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Ergonomic Hazards in Agricultural Work Environment

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Agriculture is a highly labor-intensive occupation where farm workers are exposed to multiple occupational health hazards. Physiological risks such as fatigue, musculoskeletal pain, and heat or cold stress are common due to long working hours, repetitive motions, and awkward postures. Mechanical hazards from tools and machinery often cause injuries, noise-induced hearing loss, and accidents. Chemical exposure during plant protection activities leads to respiratory illness, skin allergies, and eye problems, while environmental hazards like dust, poisonous bites, and sunburn further worsen health outcomes. The Mean Percent Score (MPS) reveals higher prevalence of physiological hazards, particularly among women, and significant risks from weeding, sowing, and threshing. Addressing these hazards through ergonomic interventions, safer tools, and improved work practices is essential to protect worker health and enhance agricultural productivity.

Introduction

Farmers form the backbone of our food systems, yet their work often comes at a severe cost to their health and safety. Agricultural tasks such as lifting heavy loads, bending for long hours, operating vibrating machinery, and repeating the same motions expose them to serious ergonomic hazards that increase the risk of musculoskeletal disorders and injuries. In India, agriculture is among the most hazardous sectors, with an estimated 334 incidents and 18.3 deaths per 100,000 workers annually, amounting to nearly 760,000 accidents and 45,000 deaths each year. Farm machinery remains the leading cause of such accidents, contributing to 30–77% of cases, with tractor-related incidents accounting for about 30–40% and threshing machines contributing nearly 15- 20% of reported cases followed by hand tools 10-65% and other risks such as snake bites, drowning, and lightning strikes. These alarming statistics underscore how unsafe machinery operation and poor ergonomics not only endanger farmers' lives but also inflict substantial economic losses on India's agricultural sector, demanding urgent interventions in safety training, mechanization practices, and ergonomic design.

What are ergonomic hazards?

Ergonomic hazards arise when there is a mismatch between the work, the tools, and the worker's body mechanics. These hazards are not always obvious, but they quietly cause damage over time, especially when multiple risk factors overlap. They include:

- **Awkward or Static Postures**- bending, twisting, kneeling or holding one position for too long.
- **Repetitive Motions** – tasks like weeding, picking, or packing that strain muscles and joints.

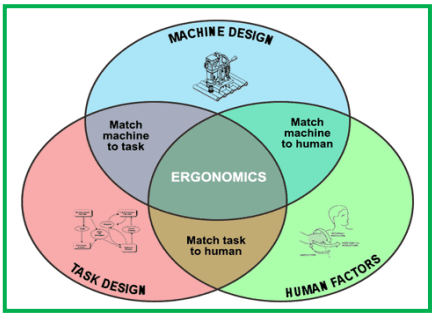

Fig. 1. Ergonomics (safety and work environment)

- **High Forces** lifting, pushing, or pulling loads beyond the body safe capacity.
- **Contact Stress & Vibration** - pressure on body parts from tools or surfaces, and prolonged exposure to machinery vibrations.

These hazards affect key body regions lower back, neck, shoulders, wrists, knees, and legs. The resulting injuries, often classified as Musculoskeletal Disorders (MSDs), Cumulative Trauma Disorders (CTDs), or Repetitive Strain Injuries (RSIs), account for nearly one-third of all non-fatal occupational injuries worldwide.

Why Agriculture Carries Higher Ergonomic Risks

Unlike office or industrial settings, agricultural work combines unpredictable environmental factors, manual handling, and long working hours. Farm workers often bend, squat, and reach overhead to harvest crops, lift and carry heavy sacks, and work with tools or ladders in awkward positions. In pack houses, they may stand for hours at sorting and packing lines, performing repetitive tasks without adequate rest. Poorly designed tools, lack of training, and absence of proper ergonomic interventions further amplify these risks. Over time, these exposures can lead to chronic pain, swelling, reduced mobility, nerve damage, and in severe cases, disability.

(a)Bending posture

(b)Squatting posture

(c) Lifting & Carrying Postures

Fig. 2. Different postures of agricultural farm workers

Consequences of Poor Ergonomics

For farm workers, the effects of poor ergonomics are not just physical. Persistent pain and injuries reduce work capacity, productivity, and quality of life. In agricultural communities, where access to healthcare is often limited, untreated MSDs can force workers to leave their jobs prematurely, impacting both livelihoods and food production. Agricultural work, especially manual tasks, exposes workers to several risk factors that strain the body. The review on ergonomics in agriculture highlights the following major causes:

Causes of Occupational Hazards

The main causes of these hazards include:

- Long working hours (78%)
- Repetitive motions (81%)
- Forceful exertions (68%)
- Prolonged bending postures (93% during weeding)

The need for ergonomic solutions

Recognizing and addressing ergonomic hazards in agriculture is essential to protecting farmer health and ensuring sustainable farming practices. This article explores the causes of ergonomic hazards, who is at risk, and effective measures to prevent them, drawing from both research evidence and real-world examples. By understanding these risks, we can work toward safer farming environments because healthy farmers mean healthy harvests.

