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Geeta Chitagubbi

Senior Scientist AICRP-HSc (FRM) & Unit Coordinator, AICRP-HSc, All India Coordinated Research Project-Home Science (Family Resource Management) Main Agricultural Research Station, University of Agricultural Sciences Dharwad, Karnataka, India

Rajeshwari Desai

Junior Scientist, AICRP-HSc (FRM), All India Coordinated Research Project-Home Science (Family Resource Management) Main Agricultural Research Station, University of Agricultural Sciences Dharwad, Karnataka, India

Shobha Kasar

Junior Research Fellow, All India Coordinated Research Project-Home Science (Family Resource Management) Main Agricultural Research Station, University of Agricultural Sciences Dharwad, Karnataka, India

Corresponding Author

Geeta Chitagubbi

Senior Scientist AICRP-HSc (FRM) & Unit Coordinator, AICRP-HSc, All India Coordinated Research Project-Home Science (Family Resource Management) Main Agricultural Research Station, University of Agricultural Sciences Dharwad, Karnataka, India

An interventional analysis on drudgery reduction technologies for empowerment of farm women

Geeta Chitagubbi, Rajeshwari Desai and Shobha Kasar

Abstract

Most of the vegetable production system activities are performed by women except land preparation and irrigation. They are still performing these activities in traditional manner using conventional tools. Majority of women performs weeding activity in squatting posture for long time which is very uncomfortable posture leads to lower back pain. Weeding and top dressing of fertilizer activities are women dominated and are performed in uncomfortable posture leading to musculo-skeletal disorders and drudgery of farm women.

Hence, the study was conducted with an objective of Intervention of drudgery reducing technologies in vegetable production system for empowerment of farm women. The study was carried out in the Mulamuttala, Garaga and Lokur villages from Dharwad district of Karnataka state with the sample size of 30 farm women and ten farm women each for ergonomic analysis (Two technologies). The data was collected by survey and experimental methods. The results revealed that the work efficiency with the use of cycle weeder showed significant increase in Pace of Work (30.83 hr/acre) and saved the labour cost of Rs 1190/- as compared to traditional method of weeding (76.25 hr/acre). The use of fertilizer trolley for top dressing of fertilizer application activity in vegetable production system showed significant increase in Pace of Work (20 hr/acre), the reduction of drudgery and postural discomfort was observed and use of these technologies helps in saving of time and energy among farm women in vegetable production system and were highly appreciated and accepted by the small farming community. Thus they proved to be appropriate technologies for the farming community.

Keywords: Vegetable production, drudgery, work out put and cost of operation

Introduction

Vegetables occupy around 10.9% area in the Country approximately 882.18 lakh hectare area in India. The annual production of vegetables is estimated to be over 196.27 million tonnes. Thus, enabling India to achieve second position after China in the World production of vegetable (Anonymous, 2020) [1]. The production growth rate of vegetables is 6.48%. While export growth rate is 20 percent. The annual export of vegetable is around 4969.73 crore. In vegetable cultivation women participation in the family farming system is crucial to the sustenance of rural economy. The farm women need to be involved in vegetable production sector to push up considerable increase in production level and area under vegetables. Vegetable cultivation in India is mainly dominated by small and even landless farmers who borrow small piece of land on lease basis. Further, vegetable cultivation in India is such an agricultural occupation where the whole works to get maximum earning from small piece of land and the role of each and every member are important social status of people has an important role. Women of such families play a crucial role in the various production activities of vegetables. Around 85 percent of the total female labourers are employed in agriculture sector in rural India. The number of women in agriculture sector is increasing continuous during last few decades due to several reasons such as migration of men to urban areas, low growth rate of agricultural sector, seasonality of work. The percentage of women agricultural labourers was around 25 percent in 1981 and now it has increased to 40 percent and by 2025 in percentage of agricultural labour will be around 55%. Since the Vegetable production is one of the fastest growing sectors of agriculture thus there are possibilities that highest number of these labourers will be engaged in Vegetable production sector particularly in the production and post harvest handling and value addition.

In recent years, Vegetable production has increased three times during the last 50 years due to technological innovations. India's vegetable production requirement is projected to rise to 151-193 million tones by the year 2030.

