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Physical and Mental Workload Assessment at the Sterilizer Station Using HRR and DRAWS

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Abstract

Physical and mental workload are important factors affecting workers' performance, health, and well-being during work activities. Excessive workload can lead to physical fatigue, reduced concentration, lower productivity, and an increased risk of work errors and accidents. Therefore, workload assessment is necessary to determine the level of physical and mental demands experienced by workers and to provide recommendations for improving working conditions and operational efficiency. PT Perkebunan Nusantara IV Regional VI Unit PKS Cot Girek is a palm oil processing company that produces crude palm oil (CPO). One of the critical workstations is the sterilizer station, where Fresh Fruit Bunches (FFB) are boiled using high-pressure steam. Workers at this station perform physically demanding tasks, such as pushing lorries, pulling slings, manually opening and closing sterilizer doors, and monitoring the sterilization process, all of which require physical effort and continuous concentration. This study aims to measure physical workload using the Heart Rate Reserve (HRR) method and mental workload using the Defense Research Agency Workload Scale (DRAWS) method, as well as to propose improvement recommendations for sterilizer station workers. The results showed that the physical workload of all workers was in the category requiring improvement, with %HRR values of 40.48% for Worker 1, 30.98% for Worker 2, and 31.17% for Worker 3. The mental workload was classified as overload, with DRAWS scores of 67.85%, 64.70%, and 63.45% for Workers 1, 2, and 3, respectively. Improvement recommendations include increasing the number of workers, improving the sterilizer door opening system, installing roller guides, conducting routine capstan maintenance, repairing the lorry rail track, implementing job rotation, establishing clear task allocation, installing fruit ripeness indicator lights, providing operational training, and improving the lorry placement system. These improvements are expected to enhance worker safety, comfort, productivity, and operational efficiency.

Keywords: *Physical Workload, Mental Workload, Heart Rate Reserve, Defense Research Agency Workload Scale, Sterilizer Station.*

1. Introduction

Indonesia is the world's leading exporter of palm oil, supplying approximately 52% of global demand. The export of Crude Palm Oil (CPO) plays a strategic role in the country's economy as the largest contributor to non-oil and gas export earnings [1]. As global demand for sustainable palm oil continues to increase, improving productivity, adopting advanced technologies, and implementing sustainable practices have become essential to maintaining the competitiveness of Indonesia's palm oil industry [2]. The Cot Girek Palm Oil Mill (POM) is a processing unit of PT Perkebunan Nusantara IV (PTPN IV) Regional VI that plays a vital role in supporting palm oil production in North Aceh, Indonesia. The mill has a processing capacity of approximately 45 tons of fresh fruit bunches (FFB) per hour, with an average daily throughput of 800–900 tons of FFB. The production process consists of several workstations, including receiving, sorting, sterilization, threshing, digestion, pressing, and clarification. Among these, the sterilizer station is one of the most critical stages, as the effectiveness of the sterilization process directly affects the quality of the crude palm oil (CPO) produced.

The focus of this study is the physical and mental workload of workers at the sterilizer station. Workers perform various physically demanding tasks, including pushing lorries, pulling wire ropes under heavy loads, aligning lorries on the rail track, adjusting rail positions, attaching capstans, and manually opening and closing the sterilizer doors. These activities are performed during long working hours of approximately 10 hours per shift, which may lead to fatigue and a decline in workers' physical condition, thereby increasing their physical workload.

In addition to physical demands, workers are also exposed to considerable mental workload. During daily operations, approximately 11–12 lorry derailment incidents occur, requiring immediate attention to prevent production delays. Workers must also continuously monitor lorry movement and the sterilization process, as errors in supervision may affect production quality. Despite these demanding working conditions, the physical and mental workloads of sterilizer station workers have not been objectively evaluated. Therefore, this study aims to assess

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physical workload using the Heart Rate Reserve (HRR) method and mental workload using the Defence Research Agency Workload Scale (DRAWS) method.

