Evaluation of the Workload on Horticultural Farmers in the Bedugul Agrotourism Area

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Abstract. Horticultural farmers' work activities include preparing land for planting, caring for plants by fertilizing, pulling grass or weeds, spraying pests, and harvesting and processing or handling post-harvest fruit. This is not easy work, especially if the land being worked on is quite large and there are so many plants. Farmers often complain in the afternoon after work, such as back pain, pain in the legs and arms, and feeling heavy all over the body. For this reason, research is needed to find out the problem of the workload of horticultural farmers. This type of research includes ex-post facto research with observation methods on 37 horticultural farmers. Workload is predicted by calculating the pulse rate measured with a pulse meter. General fatigue was predicted by a 30-item fatigue questionnaire with four Likert scales. The Nordic Body Map predicts musculoskeletal disorders. Extra calories due to peripheral temperature (ECPT) and extra calories due to peripheral metabolism (ECPM) were calculated based on the pulse recovery of the farmers. Meanwhile, work posture is measured using the RULA method. Work productivity is measured based on production results divided by the farmer's workload multiplied by his working time. The observation data was analyzed descriptively and quantitatively. The results of the research show that: (a) the workload of strawberry farmers is in the heavy workload category; (b) there is a significant difference in farmers' subjective disturbance scores (general fatigue and musculoskeletal disorder) before and after work; and (c) the ECPM value is higher than the ECPT, so that to increase farmer activities, this can be done through straw-berry farmer tasks. (d) The RULA score analysis value obtained a grand score of 7, which means immediate investigation and changes need to be made. Therefore, it is recommended to immediately improve the working posture of horticultural farmers.

Keywords: Agrotourism, ECPM, ECPT, Horticultural Farmers, RULA, Workload

1 Introduction

The Bedugul Agrotourism Area is one of the most popular tourist destinations in Bali, famous for its beautiful natural beauty and abundant horticultural products. Horticultural farmers in the region play an important role in providing a wide variety

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of fresh produce to meet the needs of tourists and local communities. However, the workload faced by horticultural farmers in Bedugul is still not widely known.

Horticultural farmers' work activities include preparing land for planting, plant care by fertilizing, removing grass or weeds, spraying pests, and harvesting and processing or handling post-harvest fruits (Yenni et al., 2022; Yusuf et al., 2016). This is not an easy job, especially if the land being cultivated is quite large and there are many plants. Farmers often complain in the afternoon after work, such as back pain, pain in the legs and arms, and a feeling of heaviness all over the body (Dianat et al., 2020; Jain, Meena, & Dangayach, 2018; Pinzke & Lavesson, 2018).

Horticultural farmers, especially in agrotourism areas, have a workload not only to prepare agricultural land but also to pay attention to the condition of the land, plants, and aesthetics to attract the attention of tourists. This adds to the workload of horticultural farmers. On the other hand, agrotourism is one of the tourist destinations that is being developed by the government, especially in Bali (Statistics, 2020; Yusuf & Irwanti, 2021). There are many studies on agrotourism, but they have not touched on the issue of evaluating the workload of farmers in the agrotourism area. There are many problems among farmers that need to be considered, and solutions are sought, such as problems with work posture, work equipment, working hours, calorie intake, and so on (Jain et al., 2018; Manuaba, 2006; Yenni et al., 2022). Many studies state that the workload of farmers is heavy (Baek et al., 2023; Brennan et al., 2022; Caffaro et al., 2018; Suarbawa et al., 2022; Kee, 2022). This needs to be considered to be evaluated and later a solution to the problem will be found.

This study aims to evaluate the workload of horticultural farmers in the Bedugul Agrotourism Area. This evaluation is important to understand the working conditions of farmers and identify factors that can affect their workload. The results of this study are expected to help in formulating appropriate policies and programs to improve the welfare of horticultural farmers in Bedugul.

2 Methodology

This study is a preliminary study conducted observantly on 37 horticultural farmers in the Bedugul agrotourism area, Tabanan Regency, Bali, Indonesia. The workload is determined by the working pulse calculated by the 10-pulse method in the radial artery with a stopwatch. The microclimate in the work environment is measured using an environment meter. Pulse frequency is measured using a pulse meter and life monitor. Subjective complaints from general fatigue were predicted by a 30-item fatigue questionnaire with four Likert scales, and musculoskeletal disorders were predicted by a Nordic Body Map. Extra calories due to peripheral temperature (ECPT) and extra calories due to peripheral metabolism (ECPM) are calculated based on the recovery pulse of horticultural farmers. Work posture is assessed using the RULA analysis. Descriptive and inferential statistics were employed in the analysis of the research data. Statistical analysis was carried out descriptively on workload, musculoskeletal disorders, subjective complaints, ECPT, and ECPM. whereas the t-test was used to examine the variation in workload between before and after work at a 0.05 error level.