Uttar Pradesh, West Bengal, Madhya Pradesh, Bihar Gujarat, Odisha, Karnataka, Maharashtra, Andra Pradesh and Chattisgarha are the major vegetable growing states of India respectively (Anonymous, 2020) [1]. Most of the vegetables are not directly seeded they are raised through seedling production in nursery beds and thereafter planting in the main fields. The women usually perform these operations. Vegetable crops require frequent watering and proper nurturing of the newly planted seedlings. Women workers perform this work very efficiently with utmost care. Weeding is difficult operation in vegetable farming. Vegetable being short duration crop, lose their yield potential if they are left un-weeded. Vegetables differ than other agricultural crops and are harvested at frequent intervals based on their horticultural maturity. Women workers are exclusively involved in harvesting of the vegetables such as pea, chillies, okra, tomato, brinjal etc. After harvesting of produce it's cleaning, curing, grading and other various operations are also performed by women labourers. Tripathi, P C (2012) [9].

In vegetable production system sowing/transplanting, weeding, fertilizer application, harvesting etc are done by women manually is very exhausting and time consuming task and the fingers and palm of farm women injured during all these activities which reduces the efficiency of farm women. Interventional analysis on drudgery reduction technologies viz., Cycle weeder, fertilizer trolley for farm women to reduce the drudgery of farm women, postural discomfort and labour cost is a need for an hour. Hence Family Resource Management component of AICRP on Home Science, UAS, Dharwad conducted study with an objective of Intervention of drudgery reducing technologies in vegetable production system for empowerment of farm women

Methodology: The study was conducted in two stages:

1. Survey: The survey was conducted to study the participation level of farm women in Vegetable production system. Self structured questionnaire with interview method was used to collect the data. The village of Dharwad taluk of Karnataka state viz Mulamuttala, Garaga and Lokur were selected for the study. Sample study involved thirty women in vegetable production system. Based on the survey results, further experiment was carried out.

2. Experiment: Twenty non-pregnant women with normal health, without any major illness or cardio-vascular problems, falling in the age range of 25-45 years were selected for the study for assessing the improved technologies viz., Top dressing of fertilizer (10 no. farm women) and Cycle weeder (10 n. of farm women). Care was taken to select the farm women who were performing the vegetable production system activities regularly.

The variables and their measurements are discussed in detail as below

1. Gender participation: Gender participation was analyzed by using the following scale of participation of women in vegetable production system

- WE: Women Exclusive only (1)
- WD: Women Dominated and supported by men (2)
- ME: Men Exclusive only (3)
- MD: Men Dominated and supported by women (4)
- EP: Equal participation by men and women (5)

2. Physical characteristics of the respondents: Measurement of physical characteristics namely, age, height and weight of each respondent were recorded before starting the experiment.

3. Body type: The respondents were classified into different body types based on the Quenelles Body Mass Index classification. (Ectomorph, Mesomorph and Endomorph)

4. Body Mass Index (BMI): The Body Mass Index is determined based on body height and weight by using the formula and were further classified based on the James *et al.*, BMI classification (1988) [3] classification table.

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

5. Aerobic capacity (VO₂max): The aerobic capacity is also another indicator of the physical fitness of the subjects. The consumption of maximum volume of oxygen (VO₂ max) was 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) [6]. VO₂ max (l/min) = 0.023 x Body weight (kgs) - 0.034 x Age (years) + 1.652.

$$\text{VO}_2\text{ max (ml/kg. min)} = \frac{\text{VO}_2\text{ max (l/min)}}{\text{Body weight}} \times 1000$$

6. Ergonomic analysis of weeding and top dressing of fertilizer activities were carried out by assessing drudgery experience of farm women and determination of physiological work load by using Heart rate monitor in vegetable production system activities.

7. Drudgery experienced by farm women was assessed by the six drudgery parameters, namely work demand, feeling of exhaustion, posture assumed in work, manual load operative, difficulty perception, work load perception and human power used by using five point scale as detailed below.

- a. Work Demand (Score 1-5):** Very demanding (5), demanding (4), moderate (3), less demanding (2), Very less demanding (1).
- b. Feeling of Exhaustion (Score 1-5):** Very exhausted (5), exhausted (4), moderately exhausted (3), Mildly exhausted (2), No exhaustion (1)
- c. Posture assumed in work (Score 1-5):** Very difficult (5), difficult (4), moderately difficult (3), Easy (2), very easy (1)
- d. Manual Load Operative (Score 1- 5):** Very heavy loads (5), heavy loads (4), moderately heavy loads (3), light loads (2), no loads (1)
- e. Difficulty perception (Score 1- 5):** Very painful (5), painful (4), moderately painful (3), Mild pain (2), no pain (1)
- f. Work load perception (Score 1- 5):** Very heavy (5), heavy (4), moderately heavy (3), light (2), very light (1)

Determination of physiological work load of farm women in vegetable production system activities

The heart rate monitor was used to determine the physiological workload of farm women while performing vegetable production system 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 05 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 ten 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, ten and five minutes respectively for each sample (Totally twenty minutes).