2. Research Methods

2.1. Location and Time of the Research

This research was conducted at PT Perkebunan Nusantara IV (PTPN IV) Regional VI, Cot Girek Palm Oil Mill (PKS), located in Cot Girek District, North Aceh Regency, Aceh Province, Indonesia.

2.2. Research Object

The objects of this study were sterilizer station workers at the Cot Girek Palm Oil Mill (PKS), who were involved in the sterilization process of fresh fruit bunches (FFB). Physical and mental workload measurements were conducted during their work activities to assess the level of workload experienced by the workers.

2.3. Data Analysis

2.3.1. Ergonomics

The term ergonomics is derived from the Greek words ergon, meaning "work," and nomos, meaning "law" or "natural principles." Ergonomics is the scientific discipline concerned with understanding the interactions between humans and other elements of a system to optimize human well-being, safety, comfort, efficiency, and overall system performance [3]. Ergonomics aims to optimize human well-being and overall system performance by designing work systems that fit workers' capabilities. Proper ergonomic implementation helps prevent work-related injuries, reduces physical and mental workload, minimizes human error, and improves safety, comfort, efficiency, and productivity [4]. Ergonomic principles are increasingly applied to develop human-centered work systems that enhance worker well-being, reduce physical and cognitive demands, and improve productivity through appropriate task and workplace design [5].

2.3.2. Workload

Workload represents the demands imposed on workers, the effort required to meet those demands, and the consequences of performing the task. It encompasses physical, cognitive, and subjective aspects that influence human performance [6]. Workload is influenced by multiple factors, including task characteristics, individual capabilities, and the work environment. Individual factors such as physical and psychological conditions, together with organizational and environmental factors, determine the level of workload experienced by workers [7]. Workload assessment provides valuable information for designing human-centered work systems that improve worker well-being, optimize task performance, and reduce both physical and cognitive demands [8].

1. Physical Workload

   Physical workload involves tasks that require muscular effort and energy expenditure. The intensity of physical workload can be evaluated through physiological responses such as heart rate and oxygen consumption, which reflect the body's energy demands during work [9]. Physical workload is affected by several task-related and environmental factors, such as awkward postures, repetitive motions, manual material handling, and interactions between workers and their work environment. These factors increase biomechanical stress on the musculoskeletal system, leading to higher physical workload and an increased risk of work-related musculoskeletal disorders [10]. Furthermore, prolonged exposure to excessive physical workload can accelerate the onset of work-related fatigue, reduce workers' functional capacity, and increase the likelihood of occupational accidents. Therefore, evaluating physical workload is essential to identify excessive physiological demands and to support the implementation of ergonomic interventions that improve workers' health, safety, and productivity [11].
2. Mental Workload

   Mental workload refers to the cognitive demands imposed on an individual while performing a task. It arises from the interaction between task demands and the operator's limited cognitive resources, influencing performance, attention, and mental effort [6]. Excessive mental workload can lead to mental health disorders such as anxiety, depression and work stress.

   Occupational stress is a psychological and physiological response that occurs when job demands exceed an individual's ability to cope. Prolonged occupational stress can negatively affect workers' physical health, psychological well-being, and job performance [12].

   Occupational stress can adversely affect workers' physical, mental, emotional, and psychological well-being, leading to reduced health status and impaired work performance if it is not effectively managed [13]. Occupational stress may also manifest through various physiological and psychological symptoms. Physiological symptoms include headaches, fatigue, heart palpitations, gastrointestinal disorders, sleep disturbances, and changes in eating or smoking habits. Psychological symptoms include anxiety, depression, burnout, anger, frustration, and irritability [14].

