

Total SHIP Ergonomic Approach in Economic Empowerment of Munduk-Bali Tourism Villages

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ABSTRACT

Ergonomic interventions enable collaboration between labour and management in terms of reducing costs, increasing productivity, safety, health, comfort so that good ergonomics is good economics. The aim of this research focuses on the application of ergonomics which considers the task-organizational-environmental aspects as the main components in the total ergonomics of SHIP which includes (1) Systemic (2) Holistic (3) Interdisciplinary and (4) Participatory. Data on community economic improvement is measured from the difference in productivity before and after receiving the SHIP total ergonomics assistance program. Observations are carried out through direct observation of the actual implementation process and its impact on local communities. The collected data was analysed using an interactive qualitative analysis model. Total SHIP ergonomics approach for 2 years (2022-2023 period) general can increase economy public be measured from program success: (1) Redesigned of the Dry Coffee Peeling Machine increases the capacity of the coffee bean peeling capacity original production averaged 85 kg per day to 110 kg per day or an increase of 29.41%, the working capacity

of the dry coffee skin peeler (Kp) was 176.88%, and the quality of well-peeled coffee beans (Kw) increased by 6.24%; (2) Increasing number of tourists staying at Model Second Home by 5.6%.

Keywords: [SHIP, ergonomics approach, capacity of the coffee bean, Model Second Home, economy public]

INTRODUCTION

Ergonomics is widely recognized as playing a role in harmonizing humans with task, organizational and environmental demands regarding worker-organization-technology compatibility, uses a variety of social and biological sciences in its approach and does not ignore culture differences (Thatcher et al., 2018). The various ergonomics interventions that have been implemented have a distinctive combination of three main characteristics: (1) use a systems approach (2) are design-driven and (3) the focus is on the interrelated outcomes of employability and well-being (Dul et al., 2012). Ergonomic interventions enable collaboration between labour and management in terms of reducing costs, increasing productivity, increasing safety, health, comfort and improving the quality of work life so that good ergonomics is good economics (Hendrick, 1996). Increasing

complexity in various economic sectors requires macro ergonomic interventions to overcome such as less competitive competencies, lack of involvement and cooperation, also inefficiency. (Abdollahpour et al., 2023) to increase productivity, reliability and system availability (Shahnavaz, 2000) through three axes of sustainability (social, environmental and economic) to simultaneously increase competitiveness (García-Arca et al., 2023). Today's global world challenges combine economic sustainability with ergonomics to offer solutions that bring about positive benefits and provide favorable conditions for human well-being (Sarbat & Oz Mehmet Tasan, 2022), through an approach to human factors in economics along with ergonomics (Zink & Fischer, 2013). Sustainable economic development is assessed from basic elements, namely economic, social and environmental elements which characterize the economic, ecological and social components of a comprehensive management system (Sokil et al., 2018). In Several complex technical, cultural and socio-economic factors, state development technology transfer policies are not always successful, to increase productivity (Shahnavaz, 2000), so it is necessary to consider an ergonomic approach in complex management, namely democratic involvement and user empowerment with community-based organizations (Thinyane et al., 2020). Ergonomics' role in management assistance includes identifying factors that influence the implementation of sustainability policies to produce a list of requirements for implementing the policy (Ryan & Wilson, 2013).

Rural tourism is one of the new areas in tourism that is developing, also known as agrotourism or "green" tourism (Kyzy Gandilova, 2018). The approach to assisting Tourism Villages in several countries is different, such as in North West Iran, health-based tourism using a post-covid-19 structural equation modelling approach (Esfandyari et al., 2023), in China