Occupational health hazards among agricultural workers and causes identified

Physiological Hazards

- Agricultural workers frequently encounter physiological hazards due to long working hours, repetitive tasks, awkward postures, and exposure to extreme weather.

- The study revealed that fatigue and musculoskeletal problems were the most common issues, with almost all respondents reporting body pain, particularly in the lower back, hips, and knees. Around 80–85% of workers reported very severe to severe back pain while performing agricultural activities such as sowing, weeding, and harvesting.
- Prolonged exposure to heat during summer caused problems like headaches, nausea, fainting, and fatigue in nearly 80% of the workers, while irrigation in winter exposed them to cold stress, leading to fever and discomfort.
- Both men and women reported high prevalence of physiological hazards, with nearly 65% of women and 58–60% of men experiencing them during sowing, harvesting, and threshing activities.

Mechanical Hazards

- The use of agricultural tools and machinery was found to be one of the leading causes of injury and accidents among farm workers. Injuries to fingers and hands were particularly common during weeding, where 93% of female and 83% of male workers reported such hazards.
- Threshing activities also led to mechanical injuries, affecting about 47% of men and 33% of women. In addition, exposure to the loud noise of threshers caused temporary hearing loss in 33% of men and 23% of women.
- Other mechanical hazards included accidents such as slipping or falling from tractors, threshers, and harvesters, which led to cuts, burns, fractures, and in some cases, fatalities. Approximately 30% of men and 17% of women reported such incidents.

Chemical Hazards

- Chemical hazards were mainly due to exposure to pesticides and other agrochemicals, particularly during plant protection activities. Since men were more directly involved in spraying operations, they were more prone to these risks, while only about one-fourth of female workers reported similar exposure.
- The survey showed that 80% of male workers experienced respiratory problems due to pesticide inhalation, 73% suffered skin problems, 50% reported eye irritation, and 33% experienced dizziness or giddiness.
- These hazards were influenced by the type of crop cultivated, the chemicals used, method of application, climatic conditions, and individual susceptibility. Lack of proper protective equipment further aggravated the risks.

Environmental Hazards

- Agricultural workers are also exposed to a variety of environmental hazards such as poisonous bites, insect stings, harsh climatic conditions, and dust.
- Fatal snakebites and insect stings were reported in farming fields, while sunburn and allergies were common during outdoor activities. Grain dust and suspended particles caused respiratory irritation, throat congestion, and chest problems in about 67% of male and 57% of female workers.
- Dry hay and grain dust also led to skin allergies, reported by 47% of males and 60% of females, particularly during wheat harvesting. Eye problems such as irritation and watering were observed in 23% of males and 33% of females.
- Overall, environmental hazards were found to be more prevalent among women than men, except during plant protection activities.

Table 1. Mean percent score (MPS) of hazards in agricultural work

The Mean Percent Score (MPS) of hazards in agricultural work reflects the average percentage of workers reporting specific health risks across different activities.

S. No	Agricultural activity	Mean percent score of hazards							
		Physiological		Mechanical		Chemical		Environmental	
		m	f	m	f	m	f	m	f
1.	Land preparation	35	43	17	18	25	20	27	40

2.	Sowing	58	66	26	25	35	27	14	24
3.	Weeding	44	64	83	93	17	23	32	59
4.	Plant protection	62	16	17	17	54	21	59	34
5.	Irrigation	44	50	50	35	17	18	28	34
6.	Harvesting	60	67	17	20			14	20
7.	Threshing crop	58	64	27	17			37	42
M = Male (N=60); F = Female (N=60)									

Vyas et al. (2016)

Causes of ergonomic hazards in agriculture

1. Awkward postures

Many farming activities-such as hand-picking crops, pruning, or using ladders to harvest fruits require workers to bend, twist, kneel, or reach overhead for long periods. These unnatural positions place excessive stress on the lower back, neck, and shoulders, leading to pain and long-term injuries.

