



Development and Evaluation of Ergonomically Suitable Manual Fodder Harvesting Scythe for Women

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ABSTRACT

Food is a necessity for every living thing, animals. Fodder cutting and removing it from the farms is a major activity in the farming process. This requires lots of efforts and it is a time-consuming process. There are various equipments available in the market for removing and cutting of fodder. There are many constraints like uneven height of cutting, higher cost of harvester for small-scale farmers, ergonomic shortcomings, etc. Due to these factors the feed harvesting is carried out by human labor in major parts of the country. The labour can develop Musculoskeletal Disorder (MSD's) due to incorrect posture, stress and continuous work. Ergonomics related to the design of methods and processes can help eliminate or decrease work related risks as well as improve the work quality and productivity. The developed women friendly manual fodder harvesting scythe evaluation conducted at Krishi Vigyan Kendra, Dediapada, Narmada Gujarat and nearby farmers field. It was used for harvesting Napier grass, Daincha green manuring crop which works satisfactory.

1. Introduction

There are variety of grass which serve the purpose of feeding animals. Every fodder grass has its importance in the diet of the livestock. Grass like Lucerne are a rich source in proteins while Maize, Elephant grass provide other nutrients. As per the Livestock inventory in India in 2019 India, the total number of cattle's are 192.49 million (Anonymous 2019). Thus, milk can be a good source of income to every farmer having certain number of cattle. There are many factors which affect milk productivity; fodder being a major factor. Fodder contributes in improving quality as well as quantity of milk. Therefore, the entire lifecycle of fodder grass/crop (sowing to harvesting) plays a vital role in obtaining good quality fodder.

In India, maximum farming operation is done on small and marginal holding size which poses a problem in using the mechanized equipments. However, manual harvesting techniques should also address the ergonomic aspect. Performing jobs in prolonged bending has resulted in numerous health effects such as chronic venous insufficiency, preterm birth and spontaneous abortion, and carotid atherosclerosis. (Fatellah *et. al.* 2008)

Lack of knowledge about ergonomics is observed in rural areas where work is carried out. The application of ergonomic principles would help to increase human performance and productivity, but mostly help human operator to be comfortable and secure. Ergonomics related to the design of methods and processes can help eliminate or decrease work related risks as well as improve the work quality and productivity. There is a need for implementation of gender friendly ergonomics intervention for harvesting (Thakur and Sharma,2000). The development of Ergonomically Suitable Manual Fodder Harvesting Scythe for Women at College of Agricultural Engineering and Technology Dediapada.

Present harvesting method

In presently harvesting technique cut the crop while bending. The waist is bent at 90°. This activity is continued for more than 8 hours. Cutting of crops requires force to be applied in this awkward posture.

- Repeated bending and cutting results in joint pain and back pain (problems in vertebrae) in due course of time.

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- The monotonous activity also results in mental fatigue and stress, which affects the working efficiency.

Development Ergonomically Manual Fodder Harvesting Scythe

India's economic and social strategy are Atmanirbhar Bharat Abhiyaan (self-reliant India movement) (ABA) and Be-Vocal-for-Local(Mukul and Soni, 2020) considering normally locally available material is used for blade as well as handle of harvesting tool . Harvesting blade and made of high carbon locally known as hard Patti and Teak Sag Wood handle is used. Scientific reference available, the material geometry of the blade for enhancing the durability, performance, reducing efforts and existing Vikalp blade geometry considering the refinement of blade dimensions done.

As per Pandey and Devnani (1998) the values of l_s/CS and l_f/CS ratio for serrated sickle should be 0.4 and 0.8 respectively. According the length of cutting surface and chord length were optimized as 312 and 280 mm respectively. Hence, the CS/CL ratio was obtained 1.11. The length of harvesting tool and diameter were optimized on the basis of anthropometric dimensions of women workers. As harvesting done with standing posture so 0.8 height (5th percentile) of the acromial height of female worker was considered for designing purpose (Gite *et.al.* ,2009). As per the data collected the 5th percentile value for of acromial height for female worker is 1168 mm. Distance of cutting crop considered 900 mm , from all this length of harvesting tool is obtained is 1300 mm.

