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Introduction of Drudgery Reduction Tools among farmers of the Eastern part of Bihar State

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Abstract
Agriculture being an important occupation for the rural people in Bhagalpur district has potential for development. But it is involved with a lot of drudgery work. Drudgery is generally conceived as physical and mental strain, agony, monotony and hardship experienced by the human being while all of farm labourers in this regard suffer the most due to heavy burden of drudgery on them. So the need of the day is to empower the farm labours through technology to have high efficiency in their work output and reduce drudgery through labour friendly farm tools and implements. The drudgery prone condition leads to various health problems and mechanical hazards which create physical fatigue and low productivity. Hence there is a need that all the farm tools/equipments should have ergonomic design. Ergonomics is a science that works for easing the task of human being by equipment, knowledge and surroundings that will suit each worker. It helps the farmers/labours to solve the problems involved in performing various agricultural operations. Farmers/ farm women are not always aware of the improvements they could make by using scientific and technological knowledge. Farmers/Farm women are vulnerable as new and improved technologies are inaccessible for them. It is imperative that they are exposed to these technologies and encouraged and motivated to adopt the new technologies which would help them to improve their quality of life. Three hand tools namely, Bhindi Plucker, improved sickle and tubular Maize sheller were provided to farmers of three villages under Bhgalpur district of Bihar, for minimizing the drudgery involved and increasing the output. Bhindi plucker and improved sickle has improved their work efficiency by 40% and 23.6% respectively. While use of tubular maize sheller has improved the output, reducing time for maize shelling.

Keywords: Bhindi Plucker, improved sickle, tubular maize sheller, drudgery reduction

1. Introduction
The farm labours perform agricultural tasks with the age old traditional tools since labour friendly appropriate tools are either not available or are insufficient in number or unawareness. Unsafe, hazardous, unhealthy and long hours of work with age old traditional and cumbersome tools accelerate health related problems, especially among women farmers. Farmers/ farm women are not always aware of the improvements they could make by using scientific and technological knowledge. Farmers/Farm women are vulnerable as new and improved technologies are inaccessible for them. It is imperative that they are exposed to these technologies and encouraged and motivated to adopt the new technologies which would help them to improve their quality of life. Drudgery can be reduced by providing gender-friendly farm tools and equipment which increase the productivity of worker with safety and comfort. Time scheduling is also needed for achieving such task. Generally, this type of study includes the gender-perspective such as wearing, long hair, purda system, anthropometry, muscular strength, aerobic capacity etc. In fact, drudgery is termed for hard work, monotony, time

consuming, use of traditional tools with inappropriate working posture in field. So one way of reduction of drudgery can be through quantifying the particular field operation. For example, if work is being performed by a farm women with traditional tools in bending/ squatting posture, which was reduced by providing women friendly farm equipment. So the physiological workload of same work by both the methods can be evaluated and assessed based on output. To further add the work, a subjective scale can also be used for performance as well as their feedback. In combination to these, drudgery can be assessed in quantifiable term. Excessive physical strain has been associated with injury events in women. The farm women adopt bending postures and repetitive motion of body part for harvesting activity which increases the musculoskeletal problems, so they perform the activity in their own convenient postures without realizing the harmful effect on the body. Farm women have anatomical and physiological differences that may place them risk for farm injuries (*Engber, 1993*) [4]. The use of conventional tool and method for the work of harvesting add further to their drudgeries. When a person does any physical work, he/she use muscle power (energy and skeletal tissues) to do so. During the muscular activity one's physiological responses i.e. energy expenditure and heart rate increases. This increase in physiological responses is related to the type, intensity and duration of work and thus sets limits to the performances of heavy work. Therefore, measurement of effort and physiological responses are important for designing work method. Nag and Chatterjee (1981) [9] suggested that the work levels for 8 hr activities for men and women should not exceed beyond 35 and 28 per cent of one's aerobic capacity. Use of mechanically powered equipment in harvesting is limited. Since the use of human power is extensive in cultivation of crops, the accidents occur due to highest point of various factors viz. strain, fatigue and lack of safety aspect in the traditional equipment, interference of the labourers during the use of long slashing equipment, misuse of equipment, steep slopes, landslides etc. It is very necessary to ensure that workers are using the proper size tools for the task.

