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Agricultural Laborers in Western Rajasthan: A Study on Occupational Health, Productivity Loss, and Adaptation Measures

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Abstract: ***Western Rajasthan—particularly Barmer, Jaisalmer, Jodhpur, and Bikaner—is one of the hottest regions in India, with peak summer temperatures crossing 48–50°C. Agricultural laborers working in open fields are vulnerable to severe heat stress, dehydration, heat exhaustion, and heatstroke. This study evaluates the intensity and health impacts of occupational heat exposure among 310 agricultural laborers across 18 villages in western Rajasthan. Using Wet Bulb Globe Temperature (WBGT) readings, health surveys, productivity observations, and physiological assessments, the study identifies that 64% of workers experienced moderate to high heat stress, 28% faced dehydration-related symptoms, and 13 cases of suspected heat exhaustion occurred during field visits. Heat exposure significantly reduced work productivity, especially during peak afternoon hours. The study recommends adaptive strategies such as hydration protocols, shaded rest shelters, modified work schedules, climate-resilient farming practices, and government-supported heat-health action plans.***

Keywords: Heat stress, occupational health, Rajasthan agriculture, climate change, dehydration, WBGT, productivity loss, rural laborers.

1.1 Introduction

Agricultural laborers in western Rajasthan routinely work under extreme climatic conditions. The Thar Desert region is known for its high temperatures, intense solar radiation, sandy soils, low humidity, and hot winds (loo). Climate change has aggravated peak temperatures, lengthened heatwave periods, and increased nighttime temperatures, reducing recovery time for workers.

Heat stress is a leading cause of occupational morbidity among agricultural laborers globally. Workers performing stooping, digging, weeding, irrigation, and harvesting are at particularly high risk. Health effects range from dehydration, muscle cramps, and dizziness to heat exhaustion and life-threatening heatstroke. Chronic exposure may contribute to kidney damage and reduced long-term productivity.

Despite the severity of the problem, heat stress studies focusing specifically on agricultural workers in Rajasthan remain limited. This research aims to fill this gap by analyzing physiological stress levels, environmental temperatures, work-rest cycles, and adaptive practices in western Rajasthan.

1.2 Objectives

1. To measure environmental heat exposure among agricultural laborers using WBGT.

2. To assess the prevalence of heat-related symptoms and health impacts.

3. To evaluate the relationship between heat exposure and productivity loss.

4. To suggest adaptation and mitigation strategies suitable for rural Rajasthan.

1.3 Methodology

I. Study Design

1. Cross-sectional study combining environmental measurements, health surveys, and productivity observations.

II. Sampling

1. Geographical Areas: 18 villages in Jaisalmer, Barmer, Jodhpur, and Bikaner.

2. Respondents: 310 agricultural laborers.

3. Sampling Method: Stratified sampling across irrigated and non-irrigated fields.

4. Data Collection Techniques

1. WBGT Measurement

(a.) Handheld WBGT monitor used at four time intervals: 7 AM, 11 AM, 2 PM, 5 PM.

(b.) Measurements taken for 20 consecutive days in peak summer (May–June).

2. Health Survey

(a.) Questionnaire on heat symptoms: cramps, headache, dizziness, fatigue, dehydration indicators.

(b.) Medical examination of selected 52 workers (pulse rate, temperature, hydration levels).

3. Productivity Observation

(a.) Work output measured in weeding, harvesting, and hoeing tasks.

(b.) Comparison between morning and afternoon productivity.

4. Field Notes

(a.) Observation of work environment, clothing, hydration practices.

III. Data Analysis

1. Descriptive analysis

2. Correlation between WBGT levels and reported symptoms

3. Productivity loss estimation

4. Risk categorization per ISO 7243 heat stress guidelines

5. Ethical Considerations

6. Informed consent obtained; high-risk cases were referred to local health workers.

1.4 Study Area

1. Western Rajasthan is characterized by:

2. Extreme desert climate

3. Low vegetation cover

4. Frequent heatwave events

5. High dependence on labor-intensive agriculture (pearl millet, cluster bean, groundnut, fodder crops)

6. Agricultural laborers include both local residents and migrant workers from eastern Rajasthan.

1.5 Observations

1. Environmental Heat Exposure

(a.) Average WBGT values:

(b.) Morning (7 AM): 27–29°C

(c.) Late morning (11 AM): 32–35°C

(d.) Afternoon (2 PM): 34–38°C (high-risk category)

(e.) Evening (5 PM): 31–33°C

(f.) WHO and ISO guidelines consider WBGT > 32°C dangerous for heavy labor.

