Original Research Article

A study on affordable homestead implements for stress reduction on body parts amongst farm workers of Khammam district

Abstract: The rural populations consisting of marginal and poor farmers are dependent on labourers for all farm related activities like sowing / planting of paddy, harvesting of agricultural and horticultural produce and application of pesticides which can be very costly. These labourers also face a lot of problems in sowing / planting of paddy as it has to be done by bending down continuously or during application of pesticides to cotton fields drift can be major health concern and harvesting different produce like bhendi due to its thorny spikes and capsaicin content of chilies. In view of this, KVK, Wyra, Khammam has assessed cost effective homestead implements and is relentlessly trying to popularize them. These included use of protective clothing during application of pesticides, rolling stem applicator for controlling sucking pest in cotton, knitted gloves for bhendi plucking and chilli finger guard for its plucking. These simple and cost-effective farm implements helped farm women in drudgery reduction, ergonomic stress on various body parts, improved work efficiency, decreased labour cost and body allergies. Protective clothing reduced itching, irritation, skin allergies, burning, vomiting, headache and faintness over a month's time, rolling stem applicator was ecofriendly and decreased the amount of chemicals, knitted gloves for bhendi plucking reduced the bruising and repeated damage to fingers during harvesting and chilli finger guard. The reduction in stress on body parts automatically improved the work efficiency among farm workers.

Keywords: Farm implements, improved work efficiency, ergonomics, fatigue, work related disorders, body stress

Comment [z1]: Its better if you replace withe this pharagraph b/c you missed some commas while you writte the paragraph . The rural populations, consisting of marginal and poor farmers, are dependent on laborers for all farm-related activities like sowing and planting of paddy, harvesting of agricultural and horticultural produce, and pesticide application, which can be very costly.

Comment [z2]: the way you organize the abstract is very interesting ,but still needs some modifications it contains some grammatical errors ,therefore try to modify it.

Introduction: Rural population living in India constitutes around 72.0% of the total population, constituting that include labourers, poor and marginal farmers (ICAR-DPR, 2012). India ranks second worldwide in farm outputs and as per 2018, agriculture employs 50.0% of work force contributing to 17-18% to India's GDP (The Financial Express, 2018). The women work force in agriculture and allied sectors is estimated to be around 91.0 million accounting to 37.0% of the total farm workers in India (Banthia, 2004; GOI, 2006; Anonymous, 2014).

Comment [z3]: it's nice but,try to replace with the following paragraph :
The rural population living in India constitutes around 72.0% of the total population, including labourers, poor and marginal farmers (ICAR-DPR, 2012). India ranks second worldwide in farm outputs and, as per 2018, agriculture employs 50.0% of the work force, contributing to 17-18% of India's GDP (The Financial Express, 2018). The total female work force in agriculture and allied sectors is estimated to be around 91.0 million, accounting for 37.0% of the total farm workers in India (Banthia, 2004; GOI, 2006; Anonymous, 2014).

Agriculture is considered to be the primary source of the supply of food worldwide as well as raw materials for industry and medicine. Considering the ever-burgeoning global population and its consequent demand for food, certainly agriculture constitutes the backbone of global economy (Wolfert *et al.*, 2017). To that end, agriculture production has experienced a relatively high diffusion of advanced technologies including information systems, automated machinery systems and even robotic systems that complement or substitute labour tasks (Bochtis *et al.*, 2014; Marinoudi *et al.*, 2019).

However, as an occupational environment in spite of these major technological advances, agriculture and its applied sectors are still regarded as one of the most demanding and hazardous segments (Chatta *et al.*, 2017). As a matter of fact, it is ranked second among occupational injuries, fatalities and illnesses. The multitude of health problems involve hearing loss, cancers, musculoskeletal disorders (MSDs) and pesticide caused respiratory illnesses. Among the non-fatal occupational illnesses occurring in farm workers, MSDs seem to be the most widespread. In particular, repetitive lifting and moving of heavy loads, prolonged trunk flexion (also called stooping), intensive hand work and working in awkward postures of wrist and trunk are tasks associated with the main risk factors regarding the reported MSDs. Remarkably, low back pain is recognized as the most prevalent musculoskeletal disorder that the agricultural workforce suffers from in both developed and developing countries. In fact, repetitive and sustained stooping is the primary risk factor for low back pain among agriculture workers (Chapman and Meyers 2001; Benos et al., 2020).