Most of the works performed by farm women are tedious, tiring as well as time-consuming. These tasks are performed manually or by traditional tools. Kirkhorn (2010) reported that workers in agricultural operations for both crop and animal production typically use repetitive motions in awkward positions and which can cause muscle injuries. Ergonomic risk factors are found in jobs requiring repetitive, forceful, or prolonged exertions of the hands; frequent or heavy lifting, pushing, pulling, or carrying of heavy objects; and prolonged awkward postures. Women are extensively involved in various farm operations like transplanting, weeding, harvesting, processing, marketing and selling of food grains, fruits and vegetables etc. These tasks not only demand considerable time and energy but also are sources of drudgery. Drudgery is generally conceived as physical and mental strain, agony, monotony and hardship experienced by farm women while performing these farm operations. The drudgery prone condition leads to various health and mechanical hazards which creates physical fatigue and low productivity. Bhindi picking is labor-intensive work that requires painstaking physical effort, patience and perseverance. Women usually use their hands resulting in physical and mental fatigue, hardship, exploitation and pain. Meyers *et al.* (1995) [8] stated that occupational musculoskeletal disorders (MSDs) might affect muscles, tendons, joints, nerves and related soft tissues anywhere in the body. The lower back and upper extremities, including the neck and shoulders, are the most common sites. Because repeated risk factor exposure of the same muscle or region may result in injury and inflammation to the affected area, names such as cumulative trauma disorder, repetitive motion injury, repetition strain injury, and occupational overuse syndrome have been applied to these disorders. Women workers faced severe health hazards in picking A. *esculentus (Bhindi)* (lady finger) in terms of cuts and wounds in hands, hardness of skin, blisters and abrasions. Moreover, skin allergies due to chemical sprays were commonly an acute problem to 30% of the A. *esculentus (Bhindi)*-pickers. They were using their own devised methods for protecting themselves against these hazards. Bhattacharya and Chakarbarti (2010) [2] reported high prevalence of musculoskeletal disorder among tea leaf pluckers. Shoulders, back, neck and fingers were the most affected organs. Musculoskeletal disorders were mostly related to the work habit i.e. awkward posture, repetitiveness and duration. Kaur and Sharma (2009) [6] studied that a survey was conducted by taking 200 farm women of Punjab State. The results showed regarding the level of work related body disorders in agriculture by women included pain in many parts of body followed by numbness or stiffness. Some farm women also felt itching and swelling in hands while working in the fields and some felt burning in abdomen and chest especially during spraying of pesticides in the fields due to inhalation. The reasons of pain or stiffness may be due to the poor body postures while performing certain farm operations and lack of awareness regarding the right body postures. Sometimes, they did not even take rest in between which is essential to make our body stress free. Harvesting is the operation of cutting, picking, plucking, digging or a combination of these operations for removing the crop from under the ground or removing the useful part or fruits from plant. Paddy/Wheat harvesting is performed manually only by the farmwomen. It is tedious and drudgery prone activity. Traditional Sickle made by local artisan is used for harvesting. Injuries due to sickle, skin irritation, scratches and punctures, rashes, insect bite, itching and sunburn were common problems faced by farm workers while performing harvesting of various crops. Quirina *et al.* (2008) [10] had reported the skin problems among farm workers in North Carolina, such as pimples, or acne, rash, including skin sunburn, itching and insect bite. They suggested to using the personal protective equipment and change in work practices. These were the reasons affecting work efficiency of farm workers. Harvesting is very tedious, monotonous and back breaking activity which is performed solely by farm women through small, traditional and iron made sickle due to which harvesting became the activity of full drudgery and energy intensive.