3 Result and Discussion

3.1 Result

The characteristics of horticultural farmers who are the subject of the study are as follows:

Table 1. Characteristics of the research subjects

Variable	Average	Deviation standard	Range
Age (year)	36.24	3.04	29 – 54
Weight (kg)	61.17	3.22	57.5 – 70.5
Height (cm)	164.91	4.21	157.3 – 174.6
Body Mass Index	20.24	1.26	19.06 – 23.24
Work experience (year)	6.72	3.64	2 – 21

The results of measuring microclimate conditions in the workplace of horticultural farmers in the Bedugul agrotourism area, which were carried out from morning to evening (08.00 to 16.00 WITA), are as follows:

Table 2. Working environment conditions

Variable	Average	Deviation standard	Range
Wet temperature (o C)	25.05	3.75	20.31 – 29.81
Dry temperature (o C)	30.62	3.23	25.11 – 33.71
Relative humidity (%)	70.87	4.92	65.05 – 75.52
WBGT (o C)	26.85	3.81	23.16 – 29.21

The results of the calculation of the working pulse of horticultural farmers in the Bedugul agrotourism area before and after work are presented in the following Table 3.

Table 3. Results of pulse calculation of horticulture farmers

Variable	Mean (bpm)	SD	t	p
Resting Pulse	72.18	3.39	-31.147	0.000
Working Pulse	125.12	4.28		

Remarks: bpm = beats per minute

Table 4 presents the findings from the assessment of general weariness using 30 questionnaire items and the computation of musculoskeletal diseases as reported by the Nordic Body Map questionnaire.

Table 4. Results of musculoskeletal disorders analysis and general fatigue

		Average score	SD	t	P
Musculoskeletal Disorders	Before work	33.29	3.28	-19.317	0.000
	After work	68.33	5.47		
General Fatigue	Before work	34.25	3.29	-41.207	0.000
	After work	78.86	4.53		

Both physical and internal aspects of the worker's body, such as mobility and metabolism, as well as environmental elements, like heat from the sun or chilly surroundings, can have an impact on their workload. Workloads might rise significantly in response to hot weather or intense sunlight. Temperature-induced extra cardiac pulse (ECPT) and metabolism-induced extra cardiac pulse (ECPM) measurements can be used to assess the impact of physical labor and the work environment. Following Table 5, the findings from the ECPT and ECPM measurements are displayed.

Table 5. ECPT and ECPM Analysis Results

	Average	SD	t	P
ECPT (bpm)	29.68	3.29	-3.031	0.001
ECPM (bpm)	32.01	3.78		

The score findings are acquired through the use of RULA (Rapid Upper Limb Assessment) analysis, as displayed in Figure 1 below.

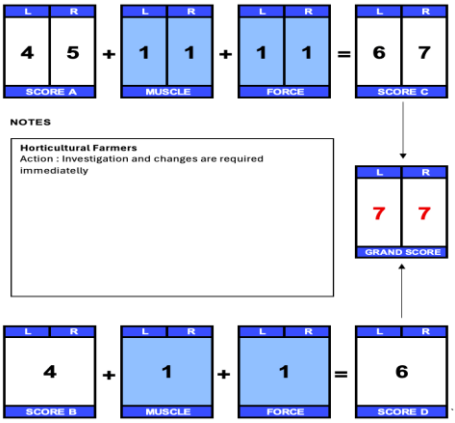

Figure 1. Results of RULA score calculation

3.2 Discussion

Horticultural farmers who meet the criteria in Table 1 are the study's subjects. Farmers typically range in age from 29 to 54 years. At employment, this age group is seen as productive. The body weight is in the range of 57.5–70.5 kg and the height is in the

range of 157.3–174.6 cm, so it gets a body mass index between 20.06 and 22.21. This index is classified as normal, not thin, and not fat. With the work experience of horticultural farmers in the range of 2–21 years, it can be stated that these farmers are experienced as horticultural farmers.

The characteristics of this subject affect work activities (Bridger, 2008). Kroemer and Grandjean (Kroemer & Grandjean, 2009) stated that the peak of muscle strength for both men and women was achieved between the ages of 25 and 35 years, a performance of 96% in activity at the age of 40. An individual with an abnormal body mass index is twice as likely to experience musculoskeletal complaints in the lower back area as someone with a normal body mass index (Kaewdok et al., 2021; Kwon et al., 2015). The longer the farming experience, the higher the level of response to an agricultural technology will be. Therefore, the characteristics of farmers will affect the completion of their work, their level of skills, and their productivity (Hansen et al., 2023; Kroemer Elbert et al., 2018).

The environmental conditions of horticultural farmers in the Bedugul Tabanan agrotourism area, as stated in Table 2, are still relatively normal. Although Bedugul is a cold area, components of environmental conditions such as wet temperature, dry temperature, humidity, radiation bulb temperature, and WBGT are still classified as normal adaptation values in the farmer's body. Moreover, horticultural farmers who have lived in the Bedugul area for a long time have been able to adapt well to the conditions of their working environment.

In the measurement of working environment conditions, a wet temperature of 25.05^{o}C, a dry temperature of 30.62 ^{o}C, and a humidity of 70.87%. This condition is relatively comfortable for horticultural farmers to work in. The air temperature threshold for workers is 33 °C, and between 60% and 80% of Indonesian workers report a relative humidity that is still pleasant (Neal A., 2022; Manuaba, 2003; Ministry of Manpower and Transmigration and ILO Jakarta, 2005).