2.3.3. Heart Rate Reserve

Heart Rate Reserve (HRR) is a physiological indicator used to assess an individual's cardiovascular workload during work relative to their maximum cardiovascular capacity while considering their resting heart rate. HRR provides a more accurate measure of physical work intensity because it accounts for individual physiological differences rather than relying solely on absolute heart rate values [15]. Heart Rate Reserve (HRR) has become a widely accepted physiological indicator for assessing physical workload in occupational settings because it reflects the proportion of cardiovascular capacity utilized during work while accounting for individual resting heart rate. Compared with absolute heart rate measurements, HRR provides a more individualized evaluation of work intensity and is effective for identifying excessive physiological strain that may increase the risk of fatigue, musculoskeletal disorders, and cardiovascular stress. Consequently, HRR is recommended as a reliable method for monitoring workers' physiological responses and supporting ergonomic interventions to improve occupational health and productivity [16].

According to [17], physical workload is classified based on the percentage of Heart Rate Reserve (%HRR), which is calculated from measured heart rate values. The physical workload classification based on %HRR is presented in Table 1.

Table 1. Physical Workload Classification Based on %HRR

HRR Value	HRR Category
<30%	No fatigue occurs
30% - 60%	Repairs made
60% - 80%	Work in a short time
80% - 100%	Take immediate action
>100%	Not allowed to do activities

Source: [17]

The data were analyzed using the Heart Rate Reserve (HRR) method through the following steps [18]:

1. Measure the workers' resting heart rate (HR_{rest}) before they begin their work activities.
2. Measure the workers' working heart rate (HR_{work}) while they are performing their work activities.
3. Determine the maximum heart rate (HR_{max}) using the following equation:
   HRMax = 220 – Age
4. Calculate the percentage of Heart Rate Reserve (%HRR) using the following equation:
   $\%HRR = \frac{HR_{Work} - HR_{Rest}}{HR_{Max} - HR_{Rest}} x\ 100$
5. Classify the physical workload based on the calculated %HRR values

2.3.4. Defense Research Agency Workload Scale (DRAWS)

The Defense Research Agency Workload Scale (DRAWS) is a subjective method used to assess mental workload based on four dimensions: Input Demand (ID), Central Demand (CD), Output Demand (OD), and Time Pressure (TP). These dimensions represent different aspects of task demands and are used to determine the overall level of mental workload experienced by workers [19]. The indicators can be seen in Table 2 below:

Table 2. Indicators in the DRAWS Method

Indicator	*Definition*
Input Demand (ID)	Mental workload that comes from external information
Central Demand (CD)	Mental workload that includes processes or actions and interpretation of information
Output Demand (OD)	Mental workload that includes physical or verbal actions in a work activity
Time Pressure (TP)	Mental workload associated with constraints or time pressure to act quickly

Source: [20]

The mental workload classification based on the DRAWS method is presented in Table 3.

Table 3. Mental Workload Classification Based on the DRAWS Method

Score	Description	Information
<40%	*Underload*	The mental burden felt is low, the impact caused is small.
40% - 60%	*Optimal load*	The mental burden felt is moderate, the impact is large
>60%	*Overload*	The mental burden felt is high, the impact is very large

Source: [21]

The data were analyzed using the Defence Research Agency Workload Scale (DRAWS) method through the following steps [21]:

1. Assign workload ratings to each DRAWS dimension
   $\bar{x} = \frac{ID1 + ID2}{n}$
2. Determine the weighting value for each DRAWS dimension.
3. Calculate the weighted score and the total mental workload score using the following equations.
   Score = Workload assessment – Weighting
   $\text{Total Score} = \frac{ID + CD + OD + TP}{100}$
4. Classify the mental workload according to the total DRAWS score.

3. Results and Discussion

3.1. Workers' Heart Rate

The worker data at the sterilizer station during Shift 1 are presented in Table 4.

Table 4. Worker Data at the Sterilizer Station During Shift 1

No	Name	Age (Years)	Gender	Length of work
1	Hadi	47	Man	7 Years
2	Aditia	26	Man	1 year
3	Fauzi	24	Man	1 year

Source : PKS Cot Girek

3.2. Physical Workload Measurement Using HRR

1. Workers' Heart Rate
   Heart rate measurements were performed on three workers at the sterilizer station using a Mi Band smartwatch. Data collection was conducted during the morning shift from 8:00 AM to 5:00 PM (WIB), with heart rate recorded at one-hour intervals throughout the work period to assess workers' physiological responses during work activities. The heart rate data for Worker 1 are presented in Table 5.

