

Research Article

Work Risk Assessment in the Tea Picking with the Key Indicator Method-Awkward Body Postures (KIM-ABP)

Y. S. Rejeki*, E. Achiraeniwati, N. R. As'ad, M. A. Shakira and V. Vedia

Industrial Engineering Department, Universitas Islam Bandung, Bandung, Indonesia

ORCIDY. S. Rejeki : <https://orcid.org/0000-0002-3612-6401>E. Achiraeniwati : <https://orcid.org/0000-0002-3175-3684>N. R. As'ad : <https://orcid.org/0000-0002-8469-9124>**Abstract.**

Tea plantation in Neglasari Pangalengan, Bandung, West Java, is a smallholder tea plantation. In the picking process, there are many manual activities, from picking tea shoots to transferring the pickings to transport trucks. The picking process is carried out for 4 hours starting. Most of this time is spent picking the tea shoots. Farmers must carry baskets where empty baskets weigh between 3.6 and 5.1 kg, while 10 - 15 kg is the weight of filled baskets. Manual handling of this material causes various risks to occupational safety and health, loads are often above the workers' ability limit and they are faced with non-ergonomic work facilities. In the picking process, workers lift weights of more than 5 kg. Workers who lift loads > 5 kg have a 2.3 times higher risk of experiencing low back pain compared to workers who lift loads ≤ 5 kg. Therefore, this study measured occupational risks and recommendations for improvements to minimize the risk of occupational diseases. The method used is the Key Indicator Method-Awkward Body Postures (KIM-ABP). The result from the risk assessment was 268 where a score greater than 100 indicates high risk and the need for improvements in the workplace.

Keywords: manual handling, work risk, Key Indicator Method, KIM-ABP

1. INTRODUCTION

Tea Plantation in Neglasari Pangalengan, Bandung Regency, West Java is a smallholder tea plantation. This plantation is managed traditionally with simple tools and work facilities. Picking is done every day, for 4 hours from

1. (a) AM until 12.00 AM. Activities in picking tea, consisting of picking tea shoots, moving the results of the picking process, and collecting. It takes 3.5 hours to take the tea shoots. The tea shoot is picked using special scissors, then put into the tea basket carried by the worker. Occasionally the worker presses the tea on the basket to compact its, by turning the upper body. There are

Corresponding Author: Y. S.

Rejeki; email:

ysr2804@gmail.com

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several unnatural movements in this process is the back bending during the picking process, the hands lifting above the shoulders when storing the tea in the basket, and the body turning when pressing the tea. The activities are repeated activities. The weight of the basket containing the tea shoots ranges from 10 to 15 kg. Manual material handling (MMH), repetitive, and heavy loads will put you at risk of working with low back pain [1-5]. Workers who lift weights > 5 kg while working have a 2.3 times higher risk of experiencing lower back pain than workers who lift weights \leq 5 kg [6]. Incorrect MMH activity can cause other musculoskeletal disorders [1,5]. Based on interviews with preliminary observations of workers, workers feel pain in the back, shoulders, and legs after doing the job. There are many types of musculoskeletal disorders caused by work in agriculture, such as tenosynovitis, tendinitis, peritendinitis, epicondylitis, non-specific muscle pain, and forearm [7]. Therefore, this study aims to measure the level of risk in tea picking work.

2. METHODOLOGY

The method used is the descriptive method. The object of the research was a group of 12 Neglasari tea picking farmers. The data needed in this study are data on working time, work posture, working conditions. These data are collected by means of observation, photos, and videos. The measurement method used is the Key Indicator Method (KIM). The key indicator method (KIM) is a method that can be used to assess the risk of musculoskeletal disorders carried out in manual handling activities in the workplace [8,9]. This method considers manual handling activities such as holding, lifting, hold back, moving, dropping, and carrying loads. This method was developed by the Federal Institute for Occupational Safety and Health (BAuA) and the Committee of the German states for Occupational Safety and Health (LASI) in collaboration with practitioners, safety representatives, occupational health doctors, employers, and employee's associations, insurers, organizations, and scientific institutions [8,10,11]. KIM's assessment consists of four levels of risk exposure, namely low, slightly increased, substantially increased, and high. Workplace evaluations are based on an analysis of ergonomic work procedures with a detailed assessment of occupational risk exposure during work. Assessment of physical workload using the key indicator method is classified into six types based on the type of manual handling carried out (Federal Institute of Occupational Safety and Health in 2019), consist of:

