Using Ergonomic Checkpoints in Agriculture to Support the Improvement of Work Systems in Rubber Plantations a Case Study in CV. Eja Nursery, East Kalimantan

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Abstract. CV. Eja Nursery is one of the rubber plantations located in Kutai Kartanegara District, East Kalimantan. Indonesia is the second largest rubber producer in the world. Based on the initial observations it was found that there was not ergonomic work environment at CV. Eja Nursery. Not ergonomic work environment will interfere with the productivity of farmers' work. Given the importance of ergonomics in agriculture, the International Labor Organization (ILO) in collaboration with the International Ergonomics Association (IEA) developed an ergonomics approach to improve safety and health in agriculture, which was named the Ergonomic Checkpoint in Agriculture. Based on this concern, research on the evaluation of ergonomics working condition is conducted in CV. Eja Nursery using Ergonomic Checkpoint in Agriculture. The results showed that 27.6% of the working conditions at CV. Eja Nursery needs improvement. This means the working conditions at CV. Nursery is mostly in accordance with ergonomics standards in agriculture. Aspects that require attention are providing welfare facilities and organization and work schedules.

Keywords: Ergonomic Checkpoint · Agriculture · Rubber Plantations

1 Introduction

Based on data from Coordinating Ministry for the Economy of Indonesia (2013), Indonesia is a tropical country where the agricultural sector is the potential aspects for the economy in Indonesia. Rubber is one of the plantation commodities for Indonesia's national income and foreign exchange. Indonesia is the biggest second rubber producer after Thailand in the world [1]. Most of Indonesia's rubber plantations are spread across Sumatera (70%), Kalimantan (24%), and Java (4%). In East Kalimantan, rubber is a traditional commodity that has been cultivated for a relatively long time as small plantations. The total area of rubber plantations in 2020 in East Kalimantan was recorded at 123,460 hectares, consisting of 95,240 hectares of small plantations, 3,630 hectares

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of state plantations and 25,638 hectares of private plantations with a total production of 55,690 tons of lumb. Rubber plantations in East Kalimantan are spread over 10 areas. Data from the Plantation Office of East Kalimantan Province, Kutai Kartanegara district is one of the second largest rubber-producing areas in East [2].

Kutai Kartanegara District, especially Marangkayu Sub-District, is a rubber-producing village. Most of the residents of Marangkayu Sub-District have rubber plantations and work as rubber farmers. CV. Eja Nursery is one of the largest rubber plantations in Marangkayu Sub-District. This company has 3 workers who work from at 06.30 until 09.30 WITA in morning and rest for 1–2 h in the afternoon. After that the workers mix the thickening of latex. From 14.00 until 17.00 WITA workers tap the rubber, then at 20.00 WITA the workers continue mixing the thickening of latex, and then take a rest.

The rubber farmer's work process consists of several stages. The first stage is the treatment stage. In the treatment stage, farmers carry out weed pioneering and spraying weeds around the rubber trees. The second stage is, the sap harvesting stage which starts from rubber tapping which is carried out for 2 weeks. Then farmers mix the thickening liquid on the latex (rubber sap) which is carried out a few hours after the tapping process. The last stage is the process of collecting the rubber sap that has solidified. This activity is carried out every 2 weeks by putting the solidified rubber sap into a bucket with a capacity of 10–15 kg, then lifting it to a shelter, and putting it in a sack. Those activities make rubber farmers faced with various potentially dangerous situations such as frequent bending, twisting, carrying loads, squatting, tedious and repetitive work. All of these are risk factors associated with various complaints. This will be more dangerous and riskier for rubber farmers if it is not supported by ergonomic working environment.

Agriculture is the sector which has the most hazardous area of working in many countries of the world. Increasing attention is being given to applying practical actions in agricultural and rural settings to reduce work-related accidents and diseases, improve living conditions and increase productivity. Reports from many countries have shown the feasibility and effectiveness of ergonomic innovations that have improved working and living conditions in agricultural and rural settings [3].