Table 5. Heart Rate Data for Worker 1

Day	***Heart Rate* (bpm)**									
	Rest	***Work***	***Work***	***Work***	***Rest***	***Work***	***Work***	***Work***	***Work***	***Rest***
	08.00	**09.00**	**10.00**	**11.00**	**12.00**	**13.00**	**14.00**	**15.00**	**16.00**	**17.00**
Monday	85	115	122	134	88	115	125	129	133	95
Tuesday	87	117	125	128	90	118	130	133	136	92
Wednesday	80	114	120	123	86	117	125	130	131	91
Thursday	88	112	120	122	91	118	127	135	137	97
Friday	86	110	123	125	90	119	126	130	132	95
Saturday	87	115	113	120	91	115	128	133	133	94
Sunday	89	116	111	117	92	116	125	130	130	96

Source: Data Processing

2. Heart Rate Reserve (% HRR)
   The calculation results of the maximum heart rate (HRmax) for each worker are presented in Table 6.

Table 6. Maximum Heart Rate (HRmax) Calculation Results

No	Name	Age (Years)	HR_{Max} (bpm)
1	Hadi	47	173
2	Aditia	26	194
3	Fauzi	24	196

Source: Data Processing

After determining the maximum heart rate (HRmax), the %HRR value was calculated for each worker.

$$\bar{X}\ HR_{Rest}\ \text{day } 1 = \frac{HR_{Rest\,1} + HR_{Rest\,2} + HR_{Rest\,3}}{3} = \frac{85 + 88 + 95}{3} = 89.33$$

$$\bar{X}\ HR_{Work}\ day\ 1 = \frac{HR_{Work\ 1} + HR_{Work\ 2} + \ldots\ldots + HR_{Work\ 7}}{7}$$

$$= \frac{115 + 122 + 134 + 115 + 125 + 129 + 133}{7} = 124.71$$

The average resting heart rate (X̅HR Rest) and average working heart rate (X̅HR Work) for Days 2–7 were calculated using the same procedure. The calculation results are presented in Table 7.

Table 7. Calculation Results of Average Resting Heart Rate (X̅HR Rest) and Average Working Heart Rate (X̅HR Work) for Worker 1

Day	Hari	***Heart Rate* (bpm)**											
		Rest	***Work***	***Work***	***Work***	***Rest***	***Work***	***Work***	***Work***	***Work***	***Rest***	**X *Rest***	**X *Work***
		8:00	**9:00**	**10:00**	**11:00**	**12:00**	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**		
Monday	Senin	85	115	122	134	88	115	125	129	133	95	89,33	124,71
Tuesday	Selasa	87	117	125	128	90	118	130	133	136	92	89,67	126,71
Wednesday	Rabu	80	114	120	123	86	117	125	130	131	91	85,67	122,86
Thursday	Kamis	88	112	120	122	91	118	127	135	137	97	92,00	124,43
Friday	Jumat	86	110	123	125	90	119	126	130	132	95	90,33	123,57
Saturday	Sabtu	87	115	113	120	91	115	128	133	133	94	90,67	122,43
Sunday	Minggu	89	116	111	117	92	116	125	130	130	96	92,33	120,71

Source: Data Processing

Furthermore, the percentage of Heart Rate Reserve (%HRR) was calculated using the following equation:

$$\%HRR = \frac{HR_{Work} - HR_{Rest}}{HR_{Max} - HR_{Rest}} \times 100$$

$$\%HRR\ on\ day\ \text{-}1 = \frac{124{,}71 - 89{,}33}{173 - 89{,}33} \times 100$$

$$= \frac{35{,}38}{83{,}67} \times 100 = 42.29\%$$

The %HRR values for Days 2–7 were calculated using the same procedure. The calculated %HRR values for Worker 1 are presented in Table 8.

