

# A Comparative Study of Observational Techniques for Assessing Postural Loads in Vegetable Production System in Uttarakhand

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**Abstract**—Agriculture ranks as one of the most hazardous industry because it is manual labour oriented and agricultural workers are exposed to a variety of hazards that are potentially harmful to the health and well-being. The physical demand of the farm work which ranges from moderate to heavy, often include standing, squatting, bending, reaching, carrying heavy loads and working for long hours may bring certain hazards to the person. Uttarakhand has 1 % share in area and 1% share in total production in India. Among all the vegetable production activities manual transplanting activity is one of the most wearisome and monotonous activity because workers requires to adopt stressful bending posture. The reason being prolonged use of a particular kind of posture, but they were compelled to adopt those postures during work for a long time, which is injurious to them. keeping in mind the research is planned with the following objectives i) To analyze work postures of workers involved in vegetable production To analyze the work posture and discomforts of farm workers REBA (Rapid Entire Body Assessment) and RULA (Rapid Upper Limb Assessment) was used. The present study was carried out in two places i.e. vegetable research center of U.S. Nagar District and Doguda villege of Nainital district of Uttarakhand to assess their work postures. A total sample size of 70 farm workers was taken for data using Purposive and Random sampling without replacement. The postural discomfort analysis revealed pain in different body parts among farm workers for which corrective measures in the near future are required. REBA and RULA suggested action level- Investigate and change soon. Due to long working hours, awkward body postures, repetitive work and physical load there exist a high prevalence of postural discomforts among farm workers. Highest Postural load factor was reported during manual transplanting activities for which workers have adopted bending or semi bending postures respectively.

**Keywords**—Hazards, Physical Load, Posture, REBA Repetitive, RULA.

## I. INTRODUCTION

Work-related musculoskeletal disorders (WMSDs) constitute an important occupational problem for both developed and developing countries, with rising costs of wage compensation and medical expenses, reduced productivity, and lower quality of life (1, 2). In Uttarakhand, although the traditional occupational hazards such as WMSDs, including low back injuries, increased by 250% in 2003, compared to those reported in 2002. In order to prevent WMSDs, major risk factors causing WMSDs should be quantitatively analyzed. WMSDs are caused by multi-factorial interactions of various risk factors, which can be classified into three main groups: individual, psychosocial, and physical. Among the physical workload, body posture, repetitive and forceful activities, static muscle load, mechanical stress, and environmental factors are known to be the most prevalent (3, 4, 5, 6, 7). Since the relation between awkward postures and pain has been discussed by Van Wely (8), several researchers have pointed out that poor working postures contribute to musculoskeletal problems in any industry (9, 10, 11, 12).

Research techniques that have been proposed for quantifying the amount of discomfort and postural stress caused by different body postures can be divided into observational and instrument based techniques. In the observational technique, the angular deviation of a body segment from the neutral position is obtained using visual perception. In the instrument-based techniques, continuous recordings of a body posture are taken through a device attached to a person. Because of non interference with job processes, low cost, and use ease, the observational techniques are more widely used in industry (13).

The observational techniques include OWAS (14), TRAC (15), PATH [16], RULA [17], REBA [18], LUBA [19], PLAS [20], etc. Of these techniques, OWAS, RULA, and REBA are widely used. A review of several observational techniques showed that they had been developed for different purposes, and consequently applied under a variety of agricultural activities [21]. Each technique has

its own posture classification scheme, which is different from other techniques. This may result in assignment of different postural load scores for a given posture, depending upon particular techniques used. However, a comparison of these techniques with respect to their performance has not been performed. Since the time of publication of these techniques, research showed their usefulness for postural assessments of jobs in several occupational settings, including construction [22], agriculture [23, 24], a hammering task [25], nursing [26, 27], supermarket workers [11, 28], poultry industry [29], ship maintenance [30], a soft drinks distribution center [31], a metalworking firm [32], truck drivers [33], a carpet mending operation [34], etc.

Therefore farm workers who are involved in vegetable production activities will be taken up for research purpose due to limited knowledge on human drudgery among them. Keeping in view the importance of human drudgery in the present context, it is important to understand the term and generate awareness among the workers to reduce level of drudgery and discomforts which is caused due to various activities of vegetable production. Thus the study was planned with the following objectives;

1. To analyze work postures of workers involved in wheat production system

## II. MATERIAL AND METHODS

The present study was carried out in two places i.e. vegetable research center of U.S. Nagar District and Doguda village of Nainital district of Uttarakhand to assess their work postures. A total sample size of 70 farm workers was taken for data using Purposive and Random sampling without replacement. The postural discomfort analysis revealed pain in different body parts among farm workers for which corrective measures in the near future are required. **REBA and RULA.**

### RULA (Rapid Upper Limb Assessment)

The RULA technique (Rapid Upper Limb Assessment) was proposed to provide a quick assessment of the loading on the musculoskeletal system due to postures of the neck, trunk, and upper limbs, muscle function, and the external loads exerted. Based on the grand score of its coding system, four action levels, which indicate the level of intervention required to reduce the risks of injury due to physical loading on the worker, were suggested [17]:

Action level 1: posture is acceptable;

Action level 2: further investigation is needed and changes may be needed;

Action level 3: investigation and changes are required soon;

Action level 4: investigation and changes are required immediately.