Not ergonomic work environment will interfere with the productivity of farmers' work. Given the importance of ergonomics in agriculture, the International Labor Organization (ILO) in collaboration with the International Ergonomics Association (IEA) developed an ergonomics approach to improve safety and health in agriculture, which was named the Ergonomic Checkpoint in Agriculture [3]. Based on this background, then conducted research on the evaluation of ergonomics in CV. Eja Nursery using Ergonomic Checkpoint in Agriculture.

Ergonomic Checkpoint in Agriculture is a tool to analyze the problem ergonomics in the environment the work of farmers in CV. Eja Nursery by assessing several Ergonomics aspects which consisted of 100 questions. Where these 100 questions are intended to make the checking for problems in the work process at the rubber plantation is easier, including storage and handling materials, workspaces and equipment, machine safety, agricultural vehicles, physical environment, control of hazardous chemicals, environmental protection, welfare facilities, family and community cooperation, organization, and work schedules, as needed improved and applied by rubber plantations. Ergonomic Checkpoint in Agriculture has proven useful in reducing ergonomics-related risks in

different work settings (Kawakami and Kogi, 2005) specifically in Agriculture, Budnizk et al., (2012) reviewed its implementation in developing countries, and more specifically, Kogi (2016) described the success of Ergonomic Checkpoint in Agriculture in Japanese agriculture[4, 5].

2 Methods

2.1 Research Location

This research is located in CV. Eja Nursery, Jalan Samarinda-Bontang KM. 71, Marangkayu Sub-District, Kutai Kartanegara District, East Kalimantan Province (Fig. 1)

2.2 Research Procedures

Ergonomic Checkpoint in Agriculture is an approach developed by the International Labor Organization (ILO) in collaboration with the International Ergonomics Association (IEA) to improve safety and health in agriculture. In general, the Ergonomic Checkpoint in Agriculture contains practical instructions as a means to improve workplace conditions from an ergonomics point of view. Ergonomic Checkpoint in Agriculture has proven useful in reducing ergonomics-related risks in different work settings [4].

Ergonomic Checkpoint in Agriculture has 100 evaluation points consisting of the following aspects:

1. Storage and transportation of materials (14 points)

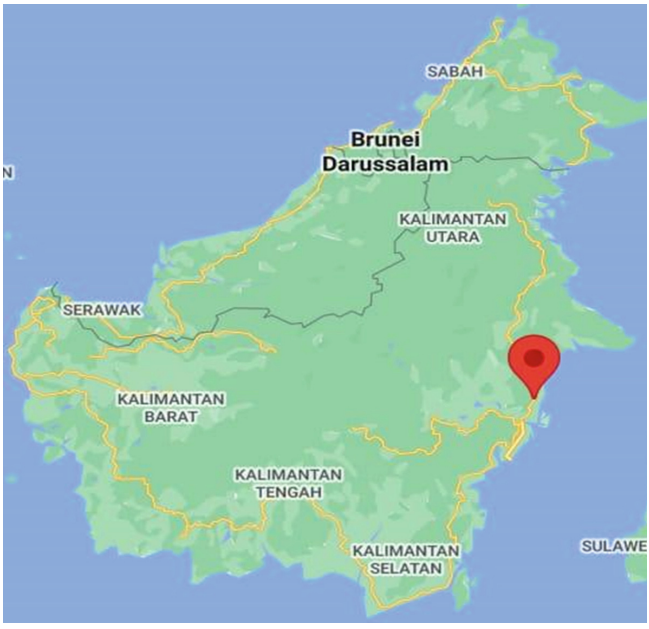

Fig. 1. Location of CV. Eja Nursery, East Kalimantan

2. Workplace and tools (14 points)
3. Machine safety (12 points)
4. Agricultural vehicles (8 points)
5. Physical environment (13 points)
6. Control of hazardous chemicals (5 points)
7. Environmental protection (6 points)
8. Safety facilities (8 points)
9. Family and community relations (8 points)
10. Organization of work and work schedule (12 points)