Table 8. %HRR Results of Worker 1

Day	$\bar{X}HR_{Rest}$	$\bar{X}HR_{Work}$	HR_{Max}	%HRR
Monday	89.33	124.71	173	42.29
Tuesday	89.67	126.71	173	44.46
Wednesday	85.67	122.86	173	42.58
Thursday	92.00	124.43	173	40.04
Friday	90.33	123.57	173	40.21
Saturday	90.67	122.43	173	38.58
Sunday	92.33	120.71	173	35.18
Average				**40.48**

Source: Data Processing

The calculations of working heart rate (HRwork) and the percentage of Heart Rate Reserve for Workers 2 and 3 were performed using the same procedure as for Worker 1. Therefore, a summary of the %HRR values and the corresponding physical workload classifications for all workers is presented in Table 9.

Table 9. Summary of %HRR Values and Physical Workload Classification

Name	$\bar{X}HR_{Rest}$	$\bar{X}HR_{Work}$	HR_{Max}	%HRR	Category
Hadi	90	123.63	173	40.48	Needs to be improved
Aditia	78.14	114.04	194	30.98	Needs to be improved
Fauzi	84.38	118.55	196	31.17	Needs to be improved

Source: Data Processing

Based on the results of the physical workload assessment using the Heart Rate Reserve (%HRR) method, all sterilizer station workers were classified as requiring improvement, as their %HRR values ranged from 30% to 60%. A comparison of the %HRR values for each worker is presented in Figure 1.

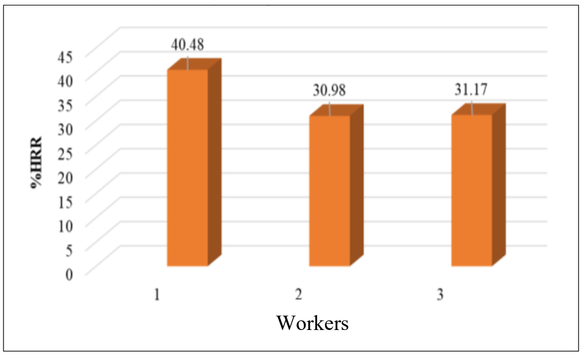

Figure 1. Comparison of %HRR Values Among Sterilizer Station Workers

Worker 1 had the highest %HRR value (40.48%) due to greater physical demands and responsibilities than the other workers. Meanwhile, Worker 2 (30.98%) and Worker 3 (31.17%) also fell within the "Improvement Required" category, primarily because of repetitive work activities. These findings indicate that improvements are necessary to reduce workers' physical fatigue and enhance occupational safety and productivity.

3.3. Measuring Mental Workload Using the DRAWS Method

1. Assessment of Workload Variables Using DRAWS

   The assessment results for each DRAWS workload variable are presented in Table 10.

Table 10. Workload Assessment Results Based on DRAWS Variables

No	Name	Variables			
		ID%	CD%	OD%	TP%
1	Hadi	56	59	69	59
		75	80	67	62
		69	69	59	77
2	Aditia	56	65	65	60
		70	63	75	55
		75	70	55	65
3	Fauzi	60	65	70	59
		65	63	66	50
		70	76	50	65

Source: Observation Results at PKS Cot Girek

The results of the mental workload evaluation using the DRAWS method for workers at the sterilizer station of PKS Cot Girek are presented as follows:

Hadi (Worker 1)

a. *Input Demand*

$$\bar{x} = \frac{ID1+ID2+ID3}{n}$$

$$\bar{x} = \frac{56 + 75 + 69}{3} = 66$$

b. *Control Demand*

$$\bar{x} = \frac{CD1+ CD2 +CD3}{n}$$

$$\bar{x} = \frac{59 + 80 + 80}{3} = 73$$

c. *Output Demand*

$$\bar{x} = \frac{OD1 + OD2 + OD3}{n}$$

$$\bar{x} = \frac{69 + 67 + 59}{3} = 65$$

d. *Time Pressure*

$$\bar{x}=\frac{\text{TP1}+\text{TP2}+\text{TP3}}{\text{n}}$$

$$\bar{x}=\frac{59+62+77}{3}=66$$

The evaluation of the DRAWS variables for Worker 2 and Worker 3 was conducted using the same procedure as for Worker 1. Therefore, a summary of the DRAWS variable assessment results for all workers is presented in Table 11.