Maize means literally that which sustains life. It is, after wheat and rice, the most important cereal grain in the world, providing nutrients for humans and animals and serving as a basic raw material for the production of starch, oil and protein, alcoholic beverages, food sweeteners and, more recently, fuel. Though the maize shelling activity seems light, women feel it as a maximum drudgery prone activity because of its monotony in performance, continuous sitting and performing it for a longer period of time. Manual shelling is a time-consuming, slow and tedious operation. The traditional system for shelling maize is to press the thumbs on the grains in order to detach them from the cobs. This activity results in a lot of physical discomfort for the workers, resulting in

damaged fingers with cuts and bruises. Also, continuous sitting in a definite posture also has its woes. Most importantly shelling maize by hands also consumes a lot of time too. Moreover the movements of thumb and fingers are repetitive and arms remain static which worsens the situation. A constant repetition of movements imposes a cumulative work load which can cause pain and weakness and impaired function of the muscles and other soft tissues (Gangopadhyay *et al.*, 2007) [5]. Azogu (2009) [1] and D-Lab (2013) [3] reported that an estimated 550 million small-holder farmers in the world lack access to mechanized agricultural technology like industrial maize shellers due to the cost (ranging from US$1,200-1,800) thus leaving rural dwellers with the option of shelling of high quantity of maize manually by hand or use of sticks. Various researches on the body posture adopted by the women workers while performing agricultural operations reveal that poor body postures may lead to increase in physiological workload and musculo- skeletal problems, thus accentuating drudgery. Keeping this in view the present study was initiated where workers output, efficiency may be increased from present scenario meanwhile reducing drudgery reduction. To analyze various improved tools in view of output, and To analyze various improved tools in view of efficiency increment over existing method were the prime objective of present work.

2. Material and Method

Birnoudh, Barahari and Sitalpur villages of Bhagalpur district under Bihar State were selected purposively due to maximum persons dependent on agriculture and allied activities undergoing in these villages. Out of these three villages, a total of 60 farmers (20 farmers in each village) were selected for distribution of drudgery reduction tools among them, so that drudgery involved with agricultural activities may be reduced. The tools distributed among the farmers were Bhindi Plucker, Improved Sickle and Tubular Maizesheller. After the distribution of these drudgery reduction tools among the farmers, 10 labourers were selected for the study of output and efficiency increase in comparison to farmer's practices prevailing in the area. The results were analysed and average data were recorded, in all the cases.

3. Result

1. Bhindi Plucker

Bhindi has a rough posture. Due to this it causes injury to finger and palm. Improved Bhindi plucker helps to reduce time and labour. Cutting efficiency of bhindi plucker is about 3.75-4 kg/hr. The tool is ergonomically designed. The plucker (Fig.1 & 2) consists of cutting blade joined to one ring, to be worn by labour. The blade is made of medium carbon steel or low alloy steel, hardened and tempered to suitable hardness. Panicles are cut individually using this tool. The operator is spared of drudgery, discomfort and itching to skin of his hands, which are associated with conventional method of manual plucking without any aid. It fits in to the fingers properly with the help of its ring. Force to cut the pedicle is exerted by moving the blade on the pedicle. Pedicle is sheared by curved blade.

Fig 1: Bhindi Plucker/ Ring Cutter

Fig 2: Working with Bhindi Plucker

When interviewed with labours, it showed that with the help of this Bhindi plucker/ring cutter, heart rate and energy expenditure was reduced as compared to the traditional tool. It was also found that low efforts were required and thus it increased the work efficiently which improved the work output. Farmers, using conventional method of bhindi plucking were able to harvest 2.5-3 kg/hr of bhindi, while with the introduction of bhindi plucker the same farmer were able to harvest 3.75-4 kg/hr, increasing their work efficiency by about 40%.

2. Improved Sickle

It consists of special self sharpening teeth blade made of High Carbon steel and wooden handle. Cutting of crop stalk is being done with the improved (serrated) sickle by sawing action as against by impact or pulling action in case of local (plain) sickle. Due its less weight i.e. about 260 g the fatigue coming on wrist is less and the drudgery involved in harvesting is reduced as compared to local sickles which are heavier i.e. weighing about 350 g. The size of the sickle (Fig. 3 & 4) is 42 x 15 x 9 cm. It was found that with the use of this sickle, frequency of postural change and angle of deviation at cervical region was reduced in compared to prevailing technologies. It can be used for harvesting wheat, rice, soybean, chickpea, grasses and thin stalked crops. Serrated sickles does not require the sharpening of cutting edge frequently. It also provides safety to the workers due to its better construction. From interview with farm labours it was found that it saves their energy in comparison to traditional sickle. It was also found that low efforts were required and thus it increased the work efficiently which improved the work output. Initially, labourers were able to harvest 70-74 m^2 of area per hour, while with the use of improved sickle labourers were now able to harvest 88-90 m^2 of area per hour, increasing their work efficiency by about 23.6%.

