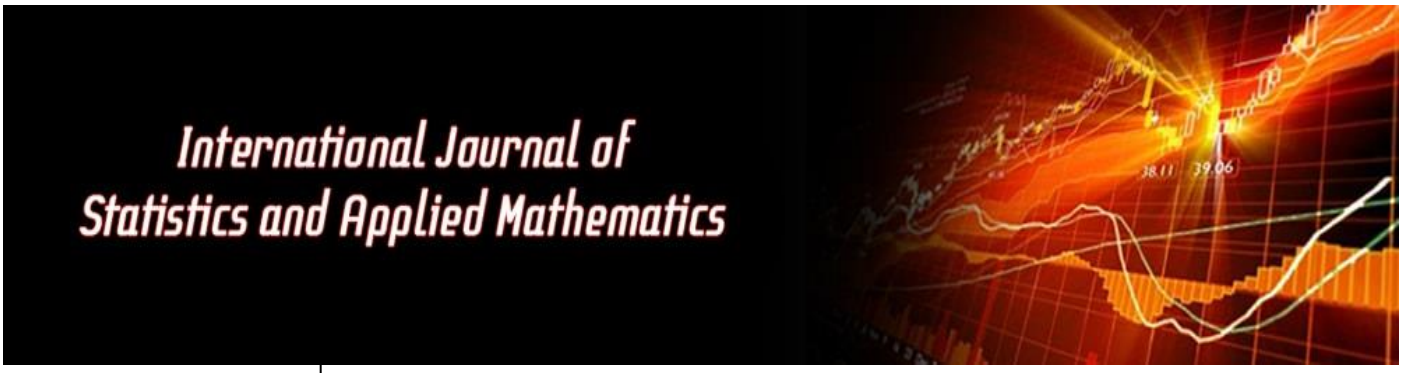
International Journal of Statistics and Applied Mathematics 2023; SP-8(3): 116-120



ISSN: 2456-1452
Maths 2023; SP-8(3): 116-120

https://www.mathsjournal.com
Received: 03-02-2023
Accepted: 04-03-2023

Rajeshwari Desai
Senior scientist, AICRP-WIA (FRM), MARS, UAS, Dharwad-580005, Karnataka, India

Geeta Chitagubbi
Professor and Head, Dept. Of Family Resource Management, UAS, Dharwad-580005, Karnataka, India

Shobha Kasar
Junior Research Fellow AICRP-HSc (FRM), UAS, Dharwad-580005, Karnataka, India

Corresponding Author:
Rajeshwari Desai
Senior scientist, AICRP-WIA (FRM), MARS, UAS, Dharwad-580005, Karnataka, India

Drudgery reducing technologies in vegetable production system

Rajeshwari Desai, Geeta Chitagubbi and Shobha Kasar

Abstract
Vegetable production is a labour intensive and women play vital role and performs ninety per cent of activities in vegetable production system *viz*., seedling / transplanting, weeding, fertilizer application, harvesting and post harvesting activities with use of traditional/ conventional tools, which adds drudgery and postural discomfort to workers. Hence to address the reduction of drudgery, postural discomfort and labour problem. All India Coordinated Research Project on Home Science, (Family Resource Management) component of Dharwad center introduced drudgery reducing technologies in vegetable production system. The study was conducted during the year 2018-19, four villages of Dharwad taluk. The sample for the study was 10 farm women. Ergonomic assessment was done. The vegetable trolley, staking method of vegetable and protective kit was introduced in harvesting activity of vegetable production system. The results revealed that the mean age of farm women was 42 years with mean height of farm women was 150.90 cms and mean weight 50.60 kgs. Majority of the respondents had mesomorph body types and belonged to normal body mass index and the physiological work load was light with use of improved method. Significance difference was observed with respect to heart rate, energy expenditure and rate of perceived exertion between improved and conventional method of harvesting. REBA scores for existing method was higher (12) which involves high risk as compared to improved method (04). The farm women experience less drudgery (13.79) after performing harvesting of vegetable (tomato) with the use of improved technology/ method as compared to traditional method (21.38).