Thus the data was collected in two replications for existing and improved methods. 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.

1. Average heart rate and peak heart rate during rest,

- activity, and recovery.
2. Energy Expenditure (kj/min) was estimated, based on the heart rate by using the following formula. $EE (kj/min) = 0.159 \times \text{Average HR (beats/min)} - 8.72$
3. Cardiac Cost of Work (CCW) = Average Heart Rate (AHR) X Duration. (During work)
4. Cardiac Cost of Recovery (CCR) = Average Heart Rate (AHR) X Duration.(During recovery)
5. Average Heart Rate (AHR) = $\frac{\text{Average Working /Recovery HR} - \text{Average Resting HR}}{\text{Total Duration}}$
6. Total Cardiac Cost of Work (TCCW) = CCW + CCR
7. Time Weighed Average Heart Rate (kcal) = $\frac{\text{Total Heart Rate}}{\text{Total Duration}}$ (TWAHR)
8. The classification of work load of each activity is done by using the classification table given by Varghese *et al*, 1994.

Table 1: Gender participation of the respondents in Vegetable production system activities

Activities	Gender participation					Technology usage
	WE	WD	ME	MD	EP	
Land preparation			21 (70.00%)		9(30.00%)	Manual
Transplanting	30(100.00%)					Manual
Weed management	30 (100.00%)					Manual
Top dressing of fertilizer		28 (93.33%)			2(6.66%)	Manual
Irrigation			30(100.00%)			Rain fed or manual
Harvesting	27 (90.00%)				3 (10.00%)	Manual

Note: Figures in parenthesis indicates percentages

WE: Women Exclusive only

ME: Men Exclusive only

EP: Equal participation by men and women

WD: Women Dominated and supported by men

MD: Men Dominated and supported by women

Table 1. Represents the gender participation and technology usage in vegetable production system. Cent percent of the women considered transplanting and weed management activities as women exclusive activities followed by harvesting activity (90%). Cent percent of farm women opined that irrigation activity was performed exclusive by

men followed by land preparation activity (70.00%). Equal participation was observed in land preparation, harvesting and top dressing activities according to 30%, 10% and 6.66% of farm women respectively. The vegetable production system activities were performed in traditional manner only.

Table 2: Comparison of drudgery experienced by the farm women in vegetable production system with the use of conventional tool

Drudgery Experience	Transplanting activity	Weed management activity	Top dressing of fertilizer activity
Rating on work Demand (Score 1-5)	3.7	3.50	3.2
Rating on Feeling of Exhaustion (Score 1-5)	3	3.30	3.45
Rating on Posture assumed in work (Score 1-5)	3.89	3.50	3.1
Rating on Manual Loads Operatives (Score 1- 5)	3.55	3.55	2.99
Rating on Difficulty perception (Score 1-5)	3.8	3.80	2.65
Rating on work Load Perception (Score 1-5)	3.2	3.90	3.12
Total Score	21.14	21.55	18.51
Total average score	3.52	3.59	3.08

Drudgery Experiences

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. 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)

Table 2 presents comparison of drudgery experienced by the farm women in vegetable production system with the use of conventional tool. Farm women experienced higher drudgery while performing weed management activity (DS : 21.55) followed by transplanting activity (DS: 21.14) and top dressing activity (DS: 18.51). Weed management and transplanting activities were consider as women exclusive and top dressing activity as a women dominating activities Because these activities were performed by women with the conventional tools / traditional method in uncomfortable

posture i.e squatting / bending posture for long period. The study in line with Hasalkar, S *et al* 2004 [2] weeding was performed for maximum number of days in a year, continuously from morning till evening in squatting position. In order to reduce drudgery and for enhancement of work output the intervention of improved technologies like cycle weeder and fertilizer Trolley are very much essential. Hence these women friendly drudgery reducing improved technologies introduced in vegetable production system.