In the application, researcher use the entire list, or only contain items that are relevant to the workplace under study. Typically, checklists of about 30–50 points are relevant for the workplace and easier to implement. The steps for using this checkpoint are as follows:

a. Knowing the workplace

Ask any questions to the farm owner. Researchers should know about the main products and production methods, the number of farm workers (male and female), the working hours (including breaks and overtime) and any important labor problems.

b. Defining the work area to be checked

Define the work area to be checked in consultation with the manager and other key people. In the case of a small enterprise, the whole production area can be checked. In the case of a larger enterprise, particular work areas can be defined for separate checking.

c. Initial walk-through

Read through the checklist, then spend several or more minutes walking through the work area before you start to check, using the checklist.

d. Writing the results of the checklist

Read each item carefully. Find a way to apply the measure. If necessary, ask the farm owner or farm

workers questions.

– If the measure has already been taken properly, or if it is not needed, mask NO under "Do you propose an action?"
– If corrective action is required, mark YES.
– Use the space under "Remarks" to add a description of the suggestion or its location.
– Selecting priorities

When finished, review the points marked "YES". Choose a few items where the benefits seem likely to be the most important. Mark PRIORITY for these items.

f. Group discussion about examination results

Discuss the results of the checklist together with other members who have taken part in the research. Then agree on the steps to be taken based on the checklist application. Finally, convey to farm owners and workers about proposed actions, and follow-up on their implementation.

2.3 Data Analysis

After filling out the Ergonomic Checklist in Agriculture, then data recapitulation is carried out to determine how much the environmental conditions of CV. Eja Nursery meets ergonomics criteria. After that, recommendations for improvement are given for environmental conditions that are not suitable with the checklist and are priorities for improvement.

3 Result and Discussion

The results of the study based on Ergonomic Checkpoint for Argiculture in CV. Eja Nursery is presented in Table 1.

Based on the results of the data recapitulation in Table 1, Table 2 presents details of the sub-sections that require improvement in CV. Eja Nursery. Meanwhile, Table 3 shows the irrelevant sub-sections applied in the CV. Eja Nursery.

Table 1. Ergonomic Checkpoint Data Recapitulation for Agriculture in CV. Eja Nursery

Section	Checklist section	Number of Sub Section	Not Relevant	Improvements Needed	
				Yes	No
A	Storage and handling of materials	14	2	4	8
B	Workstations and tools	14	4	4	6
C	Machine safety	12	4	0	8
D	Agricultural vehicles	8	2	1	5
E	Physical environment	13	8	2	3
F	Control of hazardous chemicals	5	0	0	5
G	Environmental protection	6	0	2	4
H	Welfare facilities	8	1	3	4
I	Family and community cooperation	8	2	0	6
J	Work organization and working schedules	12	1	5	6
Total		100	24	21	55
		76		76	

Table 2. Details of the sub-sections that need improvement in the CV. Eja Nursery

Section	Sub-Section	Priority	Not Priority
Storage and handling of materials	Keep transport routes clear and in good condition for the movement of people and materials.		√
	Eliminate sudden height differences and holes on transport routes, and use ramps or slopes where necessary.	√	
	Instead of carrying heavy weights, divide them into smaller, lightweight sacks and packages.		√
	Use carts, hand-trucks and other wheeled devices when carrying materials, tools and products.		√
Workstations and tools	Change farming arrangements in the field to avoid strenuous working postures as much as possible.	√	
	Choose work methods that alternate standing and sitting, and try to avoid bending and squatting as much as possible.	√	
	Choose tools that can be operated with minimum force.		√
	Attach labels, signs and symbols that are easy to understand, in order to avoid mistakes.		√
Machine safety	-		
Agricultural vehicles	Provide a sufficient number of traffic signs, mirrors, warning signs and reflectors.		√
Physical environment	Provide sufficient appropriate personal protective equipment for workers, and maintain it regularly.		√
	Be aware of animals and insect that might harm farmers unexpectedly.		√
Control of hazardous chemicals	-		

(*continued*)

Table 2. (*continued*)