Keywords: Drudgery, staking of vegetable plant, protective kit

Introduction
The major vegetable crops grown in India, which accounts for 11.2 per cent of global vegetable production are potato, tomato, onion, brinjal, cabbage, cauliflower, peas, and okra. With a production of 98.58 mt, fruits account for about 31.4 per cent of the total production of horticulture crops in the country. Though India is second largest producer of vegetables in the world it ranks 24th in the export value of vegetables.

Vegetable production is a labour intensive and women play vital role and performs ninety per cent of activities in vegetable production system *viz*., seedling / transplanting, weeding, fertilizer application, harvesting and post harvesting activities with use of traditional/ conventional tools, which adds drudgery and postural discomfort to workers. Which adds to the drudgery of farm women.

Human energy is essential to survival in the rural production system. Many agricultural operations seem to be simple and not too tedious with relatively less level of energy expenditure rate. But, the activities may pose threat to the worker because of the arduous and unnatural postures adopted by the worker throughout the task. One of such activity harvesting in vegetable cultivation carried out by women is one of the drudgery prone activities. Drudgery in farming operations is an important gender issue and efforts are under way by research and development organizations and development agencies. As it is widely recognized that women are the major workforce in agriculture who predominantly sustain the life support system of the rural India. Because since dawn to dusk, they share abundant responsibilities and perform a wide spectrum of activities related to agriculture, household chores and allied. With the feminization of agriculture, scarcity of farm labour and outmigration of male, women are forced to carry out work previously done by men.

Consequently women are increasing their workload and taking care of a wider scope of agriculture tasks, but the degree to which they have access to improved technologies need special consideration. Rural women's daily activities revolve around a mixture of tasks pertaining to domestic and productive work. It is estimated that during peak period, women work every day for about 8-9 hours in agriculture and 4 hours in household activities. Thus, time-saving in one sphere can directly affect time availability in the other, and vice versa. Energy and time saving technological interventions are need of an hour to reduce the work burden and increase efficiency (IFAD 2014) [4].

Vegetable cultivation has become highly commercialized but still there is a wide gap between current production and potential productivity. Women participation in the family farming system is crucial to the sustenance of rural economy. Vegetable cultivation in Dharwad district has a vast potential of improving the economic status of farming community. It has been observed that in farm family the participation of women during decision making as well as in the implementation and management of farm planning is very poor, although their contribution towards total land and labour is significant. It is realized on the national basis that being an equal stake holder of society women's participation farm planning to execution plays a significant role in sustainable development any enterprise. Therefore study was carried out to drudgery reducing technologies in vegetable production system with vegetable packages the extent of women participation in different activities and decision involved in vegetable cultivation, So that suitable intervention can be planned. The collected data was processed, tabulated and presented in the form of table

Methodology

The present research was carried out by the staff of AICRP-FRM, University of Agricultural Science, and Dharwad. The work was carried under the jurisdiction of University of Agricultural Sciences, Dharwad. To study the drudgery reducing technologies in vegetable production system by farm women. Vegetable cultivating farm women from the four villages *viz*., Narendra, Mulamuttala, Managalagatti and Lokur were selected randomly from Dharwad taluk. The total sample comprised of 30. Non pregnant women with normal health. Technology used and activity analysis in vegetable production was collected through various tools like personal interview method, heart monitor for analysis of circulatory stress of farm women, REBA tool for postural analysis and drudgery score for drudgery rate of farm women. The collected data was processed, tabulated and presented in the form of table.

1. Body Mass Index (BMI)

The Body Mass Index is determined based on body height and weight by using the formula

$$\text{BMI (kg/m}^2) = \frac{\text{Weight (kg)}}{\text{Height}^2\text{ (m)}}$$

The sample were classified based on the Garrow *et al*. (1981) [12] classification table as given below.

Body Mass Index range	Presumptive diagnosis
< 16.0	CED Grade III (Severe)
16.0-17.0	CED Grade II (Moderate)
17.1-18.5	CED Grade I (Mild)
18.5-20.0	Low Weight Normal
20.0-25.0	Normal
25.0-30.0	Obese Grade-I
> 30	Obese Grade-II

Body type

The respondents were classified into different body types based on the Quetelets Body Mass Index classification table.

