

Composite Benefits of Yogic Asanas in Alleviating Musculoskeletal Ailments in Agricultural Laborers

Mukesh Kumar Pathak^{*1} and Yogesh Kumar Agarwal²

^{*1}Department of Yoga, Maharaja Agrasen Himalayan Garhwal University, Pokhra, Uttarakhand-246169

²Faculty of Agriculture, Maharaja Agrasen Himalayan Garhwal University, Pokhra, Uttarakhand-246169

*Corresponding E- mail: mukeshpathak.001@gmail.com

Abstract

Agricultural labor stands one of the most physically demanding occupations on a global level, as evidenced by long manual working hours, repetitive works, difficult postures, and prolonged working demands. These instances significantly increase the high chances of Musculoskeletal Disorders (MSDs) in agricultural laborers, resulting in body pain, reduced working capacity, and economic loss. Traditional work-related interventions, like tool redesign and occupational assistance, are generally unviable economically or inaccessible for smallholder farmers in many scenarios. This paper elaborates the potential of Yogic asanas as a cost effective, easily administered, and culturally viable ergonomic approach to reduce work-related orthopedic musculoskeletal ailments. By investigating the biomechanical and physiological characteristics of common agricultural works—such as farming, harvesting, and produce carrying—this research maps some important Yogic Asanas like Gomukhasana, Tadasana, Marjariasana, Bhujangasana to prone anatomical segments in spine, hip region, knees, and shoulder area. The paper examines the neuro-muscular ways through which yoga enhances muscle flexibility, core joint stability, and gross proprioception, thereby balancing the repetitive cycles of farm work. Synthesizing practical evidence, body frameworks, and occupational implementation strategies, this research emphasizes that customized yoga exercises can act as an effective curative and rehabilitative measure, enhancing the gross occupational wellbeing and quality level of life for agricultural field workers.

Keywords: *Agricultural labor, Musculoskeletal Disorders (MSDs), Yoga, Yogic Asanas, Occupational Health, Biomechanics etc.*

Introduction

Role of physical work in agriculture labour

In broad sense, Agriculture is the science or practice of farming. It is the base of a rural economy, especially of a developing country like India. In India, a variety of agriculture tasks like sowing the seed, weeding, land preparation *etc.* depend on the supply of physical labour since these are performed manually by traditional workers.

These works are performed by hard physical work, prolonged postures and exposure to hard environmental conditions. Unlike mechanical setups where tasks can be efficiently optimized, the agricultural surroundings are dynamic, uncertain, and highly dependent on the physical body resilience of workers.

Rise of MSDs in agriculture labour

Occupation-related Musculoskeletal Disorders (MSDs) are trauma, injuries and ailments that affect the human body's locomotion or musculoskeletal working related with muscles, bones, tendons, nerves and other elements (Alghadir, *et al.*, 2018). In agriculture, MSDs occur on a large scale as shown figure 1. Workers most often experience chronic pain in the lower spine, cervical area, shoulders, and knees. The causes of these ailments are deeply rooted in the occupational hazards related with traditional ways of farming. Here we see long duration forward bending due to work needs like weeding and harvesting that require laborers to maintain a bended posture for hours. Recurring Motions are also important such as harvesting by using sickle and manual threshing work involve thousands of repetitive cycles of upper-limb movements daily. There is a need to carry heavy loads to transfer crops and materials that require spine

movements thereby making the spinal column prone to acute and prolonged compressive forces. The results and effects of MSDs extend beyond body suffering. In broad sense, they lead to spoilage of working days, decreased crop yield, rising hospital expenditures, and a notable fall into deeper poverty levels for vulnerable agricultural communities.

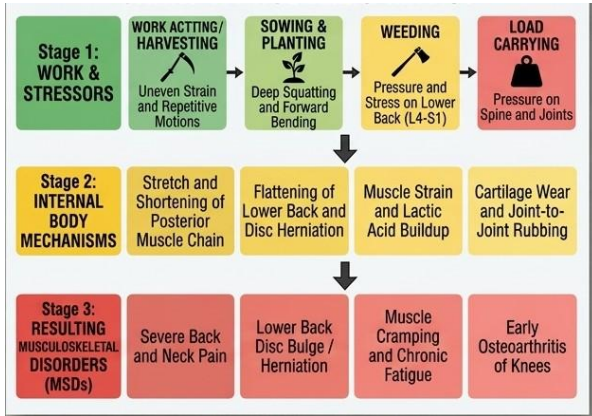


Fig. 1: MSD arising in Agricultural Workers

Limitations of Conventional Work Approaches

Conventional work-related health policies mainly rely on technical controls, such as designing handy tools, introducing machine seed drills, or customized workstations. While these approaches seem to be highly effective in theory, their on ground implementation in miniature farming confronts massive hurdles (Basak, 2021). Here we see economic limitations where small farmers are unable to afford costly equipment and customized tools. There are geographical constraints in some areas making agricultural activities quite tough as faced in hilly, unsymmetric terrain. In case of uneven ground, it is difficult for the farmers to use medium and heavyweight machines. Problems are also seen with farmers who are ill-trained for using modified tools and agriculture techniques. Therefore, it is extremely crucial to develop an user-friendly solution that is compatible with biological buildup of workers so as to withstand physical stress without having costly structural changes.