In India, women have traditionally been involved in labour intensive, time consuming and tedious jobs like sowing, transplantation, weeding, harvesting, threshing and post-harvest operations from times immemorial working 14 to 18 hours in a day (Srivastava, 1985). The traditional methods used by farm labourers causes drudgery leading to serious health issue such as back pain, knee pain and other work-related health hazards (Khadatkar, *et al.*, 2017). The minimal independent participation of women was observed in seed treatment and fertiliser application as technical aspects were involved. Less participation by women in

irrigation activities may be due to restrictions in movement outside the house during odd hours (Sidhu and Pannu, 2005; Sahoo and Klasen, 2018). Almost 45 percent women participate in family farm and animal work that are least remunerative activities (Sahoo and Klasen, 2018).

Scientific along with technological inputs and interventions in agriculture help to relieve farm women from the physical and mental strain (Patel *et al.*, 2015). Women in the hilly areas play a vital role in household, allied and agriculture activities. They are considered as the backbone of agriculture in hilly areas as in these areas agriculture is the only option of livelihood for women. Women in the mountain regions work longer hours and harder than men. They play a vital role in conservation and management of sustainable ecosystem (Pant *et al.*, 2020).

Women's participation rate in agricultural related sectors is about 47.0% in tea plantations, 46.84% in cotton cultivation, 45.43% growing oil seeds and 39.13% in vegetable production. While these crops require labour intensive work with the work being considered highly unskilled. Women are also heavily involved in ancillary agricultural activities like animal husbandry, fisheries, sericulture, poultry, duck rearing and so on (Centre for Trade and Development and Heinrich Boell Foundation., 2009).

Drudgery involves physical agony, mental strain, fatigue, monotony in work and extreme hardships experienced by humans. It also increases the stress levels on the body. Improved simple implements and tools developed, refined and evaluated based on feedback of the farm women can be helpful to them. The number of machines developed so far to increase efficiency, reduce drudgery and stress levels on body parts at lower cost are usually popular among male farmers (Mukherjee, 2014).

Rural women play a significant role in agriculture and other agro based activities like transplanting, weeding, harvesting, threshing and storage using traditional equipment for 9 to 10 hours and an average of 4 hours in household activities during which their bodies get tired and work efficiency reduces (Kumar and Raheman, 2008).

Gite and Singh (1997) found that during farm activities women tend to adopt unnatural body postures due to which their physiological workload increases and many types of muscular-skeletal problems can arise. The majority of Indian farmers have small land holdings and are unable to procure high-cost machinery for vegetable cultivation. The cheaper technologies beneficial over the traditional cultivation practices are the current need in farming (Bergamo and Romano, 2016).

Ergonomics is the scientific study of the relationship between person and his working environment that includes ambient conditions, tools, materials, methods of work and organization of work. The performance of person – implement system may be poor, if ergonomic aspects are not given adequate attention leading to clinical or anatomical disorders and affecting person's health. There is a need for proper attention to ergonomic aspects in design and operation to increase the person – implement system efficiency and also in safeguard person's health (Gite and Singh, 1997).

The scientific literature regarding prevention of musculoskeletal disorders (MSDs) and other occupational health risks in agriculture were mostly carried out in developed countries. There is a need to make research strategies that help to develop and analyze the new interventions for manual harvesting in least developing and newly industrialized countries (Jain *et al.*, 2017).

Comment [z4]: Please try to explore the gap in details

The main aim of this study was to assess stress levels on body, increasing the working efficiency among farm workers and reduce the cost of cultivation by introducing simple homestead implements in comparison to the traditional methods.