Quetelets Index (BMI)	Body type
< 20	Ectomorph
20-25	Mesomorph
> 25	Endomorph

2. Aerobic capacity method (VO_2 max)

The aerobic capacity is also another indicator of the physical fitness of the subjects**.** The consumption of maximum volume of oxygen (VO_2 max) is estimated based on the body weight and height of the respondents. The respondents were classified into various physical fitness categories according to the classification given by Saha (1996) [9].

VO_2 max (l/min) = 0.023 x Body weight (kgs)-0.034 x Age (years) + 1.652.

$$VO_2 \text{ max (ml/kg. min)} = \frac{VO_2 \text{ max (l/min)}}{\text{Body weight}} X\ 1000$$

Physical Fitness Index table as per Aerobic Capacity

Physical Fitness	VO_2 max (ml/kg. Min)
Poor	< 15.0
Low average	15.0 – 22.5
High average	22.6 – 30.0
Good	30.1 – 37.5
Very good	37.6 – 45.0
Excellent	> 45.0

3. Determination of physiological work load of Vegetable harvesting activity

The heart rate monitor was used to determine the physiological workload of farm women while performing transplanting and weeding activities. It is set to record the heart rate of the respondents per minute. It was tied to the sample and the recording process was done as detailed below.

1. The respondent was allowed to rest for 5 minutes if she was working. Later the heart rate monitor was tied and the watch was started to record the resting heart rate for five minutes
2. Soon after the rest the respondent was made to perform the selected farm activity for twenty minutes
3. Later she was allowed to recover for five minutes
4. Thus the heart rate during rest, work and recovery was recorded for five, twenty and five minutes respectively for each sample (Totally thirty minutes)

Thus the data was collected in two replications for existing method and two replications for improved method. The existing and the improved methods of performing the activity were taken up alternatively. Based on the records of heart rate monitor, the following parameters were calculated

Rapid Entire Body Assessment (REBA)

Score	Level of MSD Risk
1	negligible risk, no action required
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, implement change

This ergonomic assessment tool uses a systematic process to evaluate whole body postural MSD and risks associated with job tasks. A single page worksheet is used to evaluate required or selected body posture, forceful exertions, type of movement or action, repetition, and coupling

Terminologies

Vegetable trolley

Manually operated vegetable trolley used for carrying harvested vegetables

Staking / Training the plants

Staking / Training the plants refers to inserting a stake beside the plants in order to provide it with support while it grows.

Personal Protective Kit

PPE refers to any specialized equipment or clothing worn by farmers for protection against environment, health and safety hazards.

Results

The physical characteristics of respondents selected for the ergonomic analysis of vegetable in harvesting and post harvesting activity of tomato production system is presented in table 1. The mean age of farm women was 42 years with the mean height 150.90 cms and mean aerobic capacity based on height and weight was 27.75 ml / kg. The contradictory results with Chaya badiger *et al.*, 2003 [2]. The mean age was 35.8 years and height was 148.53 cm with the mean weight of 41.17 kg. The mean blood pressure was 101.93/ 70.00 and body temperature was observed to be 36.48 ºC.

Distribution of sample selected for intervention of technology distribution of respondents based on physiological parameter like body type, body mass Index and aerobic capacity are presented in the table 2 majority (60%) of the respondents had mesomorph body type followed by ectomorph (30%)and endomorph (10%). The results on par with Suma Hasalkar *et al.*, 2010 [10] Maximum percentage of the women (43.33%) were in the normal range body mass index range

Maximum per cent of the respondents (60%) belonged to normal body mass Index ranging between 20-25 per cent followed by CED grade III sever (20 per cent).Lesser and equal (10%) per cent of the respondents were in low weight normal and obese grade I physical fitness categories according to body mass Index classification

Fifty per cent of the respondents were in good range of aerobic capacity followed by high range category (30%) and equal per cent (10%) of respondents were in low average and poor to according to estimated aerobic capacity of the selected sample based on body height and body weight

