

Importance of Ergonomics in Agriculture: A Farmer-Centric Approach

Anusha S¹, Sunil Shirwal², Bhagyashree¹, Raviraj J¹ and Murali M³

¹MTech Scholar, Department of Farm Machinery and Power Engineering, CAE, UAS, Raichur - 583131

²Associate Professor, Department of Farm Machinery and Power Engineering, CAE, UAS, Raichur - 583131

³Assistant Professor, Department of Farm Machinery and Power Engineering, CAE, UAS, Raichur - 583131

Corresponding Author: anushashiratti@gmail.com

Abstract

Agriculture remains a physically demanding occupation, exposing farmers to a high risk of musculoskeletal disorders, fatigue, and injury due to repetitive tasks, awkward postures, and poorly designed tools. Despite advancements in technology, ergonomic considerations in agricultural practices especially among small and marginal farmers are often overlooked. This article emphasizes the importance of integrating ergonomics into agriculture with a farmer-centric approach, focusing on designing tools, work environments, and techniques that align with the physical capabilities and needs of farmers, including women and elderly workers. By promoting ergonomic awareness, customized tool design, and farmer education, this approach aims to improve productivity, reduce health risks, and enhance the overall well-being and dignity of farmers. A sustainable future in agriculture must prioritize not only productivity but also the safety and comfort of those who cultivate our land.

Introduction

Agriculture forms the backbone of food production and rural economies across the globe. But behind the beauty of green fields lies a physically demanding and often hazardous reality for those who work the land. From sunrise to sunset, farmers engage in repetitive, labour-intensive tasks bending, lifting, cutting, and carrying that can take a serious toll on the body.

While technological progress has brought tractors, harvesters, and irrigation systems to many farms, one critical component remains underutilized: ergonomics. A farmer-centric ergonomic approach can dramatically improve the safety, health, and productivity of agricultural workers—especially in small-scale and developing country contexts. Ergonomics in agriculture focuses on designing tools, tasks, and environments that fit the physical and cognitive capabilities of farmers. Given the physically demanding nature of agricultural work, a farmer-centric approach to ergonomics aims to reduce fatigue, injuries, and long-term health issues. By adapting equipment and practices to farmers' needs considering their age, gender, and body dimensions this approach enhances productivity, safety, and overall well-being in the farming community.

Ergonomics

Ergonomics is the science of designing tools, machines, and work environments to fit the people who use them. In simple words, it's about making work easier, safer, and more comfortable. When applied to agriculture, ergonomics focuses on reducing the physical strain on farmers, improving their posture, and preventing long-term injuries caused by repetitive or awkward movements.

Ergonomics in Agriculture

Ergonomics is the science of designing tools, tasks, and environments to fit human abilities and limitations. In agriculture, this means tailoring farm tools, machinery, workstations, and practices to reduce physical strain and injury risks for farmers. Ergonomics doesn't just make work easier to makes it **smarter, safer, and more sustainable**.

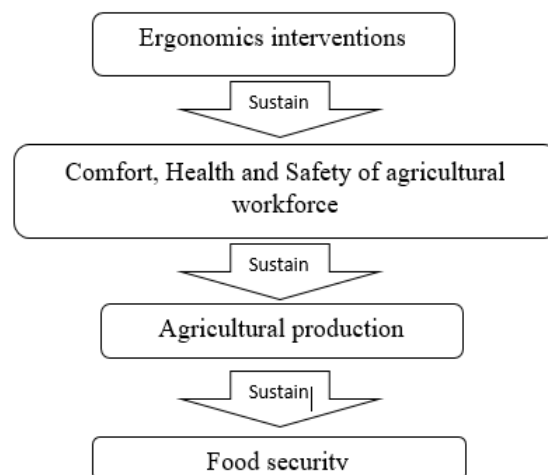


Fig.1. Conceptual model of ergonomics for food security
Need of Ergonomics in Agriculture

Agricultural work is often ranked among the most physically demanding jobs. Tasks like planting, weeding, harvesting, and spraying pesticides involve: shown in the Fig. 2.

- Repetitive motions
- Heavy lifting
- Poor posture
- Prolonged standing or squatting
- Exposure to harsh weather condition

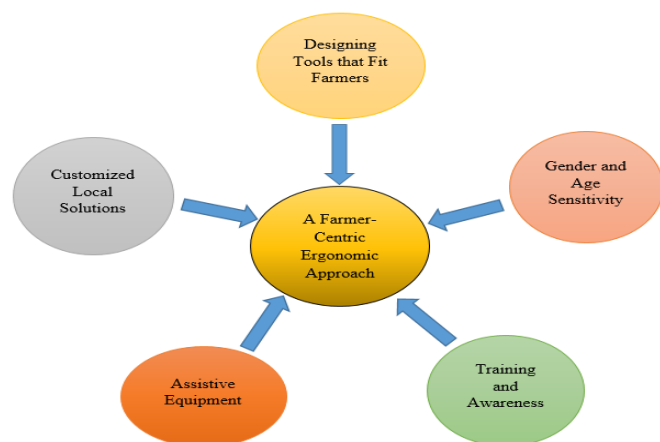


Fig.2. Different working postures during agricultural activities which leads to musculoskeletal disorders

These factors frequently result in musculoskeletal disorders (MSDs), chronic back pain, joint issues, and fatigue. Women and elderly farmers, in particular, face higher risks, often using tools designed for taller or stronger male users. As farming communities continue to age and labor shortages increase, ergonomic interventions are not optional they are essential.