Note: the background of the study is to much bulky so try to concise it into the maximum one and half page

Materials and Methods: The ergonomic evaluation was carried out in farmers / farm women working in cotton, bhendi and chilli randomly in the age group of 25 – 45 years with no major health issues and normal physiological parameters between 2016 to 2020. The evaluations were carried out after the farm workers were demonstrated the use of these simple homestead implements and data consolidated. Each of the assessments were carried out 7 to 10 times.

The stress levels on various body parts were assessed using standard rating scale where 0 indicates no effect and 4 indicates severe discomfort on body parts (Corlette and Bishop, 1976).

Comment [z5]: the methodology of the study is not such much consistent so try to modify it inline with the scope.

Result and Discussion

Use of farm implements: The use of simple homestead implements can reduce the ergonomic stress on the body, help in improving work efficiency and decrease man hours in case of few of the implements. These homestead implements can be used by farm workers and are very effective as they are simple to use. Some of the implements

introduced to the farming community by Krishi Vigyan Kendra, Wyra, Khammam district are as given in Table 1. The actual and reduced stress levels on body parts along with adaptability and non-adaptability of homestead implements are given in Figures 1 and 2.

Table 1: **Efficiency of simple homestead implements**

S. No.	Name of farm implement	Cost of implement in Rs.	Reduction in stress levels (%)	Adaptability of implement (%)
1.	Protective clothing	650.00	78.0 ± 3.0	90.0 ± 2.0
2.	Rolling stem applicator	250.00	92.5 ± 2.5	95.0 ± 3.0
3.	Knitted gloves for bhendi plucking	60.00	85.0 ± 3.5	92.0 ± 3.5
4.	Chilli finger guard	40.00	48.0 ± 2.5	86.0 ± 4.0

Figure 1: **Actual and decreased stress levels on body part due to homestead implements**

Figure 2: **Adaptability and Non-adaptability of homestead implements**

Protective clothing: Protective clothing should consist of polyester and cotton blended fabric for a new one whereas a blended old shirt can be starched to close the pores in the fabric to prevent any chemicals coming in contact with skin. The stiffness of the fabric prevents the adherence of pesticides on the fabric and can be worn continuously for 1 – 2 hours. These were worn during spraying of pesticides to reduce the occupational hazards that include itching, irritation, skin allergies, burning, vomiting, headache and faintness. With the use of protective clothing the occupational health hazards (stress levels on the body)

decreased in one month by 78.0 ± 3.0%. As old full hands shirts were starched and used, the durability can be improved and was cost effective also (Jyoshna *et al.*, 2017).

The continuous use can reduce these incidences completely with field acceptability of 90.0 ± 2.0%. The cost of protective clothing is around Rs. 650/- (Table 1). It can be used repeated after washing as it is made of cotton, with stand regular wear and tear of repeated washing as demonstrated at Krishi Vigyan Kendra, Wyra.

Plate 1a: **Protective clothing**

Plate 1b: **Use of protective clothing during spraying**

Rolling stem applicator: The rolling stem applicator consisted of a 2.5 feet length pipe with 2.5 cm diameter, a foam holder with reusable sponge and weighing 250g. The light weight applicator is operated by dipping the sponge into prepared spray chemical fluid and can be applied to the base of the stem for about 15 to 20 plants at a time. This implement reduced the drudgery to minimum levels, the time required for applying chemical spray decreased by 45 to 50%, with no environmental pollution, negligible levels of pesticide inhalation during spraying, no drift loss and high level of impact on sucking pest which is a major problem in cotton. The amount spent on pesticides decreased by 55 to 66% for each application. The implement is very easy and comfortable to use as it is of desired length (Kumar *et al.*, 2019).

It costs around Rs. 250/- and each sponge change can be used for one season of cotton crop. After every season there is a need to change the sponge attached to the foam holder. The decrease in drudgery levels on back bone and hands is by 92.5 ± 2.5% and field acceptability is 95.0 ± 3.0 %.