1. Cycle weeder

Features

- Light in weight, simple to operate and can be used both by men and women
- It is manually operated equipment for weeding and inter-culturing in upland row crops in black soil region and easy to handle
- It consists of single wheel, frame, flat type with sharp edges -blade. Cutting and uprooting of weeds are done through push and pull action
- It reduces musculoskeletal problems and postural discomfort
- It has economical advantage, saves the time and improves in work efficiency due to comfortable posture



Fig 1: Cycle weeder

2. Fertilizer trolley

Features

- It has three wheel and circular stand at the top to hold the fertilizer basket
- It can be easily pulled with the chain/rope in the field while performing the activity
- Fertilizer trolley help women to be in good position while applying fertilizer
- It increases the work efficiency among women
- Fertilizer trolley can carry about 10 kgs of fertilizer at a time so it will reduces the walking distance while applying fertilizer
- The drudgery of the farm women is also reduced due to minimized physiological and muscular stress
- Reduces the load on the spine and cervical region while performing the top dressing of fertilizer activity by the farm women.
- The women can pull trolley from plant to plant easily with left hand and apply the fertilizer with right hand
- It reduces the total cardiac cost of work and the fatigue of muscles
- Fertilizer trolley helps women to be in good posture while applying fertilizer



Fig 2: Fertilizer trolley

Table 3: Physical characteristics of the selected sample while performing weeding and top dressing of fertilizer activities in vegetable production system

N=20

Physical Characteristics	Weeding n=10	Top dressing of fertilizer n=10
Age (years)	39.13±0.62	33.68 ±0.52
Height (cms)	150.7±2.16	150.20±1.39
Weight (kgs)	50.9±3.10	42.10±1.52

The physical characteristics of the selected sample depicted in Table 3. The results show that the average mean age of farm women involved in weeding activity was 39.13 years with the mean height of 150.7 cms and mean weight of 50.9 Kg. Further results revealed that the average mean age of farm women involved in fertilizer activity was 33.68 years with the mean height of 150.20cms and mean weight of 42.10 Kg.

Table 4: Distribution of the selected sample based on Body type, BMI and Aerobic capacity

N=20

Parameters	Weeding n=10	Top dressing of fertilizer n=10
Body Type (BMI)		
Ectomorph (<20)	-	9(90)
Mesomorph (20-25)	9(90)	1(10)
Endomorph (>25)	1(10)	-
Body Mass Index		
CED Grade III-Severe (<16.0)	-	-
CED Grade II –Moderate (16.0-17.0)	-	-
CED Grade I – Mid (17.0-18.5)	-	-
Low Weight Normal (18.5-20.0)	-	9(90)
Normal (20.0-25.0)	09(90)	1(10)
Obese Grade I (25.0-30.0)	01(10)	-
Obese Grade I (>30.0)	-	-
Aerobic Capacity (vo2 max. (L/min.))		
Poor (<15.0)	-	-
Low Average (15.0-22.50)	-	-
High Average (22.6-30.0)	08(80)	-
Good (30.1-37.50)	02(20)	10(100)
Very Good (37.60-45.0)	-	-
Excellent (>45.0)	-	-

Figures in the parentheses indicate percentage

Distribution of sample based on physiological parameters of farm women involved in weeding activity and top dressing of fertilizer application is depicted in Table 4. The majority of the respondents (90%) involved in weeding activity had mesomorph body type followed by endomorph (10%). Regarding the nutritional status of the farm women majority of the selected respondents (90%) fell under normal Body Mass Index and least no. of the respondents belonged to

Obese Grade I (10%). The aerobic capacity of the respondents was also assessed and the results revealed that eighty per cent of the respondents had high average aerobic capacity (80%) followed by good aerobic capacity (20%). These findings are on par with results of the study conducted by Suma Hasalkar and Rajeshwari Desai (2007) [8].
The farm women involved in top dressing of fertilizer activity

majority of the respondents (90%) had ectomorph body type followed by mesomorph (10%). Regarding the nutritional status of the farm women, majority of the respondents (90%) had low weight Normal Body Mass Index followed by Normal BMI (10%). Further the aerobic capacity of the respondents was observed to be 'good'.

Table 5: Performance evaluation of cycle weeder and fertilizer trolley in comparison with traditional methods

N=20

Parameters	Weeding n=10			Top dressing of fertilizer n=10		
	Traditional (minutes)	Cycle Weeder	't' value	Conventional	Improved	't' value
Pace of Work(hr/acre)	76.25	30.83	60.16 **	22.50	20.00	2.55**
Drudgery score	21.55	14.20	13.51 **	18.51	13.18	11.92 **
Labour employed/ acre	9.53	3.85	26.84 **	2.81	2.50	2.59**
Labour wages	1960	770	33.90 **	562	500	2.81**
Economic Benefit		1190			62	

Note: Labour charges -200/- day/ FW

**At 1% level of significance

The results showed that the use of cycle weeder for weeding activity in vegetable production system showed highly significant change in pace of work, economic benefit, & labour requirement over traditional tool. Reduction in labour requirement was significantly low (3.85/acre). The higher economic benefit was observed with the use of cycle weeder as compared to traditional method.