A Farmer-Centric Ergonomic Approach

A farmer-centric approach means placing the needs, comfort, and safety of farmers at the center of agricultural design given below:



1. Designing Tools that Fit Farmers

Designing agricultural tools that truly fit farmers means creating equipment tailored to their physical, ergonomic, and practical needs. Farmers, especially women in rural areas, often use traditional tools that are not designed with human comfort or efficiency in mind. This mismatch leads to fatigue, low productivity, and long-term health problems like back and joint pain. By applying ergonomic principles—such as adjusting tool size, weight, and handle design to fit the user's body—we can significantly improve comfort, reduce strain, and increase work output.

2. Gender and Age Sensitivity

Gender and age sensitivity in agricultural ergonomics ensures tools and tasks are suited to the physical

needs of all farmers. Women often face challenges with equipment designed for average male body sizes, leading to fatigue and injury. Similarly, elderly farmers experience reduced strength and mobility, increasing their risk during labour-intensive work. Designing ergonomically appropriate tools that consider these differences improves safety, comfort, and productivity, making agriculture more inclusive and sustainable.

3. Training and Awareness

Training and awareness play a vital role in promoting ergonomic practices in agriculture. Many farmers are unaware of the risks associated with poor posture, improper tool use, and repetitive tasks. Educating them about safe work techniques, proper tool handling, and the importance of rest can significantly reduce injuries and enhance productivity. Awareness programs, workshops, and demonstrations help farmers recognize early signs of strain and adopt preventive measures. By building ergonomic awareness at the grassroots level, farming communities can work more safely, efficiently and sustainably.

4. Assistive Equipment

Assistive equipment in agriculture includes tools and devices designed to reduce physical strain and improve safety and efficiency. Examples are ergonomic tools, mechanized weeders, and load-carrying aids that help minimize injuries and fatigue. These are especially beneficial for women, elderly, and differently-abled farmers, making farming tasks easier, safer, and more inclusive.

5. Customized Local Solutions

Customized local solutions involve designing agricultural tools, equipment, and practices that are specifically tailored to the local environment, crop types, farming methods, and the physical characteristics of local farmers. These solutions consider regional needs, such as soil type, climate, and available resources, while also accommodating variations in farmers' body sizes, strength, and working habits. By using locally available materials and involving farmers in the design process, these solutions become more cost-effective, acceptable, and sustainable. Customized approaches ensure that ergonomic interventions are practical, user-friendly, and directly beneficial to the community they serve. This includes using regional anthropometric data for tool design.

Benefits of Ergonomics in Farming

- ✓ Reduces fatigue and risk of injuries
- ✓ Increases work efficiency and output
- ✓ Enhances comfort and confidence of farmers
- ✓ Encourages participation of women and elderly

✓ Lowers healthcare costs and improves quality of life of farmers

Case Study

The study titled “Ergonomic Study of Farm Women During Wheat Harvesting by Improved Sickle” by Alka Singh, (2014) examined the impact of using a serrated sickle on the efficiency and physical strain of farm women during wheat harvesting in Madhya Pradesh. Involving 20 women aged 25–45, the study compared the traditional local sickle with an ergonomically designed serrated sickle. Results showed that the serrated sickle increased harvesting efficiency by 19.5%, reduced cardiac cost by 19%, and allowed women to work without prolonged squatting or bending, thus minimizing physical discomfort. The study concluded that the serrated sickle is a women-friendly tool that enhances productivity, reduces drudgery, and supports health and empowerment of rural women in agriculture.



Fig.3. (Harvesting with serrated sickle)



Fig.4. (Harvesting with local sickle)

Comparison with method of harvesting showed in the fig.3 and fig.4 that Serrated Sickle was easy in operation, no squatting and bending position relaxed women against Back pain with increased work force.

Why Ergonomics in Agriculture Matters

Farming is tough on the body. Over 65% of Indian farmers suffer from back, knee, or joint pain due to repetitive work and awkward postures (ICMR). Among women farmers, the impact is even higher nearly 80% report back pain, and 61% struggle with knee issues (IJOS&E, 2020).

Farmers often work 8–12 hours a day, lifting up to 40 kg, which can lead to long-term injuries. Poorly designed tools reduce efficiency and increase fatigue, causing up to 30% productivity loss (NIOH). However, ergonomic tools can make a difference: Fatigue drops by 25–35%, Productivity rises by 20–30%, Injuries fall by 30–40%, Energy use reduces by 20–45% (ICAR-CIAE). With over 70% of rural women in agriculture, and 36% of farmers over age 50, ergonomics must focus on gender- and age-friendly design.

Conclusion: A Safer, Smarter Future for Farmers

Farmers deserve more than praise they deserve practical support. By embracing ergonomics with a farmer-first mind set, we can create safer, healthier, and more dignified working conditions in agriculture. This is not just about comfort; it's about protecting the very people who feed the world. It's time to shift the focus from just increasing yields to improving the well-being of those who grow them. It also increases efficiency of farmers across different operations such as ploughing, sowing, weeding, harvesting, and post-harvest handling. By applying ergonomic principles, the physical strain, musculoskeletal disorders, and fatigue commonly faced by farm workers can be significantly reduced. Ergonomics also play vital role in tractor design system also by proper seat design, adjustable controls, low vibration, noise reduction, and good visibility not only enhance operator efficiency but also minimize health risks like back pain and stress injuries.

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