1. (a) i. Key Indicator Method with respect to manual Lifting, Holding, Carrying of loads (KIMLHC).
- ii. Key Indicator Method with respect to manual Pushing and Pulling (KIM-PP).
- iii. Key Indicator Method during Manual Handling Operations (KIM-MHO).
- iv. Key Indicator Method with respect to Whole-Body Forces (KIM-BF).
- v. Key Indicator Method with respect to Awkward Body Postures (KIM-ABP).
- vi. Key Indicator Method with respect to Body Movement (KIM-BM).

The tea picking activity is repetitive work and there are unnatural movements, so the measurement method used is the Key Indicator Method - Awkward Body Postures (KIM-ABP). The Key Indicator Method - Awkward Body Postures (KIM-ABP) assess activities with unnatural work posture [12]. The purpose is measuring physical workload to determine the correlation between work activities and physical workload experienced by workers. The result used as recommendations to determine the actions needed for the health and needs of workers. The awkward posture can see from the following [12]:

1. (a) i. Frequency of deviation from the normal position in the back, shoulders, or upper arms and knees or feet.
- ii. Time needed to hold the posture (constant posture \geq 1 minute and repetitive posture \geq 10 seconds).
- iii. Changes in posture can interfere with the normal position of workers.

3. RESULTS AND DISCUSSION

The main activity of the plucking process is tea leaf picking. Picking is done using scissors. Cutting is done by pointing the scissors at the shoots of the leaves, the cut leaves will collect in the place above the scissors. After placing the leaves on the scissors full, the collected leaves are transferred to the carrying basket, lifting both hands towards the back. The frequency of cutting done until the container on the scissors is filled is 5-10 times. The position of the body when picking is in a standing state, holding the basket, and both hands holding the plucked scissors. There are two types of baskets used in the tea picking process, each basket weighing 3.6 and 5.1 kg. The weight of a basket that has been filled with plucked tea leaves ranges from 10-15 kg. The time it takes for the basket to be fully filled with tea leaves ranges from 13-15 minutes, so the time to pick tea leaves in one working day ranges from 3-3.5 hours. A worker can produce about 7-20 baskets filled with tea leaves. Tea picker workers often press the tea leaves in the basket by hand, this is done so that the tea leaves are denser and the

results obtained in one transportation are more and more. The tea leaf picking process is shown in Figures 1 - 3.



Figure 1: Tea shoot cutting activity.



Figure 2: The activity of putting tea leaves in a basket.

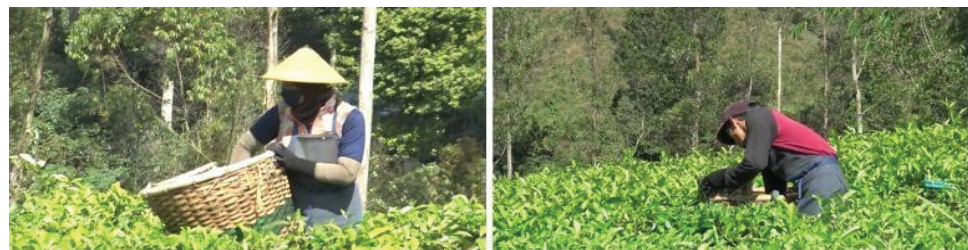


Figure 3: The activity of pressing tea leaves on the basket.