Objectives of the Paper

This research paper aims to:

- Discuss the occupational stressors and physical loads affecting biomechanics of workers performing agriculture work.
- Analyze the physiological and neuromuscular working process of Yogic practices that balance physical stress and strain.
- Ascertain a composite conceptual framework encompassing agricultural tasks, damage prone

body parts, and specific Yoga Asanas that can provide preventive and curative relief.

- To discuss empirical evidence about the effectiveness of yogic posture in reducing pain and improving overall capacity.
- Provide a practical, social framework for incorporating yoga into the daily routines of agricultural workers.

Work related Strains and MSD Biomechanics

Analysis of main Agricultural Activities and body posture Stressors

To grasp how yoga can reduce MSDs, it is important to first analyze the biomechanical stressor elements inherent in the elementary stages of traditional crop farming.

Biomechanical Mechanisms of Tissue Degradation

The onset of MSDs in agricultural workers follows a predefined pathophysiological mechanism driven by cumulative trauma:

Deconditioning of spine in lumbar region

When a worker acquires stooped posture bending forward to weed or harvest, the natural curvature of the spine is disturbed thereby inducing lumbar lordosis. This results in flattening the lower hip area. This biomechanically shifts the body load from the erector spinae muscles that run along the spine to the intervertebral discs and associated ligaments. Long period flexion mounts intra-discal pressure, thereby stretching the posterior side of annulus fibrosus. This can lead into disc protrusion, disc herniation, and moderate to heavy lower back pain (Chang, *et al.*, 2016).

Muscle Ischemia and fatigueness

Prolonged static postures need continuous isometric contractions of the muscle groups acting as stabilizers. This enhanced intramuscular tension compresses the blood vessels thereby obstructing local blood flow resulting in ischemia. The scarcity of oxygen and storage of metabolic waste substances like lactic acid causes acute muscle fatigue, muscular spasms, and body inflammation.

Degeneration of body joints

Deep squatting for long durations during transplanting matters compel the tibiofemoral and patellofemoral ortho joints of the knee to withstand extreme surface contact forces. This increases the gradual destruction of soft articular cartilage making young agricultural laborers prone to develop early-rise osteoarthritis.

The Physiological and Ergonomic Foundations of Yoga Asanas

Yoga is a thousand years old knowledge system that encompasses yogic asanas, breath control techniques (pranayam) and other yogic practices. Therapeutically Yogic postures can be used to treat many health conditions (Woodyard, 2011). In the agricultural perspective, yoga can act as a psycho-social system inducing body-mind based neuromuscular conditioning mechanism (Bharshankar, *et al.*, 2015).

Neuromuscular and Biomechanical Mechanisms of Yoga

Yoga consists of exercises for body and for controlling the breath used by people to keep them relax and fit (Oxford University Press, 2026). Traditionally, Yoga has been considered as a mean to achieve perfectness in work (Bhagwad Gita, 2.50). Agricultural manpower is exposed to moderate to severe physical and work strains during different phases of crop cultivation. The systematic breakdown of main agricultural works, the various anatomical areas they affect, and their elementary biomechanical stressor elements are explained below to deeply analyze the issues.

Sowing the seeds and transplanting the saplings: During this work, laborers are needed to maintain a predefined posture characterized by deep squatting position, prolonged position in forward stooping, and cyclic reaching. This posture significantly affects the biomechanical forces working on the lumbar spine area, knee joints, ankles, and neck. The main physical stressor originates from prolonged rhythmic muscle contractions and the extended flexion of the both knee joints.

Weeding: This work forces workers to acquire postures that involve the upper trunk bending deeply from the waist, deep squatting, or performing kneeling for prolonged periods. It significantly targets the lumbar area in L4-S1 vertebrae region, leg hamstrings, and region of wrists. The main biomechanical force stressors are high spinal compressive forces and static loading forces on the lumbar extensor muscles.