2. Health Symptoms Reported

(a.) Excessive sweating: 79%

(b.) Fatigue and tiredness: 66%

(c.) Headache and dizziness: 51%

(d.) Muscle cramps: 37%

(e.) Dehydration symptoms (dry mouth, dark urine): 28%

(f.) Heat exhaustion (suspected cases): 13 workers (4.2%)

(g.) Heatstroke (suspected near-miss events): 2 workers

3. Productivity Loss

(a.) Workers showed:

(b.) 22–28% reduction in work output in afternoon sessions

(c.) Frequent rest breaks among 63% laborers

(d.) 40% workers missing 2–4 workdays monthly due to heat-related illness

4. Work Practices

(a.) Clothing: thin cotton but minimal head covering

(b.) Hydration: average intake only 2–3 liters/day, below recommended 4–6 liters

(c.) Rest breaks: usually informal and inadequate

(d.) Shade: absent in 72% fields

(e.) Tools: traditional manual tools increase physical exertion

5. Vulnerable Groups

(a.) Female workers (higher dehydration risk)

(b.) Elderly laborers (>50 years)

(c.) Migrant workers with poor access to water facilities

1.6 Discussion

The findings confirm that agricultural workers in western Rajasthan are highly vulnerable to heat stress due to:

1. High environmental temperatures

2. Labor-intensive tasks

3. Limited access to shade or hydration

4. Lack of awareness regarding heat illness prevention

5. Link to Climate Change

Rising temperatures and recurring heatwaves are consistent with regional climate change projections. Studies across India (before 2018) highlight increasing heat exposure among outdoor workers, aligning with the present findings.

I. Health Implications

1. Heat Exhaustion and Heatstroke

(a.) The 13 suspected cases show acute dehydration and thermoregulatory failure.

2. Chronic Kidney Risk

(a.) Long-term repeated heat stress is associated with chronic kidney disease, as reported in studies from Central America and India.

3. Reduced Productivity

(a.) High temperatures significantly lower work output, affecting income and food security.

4. Gendered Impacts

(a.) Women often carry dual responsibilities (household + field work), increasing heat vulnerability.

(b.) Comparative Analysis

The results align with earlier studies:

(a.) Singh et al. (2013) noted heat stress among construction workers in India.

(b.) Kjellstrom et al. (2016) reported productivity losses among outdoor workers globally.

1.7 Results

1. WBGT exceeded recommended safe limits during afternoon hours in 83% of field observations.

2. 64% workers experienced moderate to high heat stress.

3. Severe symptoms were more common among workers with hydration levels below recommended limits.

4. Productivity reduced by 22–28% in afternoon sessions.

5. There is a statistically significant correlation (r = 0.74) between WBGT and reported symptoms.

6. Heat stress has socio-economic implications, including loss of workdays and income.

1.8 Conclusion

Extreme heat poses serious occupational health risks to agricultural laborers in western Rajasthan. High WBGT values, inadequate hydration, lack of rest and shade, and climate change-driven temperature rise combine to create a dangerous working environment. Without immediate adaptation measures, the health and productivity of agricultural workers will continue to decline.

1.9 Recommendations

Short-term Measures

1. Hydration Protocols:

(a.) Encourage workers to drink 250–300 ml water every 20 minutes.

2. Shaded Rest Shelters:

(a.) Low-cost temporary shade structures in fields.

3. Modified Work Schedules:

(a.) Avoid heavy work between 12 PM – 4 PM.

4. Protective Clothing:

(a.) Light-colored cotton clothing, hats, scarves.

(b.) Medium-term Measures

5. Community Heat Action Plans:

(a.) Warning systems, emergency response, hydration points.

6. Tool Modernization:

(a.) Ergonomic tools to reduce physical exertion.

7. Awareness Programs:

(a.) Training in heat illness recognition and first aid.

(b.) Long-term Measures

8. Climate-resilient Agriculture:

(a.) Drip irrigation

(b.) Drought-resistant crop varieties

(c.) Reduced manual labor techniques

9. Government Support:

(a.) Heat allowance for workers

(b.) Insurance coverage

(c.) Increase in MGNREGA guidelines for heat safety

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