Measurement using the KIM-ABP method includes several stages are an assessment of time indicators, assessment of key indicators, and risk assessment.

3.1. Assessment of Time Indicators

Assessment of time indicator got from the total duration of each activity carried out by the worker [12]. The measure of time indicators is carried out on the work elements of cutting, moving, and collecting tea leaves in one working day. The total duration of action on the cutting elements was 210 minutes, transferring 20 minutes, and tea leaf collection 10 minutes, therefore that the time indicator values for these work elements are 4, 1, and 1, respectively.

3.2. Assessment of Key Indicators

Key-indicator assessment used for risk assessment of body posture from 3 parts, consists of the back, shoulders / upper arms, and legs/knees. The measure of key-indicators also carried out on unfavourable working conditions and other working conditions [12].

3.2.1. Posture Assessment for Part A

Body posture assessment part A is carried out on the back position of the worker when cutting the tea leaves. The posture of the worker when cutting the tea leaves is bent with an angle of more than 20 ° to 60 °. The posture of bending over the tea-cutting work element is carried out for one working day so that the value in part A for the back is 30. Also, workers must press the tea leaves on the basket with their hands, causing the posture to lean forward up to 60 °. The movement included in condition 2. Therefore, the total risk value of A on the back for the tea leaf cutting work element is worth 30 points.

3.2.2. Posture Assessment for Part B

Assessment of body posture part B will measure the position of the shoulders / upper arms of the worker. When cutting the tea leaves, the upper arm is always under the shoulder. Work position standing with both hands holding the scissors without the support and at some distance from the body. The posture on the shoulder/upper arm for the work element of cutting the tea leaves is condition 2. When the worker puts the tea leaves into the basket they are carrying when the position of the arm has raised to the shoulder is category 1. Therefore, the total risk value for part B is 64.

3.2.3. Posture Assessment for Part C

Posture assessment part C is doing on the knee/leg position. The work position is always in a constant standing state with narrow space for movement so that the activity of workers when walking becomes a little disturbed. The knee/leg position value is 8.

3.2.4. Assessments for Unfavourable Working Conditions

When cutting the tea leaves, the back is often leaning forward causes the additional load received on parts A (back), B (shoulder / upper arm), and C (knee/leg) is often even constant. The plantation area has narrow space so that the movement of workers' access to the elements of the tea cutting work is very-limited. The assessment for unfavourable working conditions provides an additional risk score for each part of the body. The total risk score for part A (shoulder) is 6 points, B (shoulder / upper arm) is 2 points, and C (knee/leg) is 3 points.

3.2.5. Assessments for Other Working Conditions

The assessments for other working conditions are reviewed based on the aspects of the work environment and the level of concentration required. The plantation area has uneven ground contours and with limited stability having scoring points for each body part A (back), B (shoulder / upper arm), and C (knee/leg) worth 1 point. The total risk score for other working conditions is 1.

3.3. Risk Assessment

The evaluation has carried out to obtain the highest risk score from part A (back), part B (shoulder / upper arm), and part C (knee/leg) for the tea leaf cutting work element. The results of the assessment are a total of the overall indicators for each part A, B, and C. The results of the risk scores for each posture A, B, and C are 148, 268, and 48, respectively. The highest score in part A, B, or C is an indicator of the total risk score of the work activity carried out. The highest risk score obtained for the tea leaf cutting work element is 268. The highest risk score is used as an indicator to measure work risk. The risk score for the tea-cutting activity was more than 100 points. These show that the load intensity when cutting the tea leaves is high. High load intensity can cause excessive physical load, so that interference or dysfunction in the worker's body is more visible. The health consequences that can be experienced by workers are Musculoskeletal Disorders and Low Back Pain (LBP) [12].

4. CONCLUSION

The conclusion from this research is that the risk of tea leaf picking is very high. The highest load is on the shoulders and upper arms. This suggests that there is a higher probability of health problems, structural damage with significant disease. Recommended actions to minimize this risk are the redesign of the work facilities used and preventive action.