encouraging the management of tourist villages through tourism practices that coordinate with the business world and residents to improve the rural economy (Liu et al., 2020). In general, many countries apply a community approach base tourism (CBT), such as in Colombia, tourism development through the RCBT (rural) approach community base tourism) for community welfare (Saldarriaga Isaza & Salas, 2024), and CBT as a way to gradually eliminate the problem of destitution and social inequality in the countryside in Colombia (Rocca & Zielinski, 2022). In Peru, to increase the economic resilience of tourist villages, efforts are being made to empower ecotourism to strengthen capabilities through five dimensions: (i) social structure, (ii) community trust, (iii) cultural identity, (iv) collective self-esteem, and (v) social humor (Gabriel-Campos et al., 2021). Tourism Village Management in general is collaboration with stakeholders including resource management, tourism product marketing, positioning, host community welfare, brand building, and tourist loyalty towards rural destinations (Adeyinka-Ojo et al., 2014), and improving the welfare and quality of life of village residents (Zhang et al., 2024). The empowerment of tourist villages in Bali has special characteristics based on local culture in the form of the Tri Hita Karana spiritual belief (a harmonious relationship between spirituality, humans and nature) with the involvement of traditional villages. in managing tourist village resources (Rosalina et al., 2023) to improve the welfare of tourist villages.

Various approaches to assisting tourist villages to improve the economy of village communities are currently still partial, considering community approaches (Saldarriaga Isaza & Salas, 2024) and marketing approaches (Adeyinka-Ojo et al., 2014), traditional village approach (Rosalina et al., 2023), so it has not considered ergonomic factors that influence the human-organizational and environmental aspects as a whole. SHIP's

ergonomics approach (Manuaba, 2006): ('systemic', 'holistic', 'interdisciplinary' and 'participatory') has been adapted. This is adapted to address development pressures in Bali related to tourism in the context of community development supported by the literature, it mainly focuses on transformative agendas aimed at raising awareness and strengthening democratic participation. (Hitchcock & Wesner, 2008). The aim of this research is to focus on the application of ergonomics which considers the task-organizational-environmental aspects as the main components in the total ergonomics of SHIP which includes (1) Systemic, namely identifying systems and elements related to the Tourism Village system, (2) Holistic, namely considering economic aspects-social and cultural (3) Interdisciplinary, namely involving analysis of related scientific fields and (4) Participatory, namely an approach involving the community and all parties involved in empowering the economy of tourist villages. The hypothesis formulated in this research is that SHIP's total ergonomics intervention in assisting tourist villages can improve the village economy.

MATERIALS & METHODS

1 Research design

This research design uses a pre-test design and post-test design group. This type of research is mixed qualitative-quantitative using a Likert scale (Grimbeek, 1999). Quantitative research is collection and analysis of quantitative data to answer research questions (Rana et al., 2021), namely productivity data for recipients of SHIP ergonomics approach assistance. Quantitative methods as a way of summarizing, averaging, seeing patterns, predicting, and testing causal relationships as well as generalize the results to a wider population (Targett, 2012) and support programs for improving appropriate technology in the production process of coffee bean processing. Qualitative research methods were used to thoroughly describe the application of SHIP ergonomics in the

PIPK program in Munduk Village, Buleleng Regency, Bali to obtain further information to explore and determine new impacts and consequences of the program, (Taherdoost, 2021) namely assistance in strengthening human resource capacity through limited discussion forums and technical guidance.

2 Mentoring Program

The mentoring program implemented in Munduk Village includes: PIPK (Application of Science and Technology for Regional Development) Smart Munduk Tourism Village Through the Ergo-Infocom Approach for Economic Recovery Due to the Covid-19 Pandemic which was implemented through the SHIP total ergonomics approach for 2 years (2022-2023 period) includes the following programs: (1). Environmental conservation that is integrated with strengthening agriculture, natural tourism and the post-harvest processing industry for superior coffee and clove products, (2). Strengthening the entrepreneurial ecosystem and young entrepreneurs, (3). Strengthening village information systems.

3 Data collection techniques

Data on the perception of the community receiving the mentoring program to strengthen human resource capacity before and after SHIP total ergonomics mentoring was measured through pre-test and post-test questionnaires. The entire population who had received the mentoring program intervention filled out the pre-test and post-test questionnaires independently. Each respondent was given a pseudonym to maintain ethical confidentiality of answers and this was communicated to the respondent before starting data collection (Puji Widodo, 2014).