Plate 2a: Use of rolling stem applicator in cotton field

Plate 2b: Rolling stem applicator

Knitted gloves for bhendi plucking: Women encounter lot of hazards during harvesting of bhendi crop with bare hands as they have thorny spikes that hurt hands due to cutting, bruising and repeated damage to fingers. The knitted gloves were designed in a manner that they can be easily worn at the time of harvesting bhendi and was absorbed the sweat from hands also. At a cost of Rs. 60 per pair, these gloves lasted the entire season of harvest. Farm women harvesting bhendi felt that these gloves protected their hands from dust, cuts, sores, allergies and other skin rashes (Jyoshna *et al*., 2017). The decrease in stress levels on fingers during plucking is by 85.0 ± 3.5% and field acceptability of 92.0 ± 3.5% (Table 1).

Plate 3a: **Bhendi plucking with bare hands** 3b: **Knitted gloves** Plate 3c: **Use of knitted gloves for bhendi plucking**

Chilli finger guard: Chilli is one the largest grown crops in Khammam district with 3 to 4 pickings during harvest period. The reduction in labour availability necessitated the use of simple finger guard to hasten the harvest time increasing the harvest output. The work output increased by 48.0 ± 2.5% due to decrease in stress on fingers during chilli picking which was higher than regular plucking with bare hands and field acceptability of this guard was 86.0 ± 4.0% as demonstrated at Krishi Vigyan Kendra, Wyra. The cost of each finger guard is Rs. 40/- (Table 1).

Plate 4: **Use of finger guard for chilli plucking**

Conclusion: Harvesting can be stressful to women as many of them are involved in it. The use of these simple implements not only improved the working conditions and harvest rate there by helping the farmers to reduce the cost of harvesting. The use of protective clothing reduced risk of occupational health hazards, rolling stem applicator for cotton decreased cost on chemicals, knitted gloves for bhendi plucking reduced bruising and repeated damage to fingers and chilli finger guard improved work out.

Comment [z6]: it's very interesting but it needs some modifications

References:

Anonymous., 2014. Research Highlights of All India Coordinated Research Project on Ergonomics and Safety in Agriculture, 2012-14. Technical Bulletin No. CIAE/2014/176. Pp.: 9 – 12

Banthia, J.K., 2004. Census of India 2001 – Primary Census Abstracts. Registrar General and Census Commissioner, Govt. of India. Pp.: 12 – 14.

Bergamo, R.L., Romano, L.N., 2016. Agricultural machinery and implements design process: Guidelines for small and mid-sized businesses. *Engenharia Agrícola*. 36(1), 206-216.

Benos, L, Tsaopoulos, D., Bochitis, D., 2020 A Review on Ergonomics in Agriculture. Part I: Manual Operations. *Applied Science*. 10 (1905), 1 – 21.

Bochtis, D.D., Sorensen, C.G.C., Busato, P., 2014. Advances in agricultural machinery management: A review. *Biosystems Engineering*. 126, 69 – 81.

Centre for Trade and Development and Heinrich Boell Foundation., 2009. "EU FTA and the Likely Impact on Indian Women Executive Summary."

Chapman, L., Meyers, J., 2001. Ergonomics and Musculoskeletal Injuries in Agriculture: Recognizing and Preventing the Industry's Most Widespread Health and Safety Problem. NASD Pp.: 1 – 13.

Chatta, H., Corscadden, K., Zaman, Q. U., 2017. Hazard Identification and Risk Assessment for Improving Farm Safety on Canadian Farms. *Journal of Agricultural Safety and Health*. 23(3), 155 – 174. DOI: 10.13031/jash.11959

Corlett, E.N., Bishop, R.P., 1976. A technique for assessing postural discomfort. *Ergonomics*. 19 (2), 175-182.

Dash, H.K., 2016. Understanding Gender Perspective in Agricultural Research and Development. Compendium - ICAR short course – Empowering farm women through livestock and poultry intervention. 21st – 30th November, 2016. Pp.: 23 – 28.