Table 11. Summary of DRAWS Variable Assessment

No	Name	ID	CD	OD	TP
1	Hadi	66	73	65	66
2	Aditia	67	66	65	60
3	Fauzi	65	68	62	58

Source: Data Processing

2. Weighting of Mental Workload Variables Based on the DRAWS Method
The weighting of the DRAWS variables was performed to determine the weight of each variable based on the workers' perceptions. The weighting results are presented in Table 12.

Table 12. Weighting of DRAWS Variables

No	Name	ID	CD	OD	TP	Total (100%)
1	Hadi	20	30	25	25	100
2	Aditia	20	30	30	20	100
3	Fauzi	25	25	30	20	100

Source: Observation Results at PKS Cot Girek

3. Determination of Score and Total Score
The mental workload score was determined by multiplying the assessment score by the weighting value for each DRAWS variable. The calculation is presented as follows.
Hadi (Worker 1)
The calculation of the score and total score for worker 1 is as follows:
   a. Score input demand
      = Assessment (ID) x Weighting (ID)
      = 66 x 20 = 1,320
   b. Score control demand
      = Assessment (CD) x Weighting (CD)
      = 73 x 30 = 2,190
   c. Score output demand
      = Rating (OD) x Weighting (OD)
      = 65 x 25 = 1.625
   d. Score time Pressure
      = Assessment (TP) x Weighting (TP)
      = 66 x 25 = 1,650
   e. Total Score

$$=\frac{\textit{Score}\ \text{ID}+\textit{Score}\ \text{CD}+\textit{Score}\ \text{OD}+\textit{Score}\ \text{TP}}{100}$$

$$=\frac{1.320+2.190+1.625+1.650}{100}=\frac{6.785}{100}=67.85\%$$

The summary of the total mental workload scores and their classifications based on the DRAWS method for workers at the sterilizer station is presented in Table 13.

Table 13. Summary of Total Mental Workload Scores and Classifications Based on the DRAWS Method

No	Name	*Score*				Total Score (%)	Workload Category
		ID	CD	OD	TP		
1	Hadi	66	73	65	66	67.85	*Overload*
2	Aditia	67	66	65	60	64.70	*Overload*
3	Fauzi	65	68	62	58	63.45	*Overload*

Source: Data Processing

Based on the results of the mental workload assessment using the DRAWS method, all workers at the sterilizer station were classified as experiencing mental workload overload. A comparison of the mental workload scores for each worker is presented in Figure 2.

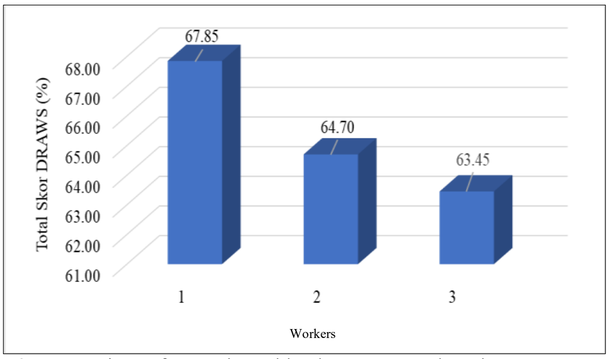

Figure 2. Comparison of Mental Workload Scores Based on the DRAWS Method

Worker 1 had the highest mental workload because the job required more complex decision-making and responses. Meanwhile, Worker 2 and Worker 3 were also classified in the overload category due to the high demands for concentration and work coordination. Therefore, improvements to the work system are necessary to optimize the workers' mental workload.