Data on community economic improvement is measured from the difference in productivity before and after receiving the SHIP total ergonomics assistance program. Observations are carried out through direct observation of the actual implementation process and its impact on local

communities. The collected data was analysed using an interactive qualitative analysis model (Ananth & Maistry, 2020). This model involves stages including data reduction, data presentation, also summarizing results. (“Qualitative Data Analysis: An Overview of Data Reduction, Data Display and Interpretation,” 2020).

4 Data analysis technique

Pre-test and post-test questionnaire measurements and productivity data before and after receiving the SHIP total ergonomics assistance program were analysed descriptively. Descriptive analysis techniques are statistical data analysis techniques which is used in describing, simplifying, and presenting sample data more simply and use current and historical data to identify trends and relationships (Simplilearn, 2023).

RESULT AND DISCUSSION

1.1 Implementation of the Mentoring Program

1.1.1 Conservation tourism development program, groundwater conservation and disaster resilience

a. Accompaniment development tour conservation

The conservation tourism development program provides technical guidance on managing waterfall tourism and trekking tourism in the Tamblingan conservation forest area to the Munduk Village tourism awareness group. Technical assistance activities to strengthen the Munduk Village tourism awareness group with a total of 20 participants. Participants are trained to develop tourism awareness group organizations, vision and mission, organizational development strategies, and strategic work programs. Before and after the training, participants' knowledge was measured. Pre-test and post-test measurement results presented in Table 1.

Table 1. Results of measuring the knowledge and understanding of participants in technical guidance for managing waterfall tourism and trekking tourism in conservation forest areas

	Average value	elementary school	Enhancement
Pre-test	5.75	1.16	42.48%
Post-test	7.80	1.32	

Table 1 shows that the average value of knowledge and understanding about the institutions of the tourism awareness group of participants is increasing. During the pre-test the average score was 5.75, while after participating in the training (post-test), the score was 7.80 or an increase of 42.48%. This increase is in accordance with awareness of tourists which has gone well.

b. Accompaniment conservation environment

The environmental conservation assistance program is implemented through groundwater conservation activities which include groundwater conservation education and the construction of rainwater recharge wells. The implementation stage begins with socializing the benefits of rainwater recharge wells, determining the location of well points and building rainwater recharge wells and integrating them as conservation tourism destinations.



Figure 1. Sustainable water conservation by building rainwater recharge wells.

Efforts to increase public knowledge regarding groundwater conservation were carried out with technical guidance on groundwater conservation for one day. The results of understanding before and after

technical guidance of 30 participants were given questionnaires in the form of pre-test and post-test, the results are presented in Table 2.

Table 2. Results of measuring knowledge and understanding of participants in technical guidance on groundwater conservation

	Average value	elementary school	Enhancement
Pre-test	5.85	0.93	40.04%
Post-test	8.00	1.17	

Table 2 shows that the average value of knowledge and understanding about groundwater conservation is increasing. During the pre-test they got a score of 5.85, while after technical guidance (post-test) the score was 8.00 or an increase of 40.04%.

c. Accompaniment toughness disaster

In an effort to increase the resilience of the Munduk community in facing disasters, it is necessary to provide disaster technical guidance which includes: (1) Types of

Disasters and Methods for Disaster Management and Implementation of Logistics Management and others; (2) Procedures for Handling Natural Disaster Management; and (3) Disaster Prevention and Management. Before the training is carried out, knowledge and participants are measured and after the training a post is also carried out test to measure the achievement of training objectives. Pre-test and post measurement results test is as Table 3.

Table 3. Results of measuring knowledge and understanding of disaster technical guidance participants

	Average value	elementary school	Enhancement
Pre-test	5.40	1.27	60.51%
Post-test	8.30	1.38	

Table 3 shows that the average value of knowledge and understanding about disaster management from participants has increased. During the pre-test they got a score of 5.40, while after participating in the

training (post-test) they got a score of 8.30 or an increase of 60.51%.