Gite, L.P., Singh, G., 1997. Ergonomics in agricultural and allied activities in India. Technical bulletin, ICAR – Central Institute of Agricultural Engineering, Bhopal, India, Pp.: 1 – 5.

GOI., 2006. Population projections for India and States 2001-2006, Report of the technical group on population projections constituted by the National Commission on Population, Govt. of India, New Delhi. "India economic survey 2018: Farmers gain as agriculture mechanisation speeds up, but more R&D needed". The Financial Express. 29 January 2018. Retrieved 8 January 2019.

ICAR-Directorate of Poultry Research., 2012. Vision 2050. http://www.pdonpoultry.org/pdpnew/i mages/extfiles/reports/vision_2050.pdf

Jyoshna, E., Kumar, J.H., Reddy, P.R., Kumar, N.K., 2017. Effect of protective clothing utilization during sprayings of pesticides and fertilizers in Khammam district, Telangana state. *International Journal of Agricultural Science and Research*. 7(5), 97-102.

Jyoshna, E., Kumar, J.H., Kumar, N.K., Reddy, P.R., 2017. Abstract presented at National conference on "Technological Challenges in social, environmental and agricultural reforms (TECHSEAR – 2017), September 9-10, 2017.

Jain, R., Meena, M. L., Dangayach, G. S., 2017. Ergonomic intervention for manual harvesting in agriculture: A review. Ergonomics in Caring for People (Proceedings of International Conference on Humanizing work and work environment, 2015 – Ray, G. G., Iqbal, R., Ganguli, A. K., Khanzode, V. – eds). Springer, Mumabi, India. Pp.: 183 – 191.

Khadatkar, A., Potdar, R. R., Shrinivasa, D. J., 2017. Drudgery reducing harvesting tools and equipment used by Indian farm women. *Innovative Farming*. 2(4), 212-214.

Kumar, G.P., Raheman, H., 2008. Vegetable transplanters for use in developing countries - A review. *International Journal of Vegetable Science*. 14(3), 232-255.

Kumar, K. R., Kumar, J. H., Srinivas, D. and Reddy, P. R., 2019. Rolling stem applicator – An eco-friendly, low cost, input saving and drudgery reducing tool for managing sucking pests of cotton. *Journal of Krishi Vigyan*. 7(2), 217-221.

Marinoudi, V., Sorensen, C.G., Pearson, S., Bochtis, D., 2019. Robotics and labour in agriculture. A context consideration. Biosystems Engineering 184, 111 – 121.

Mukherjee, S., 2014. The 'invisible' worker: Women and work in the informal economy. ZENITH International Journal of Multi-Disciplinary Research 4(9): 24-43.

Pant, K., Kwatra, J., Kwatra, S., 2020. Time utilization pattern and factor of drudgery and its impact on hill woman. *The Pharma Innovation Journal*. 9(12), 170-173.

Patel, H.S., Kher, A.O., Bariya, M.K. 2015. Use of improved sickle for drudgery reduction in farmwomen of Gir-Somnath district of Gujarat. *Journal of Krishi Vigyan*. 3, 109-112.

Sahoo, S., Klasen, S., 2018. Gender Segregation in Education and Its Implications for Labour Market Outcomes: Evidence from India (IZA DP No. 11660). Discussion paper, IZA – Institute of Labor Economics, Bonn. Pp.: 18 – 20.

Sidhu, K., Pannu, K. 2005. Women participation in farming under varying landholdings. *Asian Journal of Dairy and Food Research*. 24, 216 – 220.

Srivastava, J.E. 1985. Harnessing technology for improving the quality of life of rural women. Women and Technology. (Jain, S.C. ed.). Rawat Publications: Jaipur. Pp. 38 – 74.

Wolfert, S., Ge, L., Verdouw, C., Bogaardt, M.J., 2017. Big Data in Smart Farming—A review. *Agricultural System*. 153, 69 – 80.

Comment [z7]: Please check it if any missed reference