The anthropometric and strength data of agricultural workers of region under ICAR Adhoc research project was used for optimizing the parameters. Handle

length was optimized based on hand breadth at thumb and hand length. The 95th percentile of hand breadth at thumb was 95 mm and 5th percentile hand length 153 mm (*Aware et. al.,2016*). 155 mm (*Yadav et al.2000*) The length of handle was kept as 160 mm

The handle diameter was optimized on the basis of middle finger to palm grip diameter grip diameter (inside). The 95th percentile middle finger to palm grip diameter was 31 mm and the 5th percentile grip diameter (inside) was 39 mm The handle diameter was kept as 32 mm.

Performance evaluation of Manual Fodder Harvesting Scythe for cutting hybrid Napier

Twenty female workers who were familiar of harvesting of Napier grass and paddy with sickle by are involved in study (here after we call as subject). The information about experiment was given to subject so as to ensure their co-operation. Heart rate values (in beats per minute) were recorded using Polar HR monitor (RS 300X). Each subject operated both the sickles and fodder harvesting scythe for 60 min. At the beginning and at the end of each experiment, the subjects were given 15 minutes for rest so that all the physiological parameters regained to their normal level. The average heart rate were for the further calculation and analysis. The overall discomfort rating (ODR) of the farm women were measured by using a 10-point Visual Analogue Scale (VAS). The scale having 0 to 10 digit marked from left to right on it (0-no discomfort, 10- extreme discomfort). At end of each experiment, farm woman verbally reported their painful regions and score from 0-10 point scale. The ODR given by each of the 20 farm women were averaged to get the mean rating. Field capacity was determine by actual harvesting area in one hour and considering time spent to regain to their normal level.

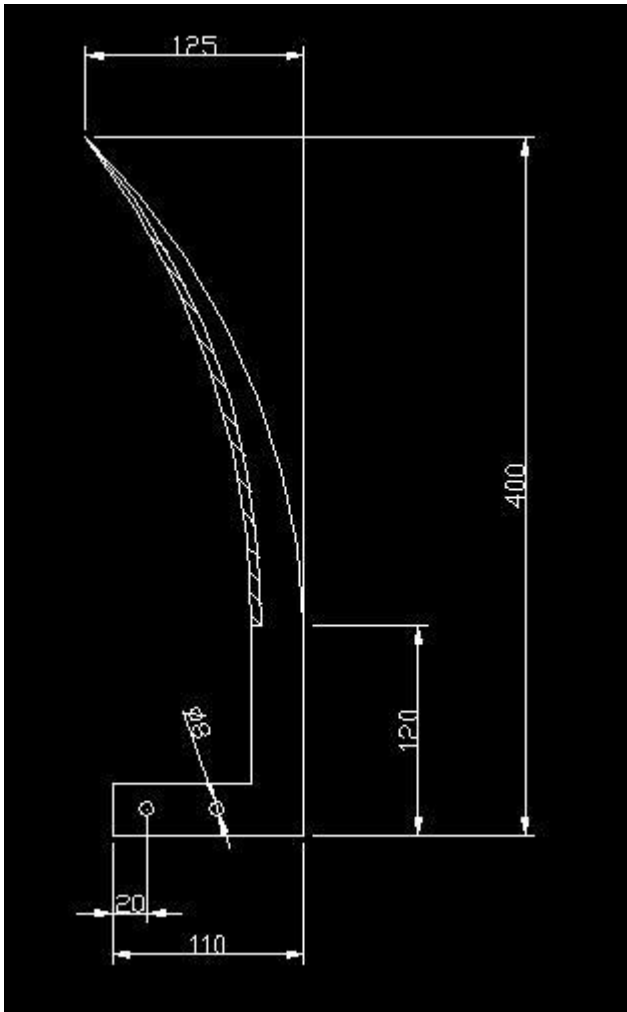


Fig 1 : Cutting blade



Fig:2 Auto Cad Drawing of Fodder Harvesting Scythe



Fig 3. Female worker harvesting Napier grass with improved manual harvesting scythe

Table 1. Comparative performance of improved manual harvesting scythe compare to sickle