1.1.2 Strengthening the entrepreneurial ecosystem and young entrepreneurs

a. Accompaniment entrepreneurship

The entrepreneurship strengthening program is implemented through technical guidance to develop the spirit of young entrepreneurs in the fields of agricultural development, agricultural products, tourism and the agricultural product processing industry in Munduk Village. In the future, it is hoped

that the agricultural and tourism sectors and their supporting industries will be able to become areas of employment for today's young generation. Pre-test and post-test measurement results test is presented in Table 4.

Table 4. Results of measuring the knowledge and understanding of technical entrepreneurship guidance participants

	Average value	elementary school	Enhancement
Pre-test	6, 83	2.02	25,18 %
Post-test	8, 55	1.01	

Table 12 shows that the average value of knowledge and understanding of disaster management from participants has increased. During the pre-test they got a score of 6.82, whereas after taking part in the training (post-test) they got a score of 8.55 or an increase of 25,18 %.

b. Accompaniment right technology

The use of appropriate post-harvest technology includes designing a ladder model for pick clove flowers. Previously, when picking clove flowers, farmers used a ladder made from a single bamboo stick

with steps attached to each segment of the bamboo stalk. The length of the bamboo room varies greatly between 40 -75 cm, causing awkward working postures when climbing stairs. In an effort to assist technology, a ladder clamp model was designed that can be installed and removed and the size of the step distance can be adjusted according to the anthropometry of the farmer's feet.

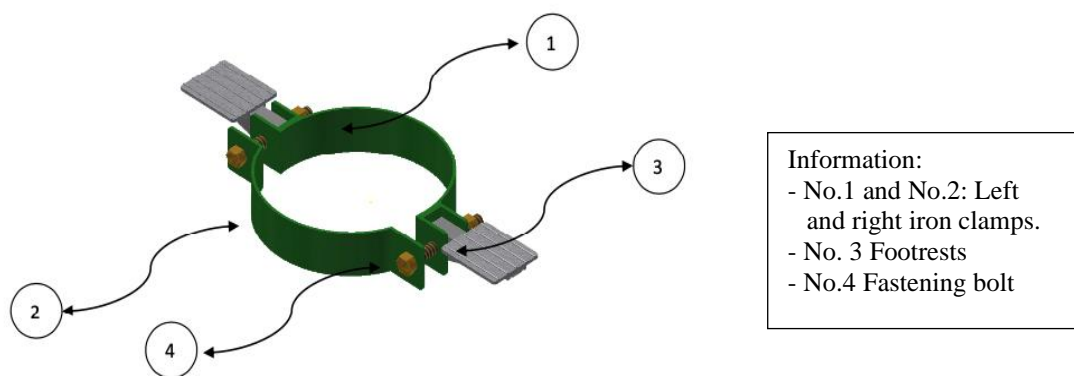


Figure 2. Ergonomic bamboo ladder clamp model for clove flower picker

Assistance program for implementing ergonomics in the process of harvesting coffee beans, farmers work from 07.00 WIT to 16.00 WIT with rest time from 11.00 WIT to 12.30 WIT. The results of

calculating work pulses, skeletal muscle complaints and farmer fatigue before work and after work picking coffee beans are presented in Table 5.

Table 5 Results of calculating the pulse rate of coffee bean picking farmers

Variable	Mean (beats per minute)	elementary school	t	p
Resting Pulse Rate	71.75	5.03	-9,034	0,000
Working Pulse	105.85	3.87		
Muscle Complaints Before work	31.43	2.01	-15,215	0,000
Muscle Complaints After Work	81.03	2.35		
Fatigue before work	33.03	0.21	-14,935	0,000
Fatigue after work	73.19	2.53		