Section	Sub-Section	Priority	Not Priority
Environmental protection	Reduce the amount of pesticides used by promoting, appropriate pest management techniques.		√
	Recycle human and animals waste by utilizing appropriate biogas technologies.		√
Welfare facilities	Provide an adequate supply of safe drinking water and refreshment at all workplaces.	√	
	Provide regularly cleaned toilets and washing facilities with soap close to the work area.	√	
	Provide first-aid equipment, and train qualified first-aiders.		√
Family and community cooperation	-		
Work organization and working schedules	Record accident, and discuss improvement measure by analyzing them.		√
	Establish a means emergency contact for farmers working alone in the fields.		√
	Plan annual work schedules, including adequate training periods.		√
	Establish regular working hours, avoid excessively long working days, and insert adequate weekend breaks.		√
	Take short breaks at regular intervals, particularly for strenous work.		√

Table 3. Sub-section that not relevant to be applied in CV. Eja Nursery

Section	Sub-Section
Storage and handling of materials	Use mobile storage racks or wheeled stands for storing and moving materials, tools and products.
	Use hoists, rollers, conveyors or other mechanical means for moving or lifting heavy materials.
Workstations and tools	Use jigs, clamps or other fixtures to hold items while work is being done. Make switches and displays easy to distinguish from each other
	Provide adjustable work surfaces for workers dealing with objects of various sizes.
	Use portable stepladders to prevent falls from unstable, elevated places.
Machine safety	Ensure that connectors for supplying electricity to equipment and lights are safe and secure.
	Use walk-behind machines that are easy to operate, and which stop automatically when the control is released.
	Ensure that hoists and cranes are operated in accordance with the specified load limits and safety precautions.
	Make emergency switches easy to locate and operate.
Agricultural vehicles	Ensure safe operation of agricultural vehicles by obtaining sufficient training, and by providing easy-to-read operation manuals.
	Increase the safety and comfort of driving cabins and seats.
Physical environment	Increase the use of daylight in buildings by means of high windows and skylights, and by painting the walls in light colors.
	Relocate lights, or provide task lights, to ensure that there is sufficient lighting for the type of work being done.
	Improve the heat protection of buildings by backing the walls or roofs with insulating materials.

(*continued*)

Table 3. (*continued*)

Section	Sub-Section
	Increase natural ventilation by having more openings, windows or open doorways for indoor workplaces.
	Supply sufficient airflow to silos, and other confined places where oxygen deficiencies may occur, before entering them.
	Isolate or enclose sources of dust.
	Provide sufficient fire extinguishers within easy reach, and make sure that workers know how to use them.
Control of hazardous chemicals	-
Environmental protection	-
Welfare facilities	Provide recreational facilities.
Family and community cooperation	Organize group work activities for performing strenuous tasks with the help of experienced leaders.
	Organize group physical exercise, and create health clubs in the community.
Work organization and working schedules	Organize appropriate rotation of tasks or teamwork to avoid excessive machine-paced work.

Based on Table 1, there were 33.3% sub-sections on the aspects of storage and material handling in CV. Eja Nursery which required improvement. Based on the results of the data recapitulation in Table 2, the sub-section that was a priority to be improved is eliminating sudden height differences and holes in the transportation route. This was because bad roads would hinder the transportation of vehicles used in the farm, especially during the rainy season. Road maintenance was required at least every 3 months, especially during the rainy season because there were several locations where the route was still dirt road, so the road becomes slippery when it rains. In addition, it was necessary to repair the road to overcome some holes and slippery roads by coating the road with cement or asphalt (Fig. 2).

Meanwhile, in the aspect of workstations and tools, there were 40% of sub-sections that required repair. The priority for improvement was in the aspect of change farming arrangements in the field to avoid strenuous working postures as much as possible and choose work methods that alternate standing and sitting, and try to avoid bending and squatting as much as possible. This was a priority because the working posture of rubber farmers has a high risk in developing musculoskeletal disorders. Based on the latest research on the assessment of work posture on rubber farmers at CV. Eja Nursery, it

Fig. 2. Condition of Transportation Routes in CV.Eja Nursery

was found that there were 71% working posture of rubber farmers in CV. Eja Nursery was slightly harmful to the musculoskeletal system, then 21% working posture was very harmful to the musculoskeletal system. There were only 7% of safe work postures in CV. Eja Nursery [6]. Based on the results of these studies, it can be concluded that the majority of rubber farmers' work postures at CV. Eja Nursery was still not ergonomic. Therefore, it was necessary to change the working position in the workplace by providing small chairs for workers who tapped low tapping areas so that workers did not bend over too much and do not squat. Equipment to make the job easier was also needed, such as a trolley to transport rubber sap buckets to make them lighter (Fig. 3).