SI. No.	Observation	Sickle	Manual Fodder Harvesting Scythe
1.	Capacity	100-125 m ² /h	100-160 m ² /h
2	Harvesting time body posture	Bending	standing
3	Chances of injuries	<i>Less but prolong bending posture fatigue and little chances of hand injuries</i>	Very less chances
4	Field capacity	0.011 ha/h	0.013 ha/h
5	Harvesting cost per ha	3409 Rs/ha	2885 Rs/ha

Table 2. Ergonomic parameter for the Manual Fodder Harvesting Scythe

SI. No.	Observation	Sickle	Mean \pm S. D.	Improves harvesting tool	Mean \pm S. D.
1	No. of subject	20		20	
2	Average age of subjects	32	33 \pm 8.27	32	33 \pm 8.27
3	Average weight, kg	43	43 \pm 6.32	43	43 \pm 6.32
4	Average resting heart rate, bpm	84	84 \pm 9	84	84 \pm 9
5	Average working Hr,bpm	128	128 \pm 14.6	120	120 \pm 13.2
6	Average work pulse, bpm	42	42 \pm 7.6	36	36 \pm 6.2
7	Overall Discomfort Rating	7.1	7.1 \pm 0.6	5.2	5.2 \pm 0.44

Comparative ergonomic evaluation of improved manual harvesting scythe with sickle were carried out to get rate of work (filed capacity) and heart rate work female workers The field capacity of improved harvesting tool was found to be 0.013 ha/h which was 18 percent higher than sickle (0.011 ha/h).

The developed Manual Fodder Harvesting Scythe used for harvesting Napier grass , Daincha green manuring crop , paddy it works satisfactory. During performance evaluation heart rate varies from 84 to 120 beats for continuously 60 minute harvesting. Energy expenditure rate varies from 5 to 12.5 kcal/min. It can save 18 percent harvesting time with compare to conventional sickle. Light in weight (1.8 kg) and ergonomically suitable and comfortable for female farmers. The farm worker is not familiar with harvesting of this scythe so promotion and working method will be describe by different extension organization.

2. Conclusion

The performance Manual Fodder Harvesting Scythe is better terms of field capacity and ergonomically aspect. The silent features of harvesting scythe is scientifically designed for female with considering anthropometry data of worker, work satisfactory so need to

promote in all parts of country so female worker and fodder grc benefited by it.

3. References

- Anonymous, Livestock inventory in India in 2019, accessed on 15 Jan, 2021 <https://www.statista.com/statistics/622709/livestock-inventory-by-type-india/>
- Aware V.V. , P.U. SHAHARE, N.A. SHIRSAT AND SEEMA V. AWARE, Modifications in serrated sickle for increasing field capacity and reducing drudgery Hind Agricultural Research and Training Institute, Agric. Update, 11(3) Aug., 2016 :313-317
- Fathallah, F.A.; Miller, B.J.; Miles, J.A. Low Back Disorders in Agriculture and the Role of Stooped Work: Scope, Potential Interventions, and Research Needs. J. Agric. Saf. Health 2008, 14, 221–245
- Gite L. P. , Majumdar, Mehta C. R. and Khandatkar A., Anthropometric and Strength Data of Agricultural Workers For Farm Equipment Design, 2009
- Khadatkar A., Potdar R R, Wakudkar H., Narwariya B.S. and Dubey U.C . Evaluation of Improved Sickle for Paddy Harvesting in Central India Indian Journal of Extension Education Vol. 54, No. 1, 2018 ,104-107

- Lefteris B. , Dimitrios T. and Dionysis B. A Review on Ergonomics in Agriculture. Part I:Manual Operations .Appl. Sci. 2020, 10, 1905; doi:10.3390/app10061905
- Mukul A. and Soni A., Modi government's two Strategic Ideas-Atmanirbhar Bharat Abhiyaan and Be-Vocal-for-Local, for post COVID era accessed on 26 Sep.2020 (<https://myind.net/Home/authorArchives/2541>)
- Pandey M. M. and Devnani R. S. (1988). Variation in design parameters of Plain and Serrated blade sickle in India *J. Agric Engg.,25(4):1-8*
- Thakur T. C. and Sharma P. Application of Ergonomically studies for Designing technologies for women farmers, Presented in National Conference “Role of Women in Agriculture”, GBPUAT, Pantnagar May 20000