Table 03 depicts the circulatory stress perceived exertion and physiological workload of women while performing tomato harvesting activity in existing and improved methods. The average working, resting and recovery heart rate of respondents were lesser while working with improved method (vegetable trolley, staking method of cultivation and hand gloves (protective kit)), Similarly the peak energy expenditure, average TCCW, Physiological cost of work and rate of perceived exertion was also less while performing harvesting activity with improved method as compared to conventional method. The physiological work performing harvesting activity in existing method and it was light while working with improved method. Circulatory stress and energy expenditure are presented in tables 2. The results on par with Chaya badiger *et al.*, 2003 [2]., The average working heart rate with improved chaff cutter was observed to be less compared to the work with the traditional chaff cutter and Deepali Bajpai *et al.*, 2018 [3]., With the use of improved equipment, farm women found a light rate of perceived exertion compared to traditional method. There is no reference available to correlate the present results. Whereas the use of the twin wheel hoe (Tripathy *et al*, 2016) [11] found working heart rate 107.0 beats/ minute.

The results of Table 04 revealed that different drudgery parameter were scored lesser after performing harvesting of tomato with improved method as compared to traditional method. Significant difference was observed between existing and improved method with respect to drudgery parameters

Table 05 shows that REBA score for existing method was higher (12) as compared to improved method the REBA score for existing method (12) indicated very high risk and implemented change for existing method and REBA score for improved method (04) indicated medium risk further investigation and change may be needed

Table 06 presents drudgery experiences compared while harvesting of tomato with conventional method and improved method. The results revealed that the represents experienced / perceived less drudgery (13.79) after performing harvesting of tomato with the use of improved technology / method as compared to traditional method (21.38) of performing activity. The results were on par with Rekha tiwari *et al.*, 2013 [7], near about 28 per cent drudgery could be reduced in improved practice. Reducing of drudgery it indicate that improved practice saves time, gives more output and it reduces body muscular skeletal problems also. It also indicate that women friendly farm tools minimizes maximum problems of the farm women but these equipments are not popular in rural area because the new techniques or technologies' are still not reached at bottom level particularly at rural area

Conclusion

Farm women were satisfied with the use of improved technology in Vegetable production system which is time, human energy saving and fatigue reducing. Further relationship between Total Cardiac Cost of Work (TCCW) and other independent variables as age, heart rate, EER, BMI etc. were also analyzed and it was found that Total Cardiac Cost of Work is positively correlated with heart rate, EER, BMI. Drudgery can be reduced by providing gender friendly farm tools and equipments which increase the productivity of worker with safety and comfort. Time scheduling and postural management are primary for achieving efficiency. A good working posture requires minimum static muscular effort. In the present investigation, vegetable trolley ergonomically

sound in vegetable production system as per physiological and subjective ergonomically parameters with reference to saving time, human effort, increasing work capacity and productivity resulting in improving quality of life. It was found to be compatible, easy to handle and applicable in field situation as well as most efficient for vegetable fields. It was observed that use of vegetable trolley improved posture and efficiency of worker. The health of farmwomen is one of the important resources for sustainable agricultural development. Therefore, such drudgery reducing farm implements needs to be demonstrated to avoid occurrence of health hazards among farm women.

Table 1: Physical characteristics of the selected sample N=30

Sl. No	Physical Characteristics	Mean	Standard Deviation
1	Age (years)	42.00	±11.24
2	Height (cms)	150.90	±1.79
3	Weight (kgs)	50.60	±10.31
4	Body Mass Index	21.13	± 4.24
5	Aerobic Capacity (ml/kg x min)	27.75	± 8.24

Table 2: Distribution of sample based on Body type, BMI and Aerobic capacity N=30