### REBA (Rapid Entire Body Assessment)

The REBA technique (Rapid Entire Body Assessment) is a postural analysis system sensitive to musculoskeletal risks in a variety of tasks, especially for assessment of working postures found in health care and other service industries. The posture classification system, which includes the upper arms, lower arms, wrist, trunk, neck, and legs, is based on body part diagrams. The method reflects the extent of external load/forces exerted, muscle activity caused by static, dynamic, rapid changing or unstable postures, and the coupling effect. Unlike OWAS and RULA, this technique provides five action levels for evaluating the level of corrective actions [18]:

Action level 0: corrective action including further assessment is not necessary;

Action level 1: corrective action including further assessment may be necessary;

Action level 2: corrective action including further assessment is necessary;

Action level 3: corrective action including further assessment is necessary soon;

Action level 4: corrective action including further assessment is necessary now.

## III. RESULTS AND DISCUSSION

### Application of REBA for the postural analysis of manual transplanting

Table 1 clearly envisages that men exclusive activity i.e. during *Land Preparation* 60 percent of the male respondents fell in action level 4 i.e. they were working in the worst posture with a high risk of injury from their work posture, and the reasons for this need to be investigated and changed soon to prevent an injury, whereas 40 percent fell in the action level 5 i.e. they were working in the worst posture with a very high risk of injury from their work posture, and the reasons for this need to be investigated and changed immediately to prevent an injury. Similarly 55 percent female respondents fell in the action level 4 that need to be investigated and changed soon to prevent an injury and 45 percent fell in the action level 5 i.e. they were working in the worst posture with a very high risk of injury from their work posture, and the reasons for this need to be investigated and changed immediately to prevent them.

Similarly during *Nursery Raising activity* 100 percent male and female respondents were fell in action level 3 i.e. they are working in a poor posture with a medium risk of injury from their work posture, and this score most likely is the result of one part of the body being in a deviated and awkward position, so change is required soon. During *Manual Transplanting* 70 percent of the male respondents fell in action level 4 which clearly indicates that they are working in a worst posture with a

high risk of injury from their work posture and very high risk was found where 30 percent of the male respondents were fell in action level 5.

Whereas during *Sapling Transplanting* activity 100 percent of the male and female respondents fell in

action level 3 i.e. they are working in a poor posture with a medium risk of injury from their work posture, and this score most likely is the result of one part of the body being in a deviated and awkward position, so change is required soon.

Table.1: Distribution of respondents according to REBA assessment

Score	Action levels	Land preparation		Nursery raising		Manual Transplanting (n=40)		Sapling transplanting (n=30)	
		M	F	M	F	M	F	M	F
1	0-Negligible risk								
2 or 3	1-Low risk, change may be needed								
4 to 7	2- Medium risk, further Investigation,change soon			20 (100)	20 (100)			15 (100)	15 (100)
8-10	3-High risk, investigate and implement change	12 (60)	11 (55)			14 (70)	8 (40)		
11+	4- Very high risk, implement change	8 (40)	9 (45)			6 (30)	12 (60)		

Percentage is given in parentheses

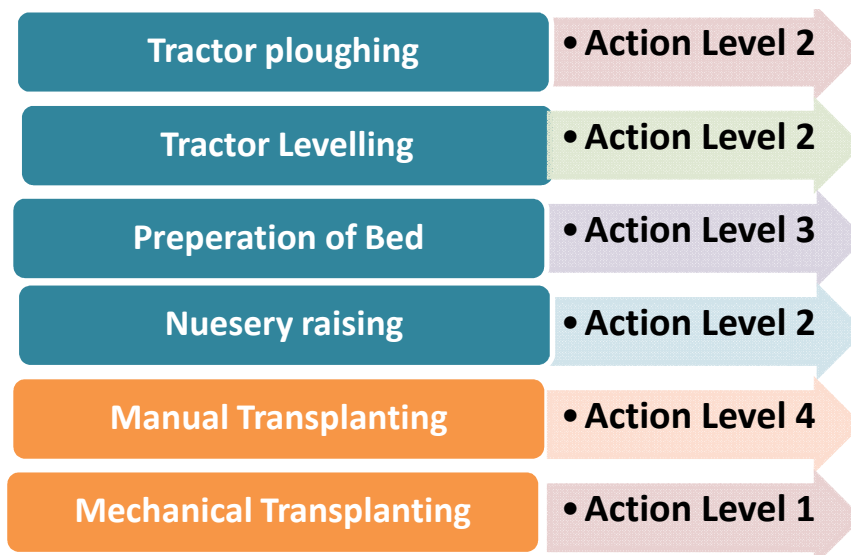






Fig.1: Series of Vegetable production activities with their REBA action levels.