The average pulse rate for coffee farmers is 105.85 beats per minute, including moderate workload (Grandjean & Kroemer, 2000). After performing the work, there was a significant increase in skeletal muscle complaints and general fatigue as listed in Table 5. In coffee farmers, skeletal muscle complaints mainly appeared in the hands, arms, shoulders, and waist (100% of workers). It's as well as pain in the neck, left and right upper arms, and back (80% of workers). In addition, subjective complaints included fatigue throughout the body, back pain, and thirst (100% of workers). There were also other complaints such as heaviness in the head, heavy legs, stiffness or awkwardness in moving, stiff shoulders, and body felt shaking. It will have bad consequences in terms of workers' health if these complaints are not properly resolved and workers continue to receive these complaints

Appropriate technological assistance for coffee bean processing includes

improvements to the dry coffee skin peeling machine with a skin removal system by side blower. In addition, there is also the possibility of improving the gap between the skin separation plates and a separate output model for the coffee that has been peeled off the blower. The design of this dry coffee skin peeling machine has been adapted to the anthropometric measurement data of 30 farmers, who have an average standing elbow height of ± 105.82 cm. As a result, the height of the machine has been planned to be about ± 10 cm lower than the elbow height, so that the height of the machine can reach 95 cm in order to facilitate operations in the process of stripping the dried coffee skin. The process of designing and testing the machine involves full participation of workers so that the machine can be used safely, comfortably, healthily and productively (Licht et al., n.d.).(Karwowski & Marras, 2003)

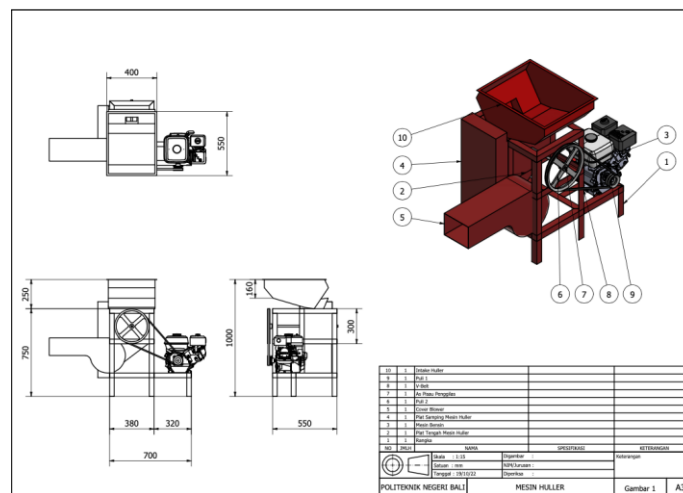


Figure 3. Design of a Dry Coffee Skin Peeling Machine

“Second-home accommodation models, is the second model accommodation

arrangement a healthy and hygienic home, because guests are always looking for a

clean, germ-free and attractive environment (Singh et al., n.d.). Second home model accommodation arrangement home aims to ensure that workplaces and equipment are designed appropriately and people are well trained to reduce the risk of skeletal muscle complaints due to non-ergonomic and repetitive movements (Mitra et al., n.d.). Ergonomic hazards in the hotel industry, the highest body part problem experienced by room attendants is low back pain (60%), followed by wrists/hands (41.5%), and knees (36.9%) (Nasrull et al., 2017). Results of the technical guidance questionnaire for arranging the "second home" accommodation model shows that there is an increase in understanding or competence in managing second home models, namely 15.00%. The pre-test score before starting technical guidance was an average of 6.3 to 7.2 after being given guidance.

1.1.3 Strengthening village information systems

The village information system strengthening program includes technical guidance on using the internet for entrepreneurship, business, promotion and strengthening hotspot networks wi-fi and improvements to the village website for services and access to village information. This activity was carried out through a participatory ergonomics approach by

involving village officials and the community in planning the village website, strengthening the wi-fi network. The results of village information system assistance showed that an average of 2.20 hours of village internet use per day was used per day before mentoring, while after mentoring village internet use of the village website averaged 3.50 hours per day or an increase of 59.00%. This increase has not been achieved optimally because internet access still has signal problems which are not very good so there are incidents of network loss for a while.