A person's workload can be measured by pulse rate (Adiputra, 2002; Chen & Tserng, 2022; Kroemer & Grandjean, 2009). The working pulse, as indicated in Table 3, was calculated to yield a resting pulse rate of 71.12 beats per minute and a working pulse rate of 125.22 beats per minute. The working pulse was significantly higher than the resting pulse ($p<0.005$). A heavy workload is defined as the pulse of the work. A working pulse that falls between 125 and 130 beats per minute is considered heavy (Bridger, 2008; Kroemer & Grandjean, 2009).

Table 4 indicates a statistically significant increase ($p<0.05$) in both general fatigue and musculoskeletal disorders between pre- and post-work assessments. Following work, musculoskeletal disorders among horticultural farmers included pain in the left and right arms, the back, the shoulders, the neck, and the waist (seen in 100% of cases). While 100% of farmers report experiencing general fatigue, other symptoms include back discomfort, thirst, and heavy head and leg sensations. Additionally, 80% of laborers report experiencing tight shoulders and trembling in their bodies. If these complaints are not properly resolved and farmers continue to receive them, it will have a bad effect on their health.

This complaint occurred because of the working posture of horticultural farmers who stood bowed. The posture of bending over for a long time is unphysiological (Kaewdok

et al., 2021; Riswal et al., 2021; Setiawan & Rinamurti, 2020). Non-physiological work posture can result from the characteristics of task demands, work tools, workstations, and work postures that are not following the worker's abilities and limitations (Manuaba, 2000; Shearer et al., 2016). Non-physiological work postures performed over the years can lead to bone abnormalities in workers (Kroemer & Grandjean, 2009; Webster, 2024). To overcome this, it is necessary to improve work posture by making new tools or new work systems and following ergonomic methods.

It is determined that the ECPT value is greater than the ECPM value and that there is a significant difference between the two based on the ECPT and ECPM values as displayed in Table 5. The following are the implications of ECPT and ECPM value calculation (Adiputra, 2002; Ruas et al., 2020):

a. The ECPT value > ECPM. Environmental factors are more prevalent when the ECPT value is greater than the ECPM, which adds to the subject's workload. The environmental factor needs to be suppressed as much as possible in order to improve.
b. A result of ECPM > ECPT indicates that the tasks being done require a significant amount of physical labor. The primary goal of its intervention efforts is to reduce the workload.
c. The value of ECPM = ECPT indicates that both the environmental factor and the physical strain of the job place a strain on the body, both are the focus of intervention efforts.

From the results of the calculation, ECPM is greater than ECPT, which shows that the physical work factor is more dominant for farmers compared to the influence of the temperature of their working environment. The work system of processing horticultural planting media in making beds, installing mulch plastics, and making holes in the mulch plastic is a job with a heavy workload and requires immediate intervention. This also shows that if you want to make interventions to improve the implementation of farmers' work activities, the intervention is directed at things related to physical work factors, such as improving work equipment and work systems. Several studies also show that reducing workload can be done by improving work posture, which is usually related to work equipment and lifting (Akbar et al., 2023; Fouladi-Dehaghi et al., 2021; Santiana & Yusuf, 2020).

By using the RULA analysis with the work as shown in Figure 1 above, the grand score value in the RULA analysis is 7 both on the left and right parts of the body with action recommendations, which is to be corrected immediately.

Therefore, based on the results of the workload analysis of horticultural farmers in the Bedugul agrotourism area, it is recommended to immediately make improvements both in their work posture and in their work equipment. Previous research also states that the recommendation for reducing workload based on RULA analysis is to change bad work postures into ergonomic work postures (Budiyanto et al., 2019; Susihono et al., 2020; Yadi et al., 2018).

4 Conclusion

The following conclusions can be made based on the analysis and discussion above.

1. The heavy workload category includes the horticulture growers' workload in Tabanan Regency.
2. The subjective complaints of farmers (musculoskeletal disorders and overall weariness) scored significantly differently before and after work. Following work, musculoskeletal disorders among horticultural farmers included soreness in the left and right arms, the back, the shoulders, the neck, and the waist (100 percent of farmers). While 100% of farmers report experiencing general fatigue, other symptoms include back discomfort, thirst, and heavy head and leg sensations. Additionally, 80% of laborers report experiencing tight shoulders and trembling in their bodies.
3. Since ECPM has a higher value than ECPT, attempts to enhance the way horticulture farmers implement their operations can focus on issues related to work implementation, like enhancing work processes and equipment.
4. The RULA analysis score was obtained with a grand score of 7. It is recommended to immediately make improvements in the implementation of horticultural farmers' work.

Based on the results and conclusions, the following can be recommended:

1. Improving work equipment so that the work posture does not bend anymore (natural work posture) and making holes in the plastic mulch can be done faster.
2. Regulating the work system, such as regulating working hours, arranging work breaks by providing short breaks of 5 to 10 minutes every working hour, providing drinking water, and the like.
3. There needs to be further research on improving the work system of horticultural farmers

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