Manual Harvesting or Sickle Harvesting: using a sickle or harvesting crops in the manual manner incorporates asymmetric forward upper trunk bending mixed with repetitive upper limb twisting movements. This exercise strains the spine area, the shoulder area, the elbow region, and the wrist area. The biomechanical damage is caused by the eccentric weight loading of spinal muscles and repetitive strain loss from ultra-high-frequency, rhythmic movements.

Load Carrying: Transporting harvested crops, heavy equipment, or water inputs puts direct pressure on the head, shoulders, or upper back. This severely affects the cervical spine, lumbar spine, hip joints, and knees. The main stress factors are very high axial compression, ongoing balancing stress, and changed walking mechanics.

Biomechanical pathway of Yoga Asanas practice

During the practices of yogic asanas, concentric muscle contraction occurs first leading to muscle lengthening in later stages. This again induces regulation of the autonomic nervous system leading to down regulation of cortisol and activation of muscle spindle. This overall enhances neuromuscular perception and control.

Muscle Lengthening and Reciprocal Inhibition

Agricultural tasks often lead to chronic muscle shortening and reciprocal tightness e.g. constant bending causes tightness in hip flexor and hamstrings. In this case, Yoga postures utilize prolonged static extending and stretching. When a posture is achieved for a long time, it triggers the Golgi Tendon elements, which overrides the preventive stretch response, allowing the muscle spindle to safely lengthen. Here, yoga exerts reciprocal prevention—contracting the antagonist muscle fibers to automatically relax and lengthening the tight agonist muscle spindle fibers.

Core region Stabilization and Intra-Abdominal Pressure shield

There are many yoga postures that focus significantly on regulating the "core cylinder," which includes various abdominal muscles like rectus abdominis, transversus abdominis, multifidus, and the muscle of the pelvic floor. A robust coordinated core works as a natural biological weight-bearing belt. By enhancing intra-abdominal internal pressure, a conditioned core acts like a barrier and shields the lumbar spine area from large compressive forces during the tasks of heavy lifting on the farm.

Proprioception and Joint Lubrication

Yogic Asanas incorporate slow, rhythmic, deliberate movements into different spatial orientations, provoking joint mechanical receptors. This increases proprioception of the brain to experience the position of the joints. It allows the workers to maintain safer, more feasible postures during handy work. The practices of yogic asanas promote cyclic loading and unloading related to the joints thereby enhancing the flow of synovial fluid. It

helps to deliver important nutrients to articular cartilage thus improving joint health.

Psychological Regulation of Anxiety and Pain

Yoga can be used as an effective remedy for anxiety related issues that may result in psychosomatic problems (Kirkwood, *et al.*, 2005). Chronic pain from orthopedic MSDs may also arise due to psychosomatic components. Physical distress on persons for prolonged periods increases systemic cortisol hormone levels and triggers the sympathetic nervous system of the body to amplify the pain perception. The controlled breathing or pranayam practices stimulate the vagus nerves thereby activating the parasympathetic nervous system dominance. This practice lowers blood pressure, decreases muscle tension and decreases the perception of chronic pain (Phatak and Kurle, 2016).

Making Framework of Yoga Asanas to Agricultural Intervention

To make a significant intervention, Yoga Asanas should be carefully selected based on their core functional ability to counteract the relevant anatomical strains induced by particular agricultural tasks.

Therapeutic Mapping Matrix

To systematically balance the physical damage caused by farm tasks, specific Yoga Asanas are thoughtfully mapped to targeted anatomical areas based on their exact structural, biomechanical, and related actions as shown in figure 2.

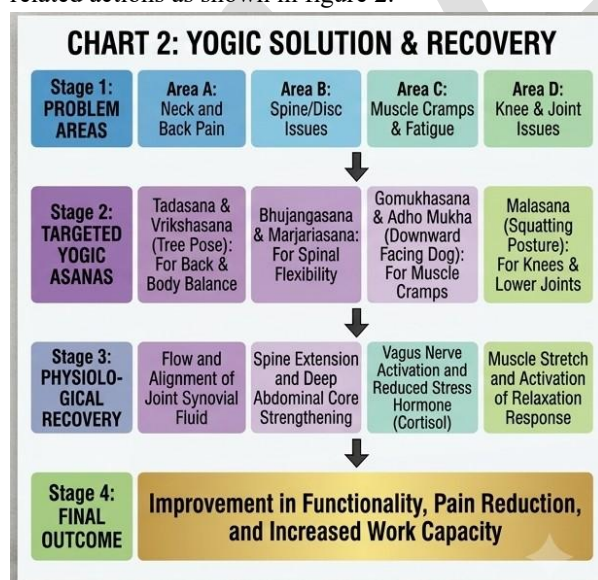


Fig. 2: Yoga therapeutic matrix yogic solution and recovery

Lumbar area and Spine column: The prolonged stooping and forward bending of trunk intrinsic to manual labor cause moderate intervertebral disc space compression. To counteract this, Bhujangasana and

Marjariasana-Bitilasana are prescribed in many instances. Their biomechanical force action restores natural curvature in lumbar lordosis as well as it mobilizes tense intervertebral joints, and removes the compression from the anterior area of the spinal discs (Sarkar and Dev 2023).