2. Repetitive movements

Tasks like weeding, trimming, and fruit picking involve repeating the same motions thousands of times in a season. This repetition, especially when combined with awkward posture, leads to muscle fatigue, tendon strain, and conditions such as carpal tunnel syndrome or tendonitis.

3. Prolonged kneeling and squatting

In operations like planting or harvesting low-growing crops, workers often stay in kneeling or squatting positions for hours. This continuous pressure on the knees can cause discomfort, swelling, and even joint degeneration over time. Studies show that female workers, who perform much of this work, are particularly at risk.

4. High physical loads

Farmers frequently carry heavy sacks, buckets, or tools, often in awkward positions. Lifting and transporting these loads without proper support strains the back, shoulders, and joints, increasing the risk of injury, especially when combined with twisting or bending.

5. Poorly designed tools

Traditional tools, while inexpensive, are often not ergonomically designed. They force workers to use awkward grips, excessive force, or uncomfortable postures. Research shows that replacing such tools with ergonomically improved versions-for example, long-handled weeders or waist-mounted harvest bags-significantly reduces discomfort and effort.

6. Personal and environmental factors

The risk of injury is higher for older workers, those with higher body weight, or those exposed to chemical stressors like pesticides. Environmental conditions such as uneven terrain or extreme weather can also increase ergonomic strain.(Benos *et al*. 2020)

Prevention strategies: Simple ergonomic fixes that work

Drawing on a decade of research, the review highlights several practical interventions that reduce the strain of manual agricultural work and help prevent musculoskeletal disorders (MSDs):

1. Use ergonomically designed tools

- Swap traditional harvest tools (like tied baskets or basic taps) with long-handled hoes, ergonomic bags, or waist-mounted carriers. These tools help maintain better posture and reduce bending, stooping, and forceful grips.
- Smaller tubs (for tasks like grape harvesting) also minimize stooping and repetitive lifting. These adjustments significantly ease stress on the back, shoulders, and arms.

2. Adjust work techniques and practices

- Introduce extended-handle implements for weeding and trimming to reduce trunk flexion.

- Encourage workers to alternate between bending and standing, and to avoid long periods in awkward positions small movement shifts can reduce cumulative muscle fatigue.
- Emphasize task rotation to avoid repetitive stress on the same muscle groups.

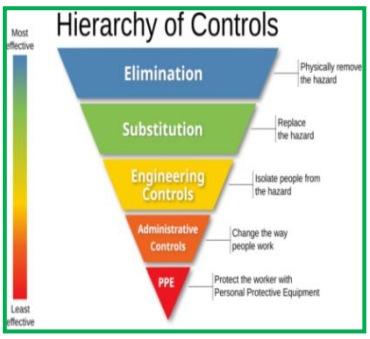

Fig. 3. Hierarchy of controls

3. **Built-in rest breaks**

- Include frequent rest intervals, especially during tasks like stooped harvesting or prolonged weeding, to give muscles and joints time to recover.
- Even short pauses can significantly lower fatigue and discomfort over a workday.

4. **Workstation and layout redesign**

- Make sure frequently used items and tools are within the "power zone"—i.e., between waist and shoulder height—to avoid excessive reaching or bending.
- For packing or sorting tasks, provide adjustable-height benches or stools so workers can alternate between standing and sitting to reduce static posture strain.

5. **Participatory ergonomics**

- Involve farm workers directly in designing solutions—their daily experience provides critical insight into what will work in practice. When workers help choose and test tools and workflows, adoption and compliance improve.

6. **Training and tool maintenance**

- Combine ergonomic changes with interactive training: show correct posture, proper tool use, safe lifting techniques, and the rationale behind interventions.
- Maintain tools regularly so handles remain smooth, grips don't slip, and equipment doesn't require excessive force to use.

Conclusion

Agricultural work exposes farm workers to a wide range of occupational health hazards, including physiological strain, mechanical injuries, chemical exposure, and environmental risks. The findings highlight that repetitive motions, awkward postures, extreme climatic conditions, and unsafe use of tools and machinery are the major causes of musculoskeletal disorders, respiratory problems, skin allergies, hearing loss, and fatigue. Women workers were found to be more vulnerable to physiological and environmental hazards, while men faced greater risks from mechanical and chemical exposures. These hazards not only reduce work efficiency but also impact the quality of life and long-term health of farming communities. Therefore, the adoption of ergonomic interventions, use of protective equipment, safe work practices, and worker training is essential to minimize risks, improve safety, and ensure sustainable productivity in agriculture.

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