The use of fertilizer trolley for fertilizer application activity in vegetable production system showed significant increase in Pace of work. The reduction in labour days and labour wage

was also observed over traditional method.

In traditional method, the top dressing of fertilizer application was performed by tying the cloth (which filled with fertilizer) to waist in bending posture. This added to the increased musculoskeletal problems of the women. Hence the fertilizer trolley was introduced to overcome the observed problems. It reduced the load on the spine and cervical region while performing the top dressing of fertilizer activity by avoiding carrying fertilizer load.

Table 6: Average heart rate, perceived exertion while performing the top dressing of fertilizer activity using existing and improved techniques

N=20

Physiological Parameters	Weeding n=10		Top dressing of fertilizer n=10	
	Existing method	Improved method	Existing method	Improved method
Average heart rate during rest (beats/min.)	98	96.10	92.22	90.15
Average heart rate during work (beats/min.)	125	117	121.62	119.96
Average heart rate during recovery (beats/min.)	122	111	132.23	130.96
Average Energy Expenditure (Kj/min.)	13.20	10.50	10.61	10.35
Average Rate of Perceived Exertion	3.25	1.50	3.00	1.68
Classification of workload	Moderately Heavy	Light	Moderately Heavy	Light
Mean Temperature (° C)	38.12	38.12	37.15	37.15
Mean Relative Humidity (%)	43	43	43.50	43.50

An observation in Table 6 reveals the circulatory stress, perceived exertion and physiological work load of women while performing the weeding and fertilizer application activities in existing and improved methods. The working, resting and recovery heart rate of farm women were lesser while working with Cycle weeder, fertilizer trolley as compared to existing method of weeding and fertilizer application. Similarly the Rate of Perceived Exertion was also less while working with improved tools as compared to existing method. The physiological of workload was moderately heavy in traditional method while, in improved method it was light

Conclusion

The ergonomic analysis of weeding and top dressing of fertilizer activities revealed that the intervention of improved technologies viz., Cycle weeder and Fertilizer trolley reduce the drudgery, MSD & postural discomfort of the worker as compared to traditional method. Further both technologies proved excellence in pace of work, reduction in labour requirement and labour cost in comparison to traditional

method. Hence these technologies can be recommended for the farming community. Thus they proved to be appropriate technologies for the farming community

References

1. Anonymous, 2020 (www.wikipedia)
2. Hasalkar S, Budihal R, Shivalli R, Biradar N. Assessment of work load of weeding activity in crop p roduction through heart rate. *J. Hum. Ecol.* 2004;14(3):165-167.
3. James WPT, Anna FL, Waterlow JC, Definition of Chronic Energy Deficiency in Adults, *European J. Clin. Nutr* 1988; 42:969-981
4. Selvaraj KN. Impact of Improved Vegetable Farming Technology on Farmers' Livelihoods in India., Tamil Nadu Agricultural University Coimbatore, India & Agricultural Economics Research Institute (LEI) P.O. Box 29703 NL-2502 LS The Hague The Netherlands., 2006, 1-2.
5. Rajeshwari Desai, Geeta Chitagubbi, Shobha Kasar, Meghana Kelageri. Development and performance evaluation of motorized groundnut stripper., *The Pharma*

Innovation Journal 2020;9(12):108-113

6. Saha PN. Work physiology, paper presented in Advanced Training Course in Ergonomics an SNDT Women's University, Mumbai 1996.
7. Sharambir Kaur Bal, Shivani Sharma, Harpinder Kaur. Assessment of drudgery experience of rural women while performing different farm operations. Advance research journal of social science 2013;4(1):68-71.
8. Suma Hasalkar, Rajeshwari Desai. Prevalence of musculoskeletal disorders among farm women., Proceedings of Agriculture ergonomics development conference., IEA press, Kuala Lumpur, 2007, 250-255.
9. Tripathi PC, Shukla AK, Babu N, Krishna Srinath. Role of Women in Horticulture and women friendly technologies 2012, 23-25.
10. Varghese KA, Nisha V, Jaitawat PS. Impact of agro climatic regions on women's' participation in agriculture in Rajasthan. Indian J Agric. Econ 1999;54(3):314-315.