3.4. Proposed Improvements to Reduce Physical Workload

1. Additional Manpower at the Sterilizer Station
   The operational activities at the sterilizer station are not proportional to the current number of workers, resulting in a high physical workload. Therefore, the following calculations were performed to determine the required number of additional workers.
   Initial average physical workload
   $$\text{Average Physical Workload} = \frac{\text{Total Physical Workload}}{\text{Number of Workers}} = \frac{40{,}48 + 30{,}98 + 31{,}17}{3} = \frac{102.63}{3} = 34.21$$
   Classification: Improvement Required

   Proposed average physical workload
   $$\text{Average Physical Workload} = \frac{\text{Total Physical Workload}}{\text{Proposed Number of Workers}} = \frac{40{,}48 + 30{,}98 + 31{,}17}{4} = \frac{102.63}{4} = 25.66$$
   Classification: Safe
   Determination of additional workers
   Additional Workers = Proposed Number of Workers − Current Number of Workers
   = 4 workers – 3 workers = 1 worker
   Based on these calculations, the company is recommended to increase the number of workers at the sterilizer station from three to four. Under the proposed work allocation, two workers would be assigned to loading the lorries, while the other two workers would be responsible for unloading the lorries and monitoring the sterilizer control panel. This arrangement is expected to distribute the physical workload more evenly among workers.
2. Improvement of the Sterilizer Door Opening System
   The company is advised to improve the sterilizer door opening system by installing an auxiliary actuator or a semi-automatic mechanism. This modification would reduce the force required during the initial door-opening process, allowing workers to focus primarily on controlling the door movement and position.
3. Installation of Roller Guides on the Sling System
   The company is advised to install roller guides along the sling system to reduce friction during the pulling process. This improvement would decrease the pulling force required, thereby reducing workers' physical workload.
4. Routine Maintenance of the Capstan
   Routine maintenance of the capstan, including lubrication, inspection, replacement of worn components, and regular cleaning, is recommended to maintain equipment performance and reduce the physical effort required when pulling the sling.
5. Repair and Maintenance of Rail Tracks

The company is advised to repair and maintain the rail tracks to ensure smoother lorry movement. This improvement is expected to reduce resistance during transportation and consequently decrease the physical workload experienced by workers.

3.5. Proposed Improvements to Reduce Mental Workload

The proposed improvements to reduce the mental workload of workers at the sterilizer station are as follows:

1. Implementation of Job Rotation
   Implement a regular job rotation system to reduce boredom, prevent mental fatigue, and improve workers' concentration during operational activities.
2. Clear Division of Tasks
   Establish a clear division of responsibilities for each worker to create a more structured work process, minimize role ambiguity, and reduce mental workload.
3. Installation of Fruit Ripeness Indicator Lights
   Install fruit ripeness indicator lights to facilitate monitoring of the sterilization process and reduce the need for continuous manual observation.
4. Sterilizer Operation Training
   Provide regular training on sterilizer operation, disturbance handling, and occupational safety procedures to improve workers' competence and confidence in performing their tasks.
5. Improvement of the Lorry Positioning System on the Rail Track
   Improve the lorry positioning system on the rail track to ensure accurate lorry placement, minimize operational disruptions, and reduce workers' mental workload.

4. Conclusion

Based on the results of this study, all workers at the sterilizer station of PKS Cot Girek experienced a physical workload classified as requiring improvement, with %HRR values of 40.48% for Worker 1, 30.98% for Worker 2, and 31.17% for Worker 3. In addition, all workers experienced a mental workload classified as overload, with DRAWS scores of 67.85%, 64.70%, and 63.45% for Workers 1, 2, and 3, respectively.

These findings indicate that the work performed at the sterilizer station involves high physical and mental demands. Therefore, several improvement measures are recommended, including increasing the number of workers, improving work facilities, implementing job rotation, establishing a clear division of tasks, installing fruit ripeness indicator lights, and providing sterilizer operation training. These improvements are expected to reduce both the physical and mental workload of workers while enhancing operational efficiency and workplace safety.

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