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References

- [1] Deros BM, Daruis DD, Basir IM. A Study on Ergonomic Awareness among Workers Performing Manual Material Handling Activities. *Procedia Soc Behav Sci.* 2015;195:1666–73.
- [2] Rejeki YS, As'ad NR, Achiraeniwati E. Improvement of work system with ergonomic approach of domestic shoe industry in Cibaduyut Bandung. *Appl Mech Mater.* 2014;606:247–51.
- [3] Rejeki YS, Achiraeniwati E, As'ad NR, Hadiid N. The design of manual packaging work station based on workers' dimension in beverage industry. *IOP Conf Series Mater Sci Eng.* 2020;830(4).
- [4] Yarmohammadi, Hamed., Ziaei, Mansour., Poursadeghiyan, Mohsen., Moradi, Mysam., Fathi, Bahram., Ebrahimi MH. Evaluation of occupational Risk Assessment.pdf. *Res J Med Sci.* 2016;10(3):116–9.
- [5] Naeini, Hassan Sadeghi., Karuppiah, Karmegam., Tamrin, Shamsul Bahri., Dalal K. Ergonomics in agriculture: An Approach in Prevention of Work-related Musculoskeletal Disorders (WMSDs) Hassan Sadeghi Naeini 1 , Karmegam Karuppiah 2 , Shamsul Bahri Tamrin 2 and Koustuv Dalal 3. *J Agric Environ Sci [Internet].* 2014;3(2):33–51. Available from: https://www.researchgate.net/profile/Koustuv_Dalal/publication/267151361_Prevention_of_Work-related_Musculoskeletal_Disorders_WMSDs_in_Agriculture/links/54d9fd990cf24647581ff9f9/Prevention-of-Work-related-Musculoskeletal-Disorders-WMSDs-in-Agriculture.pdf

- [6] Syuhada AD, Suwondo A, Setyaningsih Y. Faktor Risiko Low Back Pain pada Pekerja Pemetik Teh di Perkebunan Teh Ciater Kabupaten Subang. *Jurnal Promosi Kesehatan Indonesia*. 2018;13(1):91–100.
- [7] Singh S, Arora R. Ergonomic Intervention for Preventing Musculoskeletal Disorders among Farm Women. *J Agric Sci*. 2010;1(2):61–71.
- [8] Klusmann A, Liebers F, Brandstädt F, Schust M, Serafin P, Schäfer A, et al. Validation of newly developed and redesigned key indicator methods for assessment of different working conditions with physical workloads based on mixed-methods design: a study protocol. *BMJ Open*. 2017 Aug;7(8):15412.
- [9] Mousavian Asl Z.1 MSc BPA. P. Ergonomic Evaluation of Occupational Tasks in a Sofa Making Workshop Based on KIM and Presentation of Corrective Actions. *Int J Musculoskelet Pain Prev* . 2018;3(1)(1):1–5.
- [10] Klusmann A, Liebers F, Gebhardt H, Rieger MA, Latza U, Steinberg U. Risk assessment of manual handling operations at work with the key indicator method (KIM-MHO) — determination of criterion validity regarding the prevalence of musculoskeletal symptoms and clinical conditions within a cross-sectional study. *BMC Musculoskelet Disord*. 2017;18(1):1–13.
- [11] Klusmann A, Steinberg U, Liebers F, Gebhardt H, Rieger MA. The Key Indicator Method for Manual Handling Operations (KIM-MHO) - evaluation of a new method for the assessment of working conditions within a cross-sectional study. *BMC Musculoskelet Disord*. 2010;11(1):1–8.
- [12] Klusmann A, Liebers F, Brandstädt F, Schust M, Serafin P, Schäfer A, et al. Validation of newly developed and redesigned key indicator methods for assessment of different working conditions with physical workloads based on mixed-methods design: a study protocol. *BMJ Open*. 2017 Aug;7(8):15412.