Sl. No	Parameters	Age (20-45 years)	
		Frequency	Percentage
I	**Body Type**		
1	Ectomorph (< 20)	10	33.33
2	Mesomorph (20-25)	16	53.33
3	Endomorph (> 25)	04	13.33
II	**Body Mass Index**		
1	CED Grade III-Severe (< 16.0)	06	20
2	CED Grade II –Moderate (16.0-17.0)	--	--
3	CED Grade I – Mid (17.0-18.5)	--	--
4	Low Weight Normal (18.5-20.0)	02	6.66
5	Normal (20.0-25.0)	20	66.66
6	Obese Grade I (25.0-30.0)	02	6.66
7	Obese Grade I (> 30.0)	--	--
III	**Aerobic Capacity (vo2 max. (L/min.)**		
1	Poor (< 15.0)	02	6.66
2	Low Average (15.0-22.50)	02	6.66
3	High Average (22.6-30.0)	11	36.66
4	Good (30.1-37.50)	15	50
5	Very Good (37.60-45.0)	--	--
7	Excellent (> 45.0)	--	--

Table 3: Circulatory stress, perceived exertion and physiological work load of women while performing the tomato harvesting activity in existing and improved methods N=30

Sl. No	Physiological Parameters	Existing method	Improved method
1	Average Resting Heart rate (beats/min.)	87.06	86.94
2	Average Working Heart rate (beats/min.)	118.28	102.70
3	Average Recovery Heart rate (beats/min.)	93.36	90.86
4	Average Peak Heart rate (beats/min.)	128.20	110.10
5	Average Energy Expenditure (Kj/min.)	8.96	7.50
6	Peak Energy Expenditure (Kj/min.)	11.66	8.78
7	Average TCCW (beats)	1552.5	1481.3
8	Average Physiological Cost of Work (beats/min.)	155.25	148.13
9	Rate of perceived Exertion	3.10 (Moderately Heavy)	2.5 (Light)
10	Physiological work load (based on working heart rate)	Moderately Heavy	Light

Table 4: Mean difference of physiological and other parameters of women while performing harvesting activity in existing and improved methods

Sl. No	Parameters	Traditional method	Improved method	T-Value
1	Heart rate	118.28±4.91	102.70±7.10	0.65 *
2	Energy expenditure	10.08±0.78	7.60±1.12	0.68 *
3	Work out put (kg/h/worker)	75.60±11.73	87.00±8.12	2.52 **
4	Rate of perceived exertion ***	3.1±0.87 (Moderately heavy)	2.50±0.52 (Light)	0.16 *

*Significant at 0.5%level
** Significant at 5 % level
***RPE: scale: Very heavy - 5, Heavy -4, Moderate - 3, Light - 2, Very light -1

Table 5: REBA scores for existing and improved methods of harvesting vegetable

Activity	REBA score & Remark	
	Existing method	Improved method
Vegetable harvesting activity	12 Very High Risk. Implement change	04 Medium risk. Further Investigate. Change soon

Table 6: Drudgery experienced in harvesting activity with the use of conventional method and improved technologies/ methods

Sl. No.	Drudgery parameters	Existing method	Improved method	'T' Value
1	Rating on work Demand (Score 1-5)	3.51	2.27	0.150*
2	Rating on Feeling of Exhaustion (Score 1-5)	3.46	2.29	0.167*
3	Rating on Posture assumed in work (Score 1-5)	3.53	2.21	0.001*
4	Rating on Manual Loads Operatives (Score 1- 5)	3.66	2.31	0.247*
5	Rating on Difficulty perception (Score 1-5)	3.58	2.43	0.945*
6	Rating on work Load Perception (Score 1-5)	3.64	2.28	0.271*
Total Score		21.38	13.79	

**At 1% Level of Significance
*At 5% Level of Significance

Drudgery parameters

1. Very demanding (5), demanding (4), moderate (3), less demanding (2), Very less demanding (1).
2. Very exhausted (5), exhausted (4), moderately exhausted (3), mildly exhausted (2), No exhaustion (1).
3. Very difficult (5), difficult (4), moderately difficult (3). Easy (2), very easy (1).
4. Very painful (5), painful (4), moderately painful (3), mild pain (2), no pain (1).
5. Very heavy (5), heavy (4), moderately heavy (3), light (2), very light (1).
6. Very heavy loads (5), heavy loads (4), moderately heavy loads (3), light loads (2), No loads (1).

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