Lower Extremities: in the knees and ankles, prolonged deep squatting, long periods of standing, and traversing unequal terrains place harmful loads on the lower extremities. Tadasana, Vrikshasana and Malasana in these scenarios may serve as preventive and corrective interventions. They readjust weight distribution equally across both lower extremities, strengthen the quadriceps, and enhance structural ankle stability.

Shoulder region and Upper Back area: Overhead load carrying and the unequal movements of manual tools cause high level of tightness in the thoracic area. Gomukhasana (resembling Cow Face), Marjariasana position, and Setu Bandhasana yogic posture are applied to alleviate this tension. These yogic postures actively clear and widen the thoracic cavity, elongate chronically tight pectoral fibres, and make the supportive rhomboid muscles and lower trapezius muscles.

Posterior Chain: bending over prolonged periods results in the instances of adaptive shortening, inflammation and tightness of the hamstrings, calf area, and gluteal muscles resulting in moderate to severe levels of pain.

Svanasana performed in downward-Facing posture (Adho mukha Savasana) and a customized Uttanasana (bent knees forward) are prescribed as remedies. Their preventive and corrective action significantly elongates the shortened posterior myofascial structure, which promptly decreases the continuous pulling forces exerted on the pelvis region and lower back area.

Biomechanical dogma of Key Remedial Yogic Asanas

Bhujangasana (here the body resembles serpent Pose)

Utility for physical Laborers: Body in prone position, hands are positioned under shoulders that mildly lift the chest region with the help of back muscles and in this process keeping the pelvis firm and anchored.

Ergonomic position: This posture works like a direct counter-position to the forward-bending posture of weeding and harvesting works. It causes passive extension to the lumbar region of spine thereby driving the nucleus pulposus area of the intervertebral discs

forwardly, minimizing the risk of posterior disc herniation.

Stooped Agriculture Work: Here the spine flexes forward and the disc is pushed backward.

In case of Bhujangasana posture, the spine is backwardly extended thereby pushing the disc forward into safe alignment.

Marjariasana-Bitilasana (Posture resembling cat and cow)

Execution for the workers: On all four limbs, alternating between keeping the back into flexion and keeping it down while raising the head (extension).

Work related Action: This movement of fluid introduces on the go mobilization to the whole vertebral column. It stretches mildly and does contraction of the erector spinae muscle and multifidus muscle fibres, relieving static spindle fiber stiffness built up over prolonged field labor.

Tadasana (mountain like pose)

Execution for Agriculture workers: Here the person stands in upright posture while keeping the feet joined together, arms kept by the side, along with engaging the thighs and elongating the spine region in upward direction.

Work related Action: While seeming simple, Tadasana recreates postural alignment. Agricultural workers frequently develop positional asymmetry due to single-sided tool usage like working with a sickle with only the right hand in use. Tadasana promotes the distribution of the weight equally between both feet thereby balancing the pelvis and remaining body to align in a biomechanical vertical gravity line.

Mala Asana (The Squatting Posture)

Execution for Agriculture workers: Here the person sits in wide squatting position with heels flat and supported on the ground, elbows putting pressure on the knees outwardly, chest lifted.

Work related Action: Farm laborers squat often, but usually with mal-alignment—letting their heels lift and collapsing their lower back. Mala Asana compels the body to execute a biomechanically effective squat. It activates the Achilles tendon, opens the adductor muscle fibres of the groin, and stabilizes the pelvic floor area, turning a harmful work posture into a position of comfort and structural stability.

Review of Empirical Evidence based Cases and research Studies

While the theoretical symbiotic relationship between yoga and agricultural ergonomics is evident, clinical and field research studies provide empirical and practical confirmation of these benefits.

Evidence related with Chronic Lower Back Pain (CLBP)

Various wide-scale randomized controlled trials (RCTs) have proven yoga as an effective non-pharmacological remedy for lower back pain. A landmark study by Sherman *et al.*, 2026 elucidates that a planned 12-week yoga protocol was considerably more effective than standard traditional exercise in reducing back pain symptoms and improving functional disability. The body improvements lasted months after the planned intervention concluded (Cramer, *et al.*, 2026.)