Fig 3: Improved Sickle

Fig 4: Working with Improved sickle

3. Tubular Maize sheller

An Epoxy Powder Coated, easy to use, light weight tubular maize sheller (Fig. 5 & 6) was provided to farm labours for shelling of maize. This maize sheller is designed for separating the corns from the corn stick. The tubular maize sheller saved the time of maize shelling by 44 - 45%. The result of comparison between tubular maize sheller with the traditional method of maize shelling is given below in tabular form (Table 1).

Table 1: Comparison between Tubular Maize sheller with the traditional method

Particular	Traditional method	Tubular maize sheller
No. of workers required	1	1
Time spent to shell 100 cobs (min)	60-68	33-36
Output (kg/hr)	10-11	18-20
Labour required (man/hr/qt)	9-9.5	5-5.5
Cleaning efficiency (%)	93-95	100
Time saving		44-45%

Fig 5: Tubular Maize sheller

Fig 6: Working with Tubular Maize sheller

4. Conclusion

The introduction of three Drudgery Reduction Tools among farmers/labours of three selected villages under Bhagalpur district of Bihar state have improved their efficiency and reduced the drudgery involved with various agricultural operations. Bhindi plucker and improved sickle has improved their work efficiency by 40% and 23.6% respectively. While use of tubular maize sheller has improved the output, reducing time for maize shelling. Farmers also reported decrease in their drudgery due to these three tools, during crop cutting, maize shelling and bhindi plucking. Such type of tools may be distributed among the farming community for increasing their work efficiency, as well as reducing drudgery involved, on large basis throughout the state of Bihar.

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6. References

1. Azogu II. Promoting appropriate mechanization technologies for improved agricultural productivity in Nigeria: The Role of the National Centre for Agricultural Mechanization. Journal of Agricultural Engineering and Technology. 2009; 17(2):1-10.
2. Bhattacaharya N, Chakarbarti D. Occupational analysis of tea leaf plucking task in tea gardens of Assam. Proceedings of HWWE 2010 Chennai, 2010, 83.
3. D-Lab. Corn Sheller Background. Massachusetts Institute of Technology, 2013 http://creativecommons.org/licenses/by-nc/3.0/. Website visited on November 22, 2017.
4. Engberg L. Women and agricultural work, Occupational Medicine. 1993; 8:869-883.
5. Gangopadhyay S, Ghosh T, Das T, Ghoshal G, Das BB. Prevalence of upper limb musculoskeletal disorders among brass metal workers in West Bengal, India. Industrial Health 2007; 45:365-370.
6. Kaur H, Sharma S. Work related body disorders and health hazards faced by farm women of Punjab. Paper presented in International Ergonomic Conference 2009, Humanizing Work and Work Environment in University of Calcutta India, 2009, 17-19.
7. Kirkhorn SR, Earle-Richardson G, Banks RJ. Ergonomic Risks and Musculoskeletal Disorders in Production Agriculture: Recommendations for Effective Research to Practice. Journal of Agromedicine. 2010; 15:281-299.
8. Meyers J, Bloomberg L, Faucett J, Janowitz I, Miles JA. Using ergonomics in the prevention of musculoskeletal cumulative trauma injuries in agriculture: Learning from the mistakes of others. Journal of Agromedicine. 1995; 2:11-24.
9. Nag P Kumar, Chatterjee SK. Physiological reactions of female workers in Indian agricultural work. J of the Hum Factors and Ergons Society. 1981; 23(8):607-614.

10. Quirina M. MPH, Vallejo's and R. Mark. 2008. Self report of skin problems among farm workers in North, Carolina. Am J of Indus Med. 2011; 51(3):204-212. libres.uncg.edu/ir/listing.aspx 5 July