Then in the agricultural vehicle aspect, there were 16.6% sub-sections that required repairs, such as adding traffic signs or warning signs on the road to avoid work accidents.

Fig. 3. Non-ergonomic work posture

Fig. 4. Road bends without signs

Suggestions for improvement are to provide traffic signs or mirrors at road bends, so that vehicles from the opposite direction can be noticeable. This is not a priority to be repaired because there has never been an accident in CV. Eja Nursery. However, this situation needs to be improved because the vehicle from above cannot be seen from below if there is no help from a mirror at the corner of the road (Fig. 4).

In the aspect of the physical environment, there were 40% of sub-sections that required improvement, such as providing fire extinguishers in the garden, providing adequate personal protective equipment for workers, and taking care of them regularly and being aware of wild animals and insects that can harm farmers unexpectedly. However, this section was not a priority for repair because the location had a low fire potential, and also the equipment used had a very low potential to produce a fire. In addition, the use of personal protective equipment was quite good, it's just that routine maintenance has not been carried out. Regarding wild animals found in plantations, it was very rare to find, however insects such as ants and mosquitoes sometimes disturb the activities of workers.

Then in the aspect of environmental protection, there are still 33.3% of sub-sections that required improvement, such as reducing the amount of pesticide use and recycling waste, for example used pesticide bottles to be used as containers for sap. Pesticide bottles in CV. Eja Nursery is widely used as a container for rubber sap, by cutting the pesticide bottle into two parts, and providing a hole to hang the container bottle on the rubber tree.

Meanwhile, in the aspect of welfare facilities, there were 42.9% sub-sections that required improvement, such as providing drinking water facilities in the workplace, providing clean toilets with soap close to the work area, providing first aid kits and training workers for the first handling of accidents. These things were the priority for improvement because so far workers only carried drinking bottles and hung them on motorbikes, so drinking water consumption is only limited to the amount of water they

carried. Therefore, it was necessary to provide drinking water facilities so that the workers' drinking water needs were fulfilled. In addition, toilet and soap facilities are also not available in CV. Eja Nursery making it was difficult for workers to clean themselves. The first aid kit was also not available in CV. Eja Nursery so that if an accident occurs, such as a worker's hand being stabbed by a tapping knife, the worker must leave the garden to seek help and medical assistance.

In the aspect of work organization and work schedule, there were 45.45% subsections that required improvement, such as recording work accidents and discussing corrective measures, arranging work rotation or team work, emergency contact facilities for farmers, and planning annual work schedules. In addition, it was also necessary to improve the application of adequate rest time after heavy work such as lifting rubber sacks.

4 Conclusion

Based on the results of research using Ergonomic Checkpoint in Agriculture in CV. Eja Nursery, it was found that there were 27.6% of working conditions that did not meet the standards. In the aspect of storage and materials handling, there are 33.3% aspects that are not suitable with ergonomic standard of working conditions. Similarly, in the aspect of the workstations and tools, there are 40% of non-ergonomic conditions. Meanwhile, from the aspect of machine safety, all aspects have met workplace ergonomics standards. In terms of agricultural vehicles, there are still 16.6% aspects that are not suitable. While in the physical aspect there are still 40% that are not appropriate. However, the aspects of controlling hazardous chemicals, CV. Eja Nursery has been very well proven that there are no aspects that are not up to standard. Then, for the environmental protection there are still 33.3% aspects that are not suitable and 42.9% of welfare facilities are still not suitable. In addition, and 45.45% non-compliance with work organizations and work schedules.

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