Field related research in Agricultural and Rural Contexts

Direct research studies aimed specifically on agricultural workers has gained importance through research on yoga based rural occupational health initiatives:

Postural Stress Reduction: Field studies performed in rural populations evaluating workers exposed to prolonged periods of weeding activities have demonstrated that introducing short, structured activity breaks using adapted yoga postures considerably drops their rating of perceived exertion (RPE) on the scientific Scale.

Electromyographic (EMG) Studies: Biomechanical studies analyzing muscle activation via EMG demonstrated that individuals with regular yoga training show low levels of muscle tension and a much-improved recovery rate from muscle fatigue following prolonged physical labor compared to untrained controls.

Reduction in remedy Dependency: Community health analysis in agricultural areas where yoga programs were introduced noted a significant decline in the self-determined consumption of over-the-counter painkillers among farm workers, thereby reducing secondary health risks.

Implementation roadmaps and Field Challenges

Community level implementations should be designed to cater the core needs of the grassroots stakeholders (Osborn, and Robertson, 2019). Application of a yoga intervention program within a rural agricultural formation requires a highly feasible approach that adjusts the ground realities of a farmer's lifestyle.

The "Agro-Yoga" Operational Model

To ensure high compatibility and zero economic implications, yoga should be promoted directly into the existing workflow of the day-to-day work as depicted in figure 3, rather than requiring long,

isolated sessions (Bhasin, and Sharma, 2019). It can be further semi divided into segments of pre field, mid field post field durations. In pre-field durations, warm up may be done consisting of tadasana, dynamic shoulder movement and neck rotations. In mid field, active stretching is done consisting of standing back bending and side stretches. In the post field segment, restorative recovery postures are practiced which consists of Bhujangasana, Balasana, Shavasana *etc.* The combined duration of all these activities should be around half an hour. Here, workers should be encouraged for pre field activation activities which activates the muscular and nervous systems of the body. It consists of dynamic warm-ups, wrist movements, ankle exercises, and Tadasana to activate the nervous and musculoskeletal system.



Fig. 3: Agricultural worker's daily routine: ergonomic & occupational wellbeing flowchart.

In-Field Micro-Breaks of micro durations can also be used to enhance productivity of agricultural workers (Jain and Kar, 2020). This can be applied every 90 to 120 minutes of working in which workers place their hands on their hips, and execute gentle standing backbends (modified combined with deep breathing to offload and reenergize the spinal column. Workers can also perform a restorative phase that is done at home or in a community place at the end of the day. Here muscle relaxation and passive floor postures such as Bhujangasana are prescribed for reverse bending strain, Balasana to decompress the spine, and Shavasana for muscle relaxation.

Overcoming obstacles to Adoption

Implementing these remedies and solutions requires addressing several social mind practical challenges:

Socio-Cultural and perception Misconceptions

In many rural areas, yoga may be incorrectly viewed purely as religious custom, causing resistance among certain cultural groups. Interventions should demonstrate yoga strictly through a pragmatic lens—emphasizing it as a form of body-mind and physical conditioning solely aimed at enhancing work stamina and overall health. Time Poverty and Fatigue Agricultural laborers work for long hours, exhausting hours and are hesitant to sacrifice resting time for extra physical activity. The intervention must focus that micro-breaks do not elongate the working day, but actually reduce long-term physical fatigue, keeping their stamina levels higher throughout the afternoon durations.

Institutional Scaling

Gram Panchayats and agricultural cooperative societies, and rural healthcare workers should be adequately trained to enable them to provide yogic counselling for the workers. It enhances trust, community accountability, and long-term sustainability.

Future Research Scope

While the current literature builds a strong foundation, future research should cover advanced objective metrics to solidify this intervention. Longitudinal Field Studies can be done on large scales consisting of biomechanical analyses and socio-economic benefits studies.

Conclusion

This research paper elucidates how agricultural workers develop Musculoskeletal Disorders (MSDs) like severe back pain, joint ailments, and musculoskeletal problems due to heavy manual work, long periods of stooping, and prolonged lifting. Since the use of machinery and tool redesigns are often too costly for small farmers, Yoga emerges as a cost-effective, cognitive and pragmatic alternative. Yogic Asanas like Bhujangasana, Tadasana, Marjariasana, and Gomukhasana alleviate and balance spinal compression, enhance joint mobility, and relieve muscle fatigue. Integration of short pre-field yogic exercises, quick in-field small breaks, and post-work recovery yoga stretches reduce musculoskeletal injuries and enhance overall work capacity.

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