Table.2: Application of REBA for the Postural Analysis of Vegetable Production.

Agricultural activities in vegetable production	posture	Posture analysis		
		REBA		
		REBA Score	Risk level	Action category
	Back bent forward/backward, both arms below shoulder level, walking or moving, weight needed over 10 kg but less than 20 kg.	10	High	Action needs to be taken very soon.
	Squatting posture, knees bent walking or moving, weight needed over 10 kg or less.	6	Medium	Further consideration should be given as to how risk can be lowered.
	Back bent and twisted or back bent forward and sideways, both arms below shoulder level, both knees bent, weight / force needed 10 kg or less.	11	Very high	Work must stop until a safer solution can be found
	Standing upright, neck deviations forward, weight/force needed 10 kg or less.	3	Low	Change may be needed.

**Application of RULA for the Postural Analysis of the farm Workers**

The result of the RULA assessments was based on the calculation of a grand score that was used to determine an action level.

The grand score calculation of all the working postures of all the workers revealed that all male and female respondents who involved in land preparation activity were scored as 7 score which fall under red zone category, which indicate that all the workers were working in difficult posture with an immediate risk of

injury from their work therefore there was a need to investigate and implement change immediately. Whereas in the Nursery Raising, 60 percent male respondents scored 6 and 40 percent scored 7 with an immediate risk of injury from their work therefore there was a need to investigate and implement change soon. In the manual transplanting, 65 percent male respondents scored 6 and 35 percent scored 7 with an immediate risk of injury from their work therefore there was a need to investigate and

implement change immediately. Whereas all female respondents scored with an immediate risk of injury from their work therefore there was a need to investigate and implement change immediately.

Further it was also observed that sapling transplanting, working posture of the all the worker's grand score was 3, which showed that all respondents were working in a poor posture with a risk of injury from their work posture and investigation needed for change if required.





Table.3: Distribution of respondents according to RULA assessment

Scores	Action levels	Land preparation		Nursery raising		Manual Transplanting (n=40)		Sapling transplanting (n=30)	
		M	F	M	F	M	F	M	F
1 or 2	Indicates that posture is acceptable if it is not maintained or repeated for long periods.	-	-	-	-	-	-	-	-
3 or 4	Indicates that further investigation is needed and changes may be required.	-	-	-	-	-	-	20 (100)	15 (100)
5 or 6	Indicates investigation and changes are required soon.	-	-	12 (60)	13 (65)	4 (20)	-	-	-
7 or 8	Indicates investigation and changes are required immediately.	20 (100)	20 (100)	8 (40)	7 (35)	16 (80)	20 (100)	-	-

Percentage is given in parentheses

Table.4: Application of RULA for the Postural Analysis of Vegetable Production.

Agricultural activities in vegetable production	Posture	Posture analysis		
		RULA		
		RULA Score	Risk level	Action category

	<p>Back bent forward/backward, both arms below shoulder level, walking or moving, weight needed over 10 kg but less than 20 kg.</p>	<p>7</p>	<p>Very High</p>	<p>Investigate and change immediately.</p>
	<p>Squatting posture, knees bent walking or moving, weight needed over 10 kg or less.</p>	<p>6</p>	<p>High</p>	<p>Investigate and change soon.</p>
	<p>Back bent and twisted or back bent forward and sideways, both arms below shoulder level, both knees bent, weight / force needed 10 kg or less.</p>	<p>7</p>	<p>Very high</p>	<p>Investigate and change immediately.</p>
	<p>Standing upright, neck deviations forward, weight/force needed 10 kg or less.</p>	<p>3</p>	<p>Medium</p>	<p>Investigate further.</p>

**IV. CONCLUSION**

Vegetable production activities being a physically laborious work, inevitably places farm workers at potential risk of postural discomforts and musculoskeletal disorders such as osteoarthritis (OA) of the hip and knee, low back pain (LBP), neck and upper limb complaints. There are various risk factors related to these activities which may contribute to the development of postural discomforts among farmers. Some of these occupational risk factors include static positioning, forward bending

and squatting postures. So, the WMSDs are defined as impairments of bodily structure such as muscles, joints, tendons, ligaments, nerves or the localized blood circulation system that are caused or aggravated primarily by the performance of work and by the effects of the immediate environment in which work is being carried out (**National Institute for Occupational Safety and Health 1999**). The majority of the farm workers reported musculoskeletal problems is non-specific and lacks a

well-defined clinical diagnosis (**National Research Council and Institute of Medicine 2001**).

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