1.2 Economic Impact of Mentoring Programs

Application of SHIP ergonomics in the science and technology application program for regional development in Munduk Village - Bali, increasing community income through the application of ergonomic appropriate technology in post-harvest processing technology assistance through an entrepreneurship assistance program in the design of dry coffee skin peeling machines and assistance with "second-home" model lodging.

A. Economic Impact of Appropriate Technology Assistance

The comparison between the use of old model peeling machines and new model peeling machines is as follows:



A. Old Model Machine

B. New Model Machine (Assistance Results)

Figure 4. Comparison of old model machines and new model machines

Using model (A), there is no need to sort the coffee sizes. All sizes are processed by being fed into the inlet hole. The next step is to adjust the gap of the peeling plate by selecting the medium size. The result of the process is that almost half of the total coffee beans inserted have not been peeled so that the process needs to be repeated. Not only that, the coffee also still needs to be cleaned again because it is mixed with skin dirt. The results of measuring this dry coffee skin peeling machine performance are:

1). Old Model Engine Performance (A):

Based on 10 tests of 10 kilograms of coffee beans that are still skinned. It is known that the length of stripping is 0.58 hours on average. Thus, $K_p(A) = 55.56$ kg/hour.

Then, calculate the Kw or percentage of quality coffee beans that are properly shelled. It is calculated by dividing the weight of the shelled beans by the weight of the quality beans. In this experiment, it was found from 10 tests conducted on 10 kilograms of shelled coffee beans, that the amount of shelled was 4.8 kg. Meanwhile, the amount of good quality was 4.1 kg. Thus, $K_w(A) = 85.41\%$.

2). New Model Machine Performance (Results of Assistance)

The way the new model machine (B) works, dry coffee beans are inserted and the machine will peel and separate the coffee skin from the beans. The skin of the coffee beans peels off perfectly so there is no need for a repeat process.

Based on 10 tests of 10 kilograms of coffee beans that are still skinned. It is known that

the length of stripping is 0.065 hours on average. Thus, $K_p(B) = 153.84$ kg/hour.

Then, calculate the Kw or percentage of quality coffee beans that are properly shelled. It is calculated by dividing the weight of the shelled beans by the weight of the quality beans. In this experiment, it was found from 10 tests conducted on 10 kilograms of shelled coffee beans, that the amount of shelled was 5.4 kg. Meanwhile, the amount of good quality was 4.9 kg. Thus, $K_w(B) = 90.74\%$

Increase in the working capacity of the dry coffee peeler (K_p) = $(153.84 - 55.56) / 55.56 = 176.88\%$, while the increase in the quality of well-peeled coffee beans (K_w) is = $(90.74 - 85.41) / 85.41 = 6.24\%$. From the analysis, the new peeling machine can improve efficiency by shortening working time, reducing labor requirements, and improving the quality of coffee produced. By increasing the capacity of ground coffee beans, coffee farmers can increase their production from an average of 85 kg per day to 110 kg per day or an increase of 29.41%.

B. Second Model Lodging Assistance Home

The results increased tourist visits by 5.6%. This is in accordance with Vanessa Lizzette's research Barbosa-McCoy (2016), guest satisfaction has a positive influence on employee performance and motivation through community involvement provides a reason for employees to work well (Lizzette Barbosa-McCoy & Uk, n.d.).

Table 2. Results of Increasing the Number of Tourists Staying in the Second Model Home

	Average value per day	elementary school	Enhancement
Number of Tourists staying at Home Stay Per Before Accompaniment	158	1.16	5.6%
Number of Tourists staying at Home Stay Per day After Accompaniment	167	1.20	

CONCLUSION

(1). Integrated environmental conservation with strengthening agriculture, natural tourism and the post-harvest processing

industry for superior coffee and clove products.

a. Enhancement knowledge and understanding of participants in

- technical guidance for managing waterfall tourism and trekking tourism in conservation forest areas amounting to 42.488%.
- b. Increased knowledge and understanding of participants in technical guidance on groundwater conservation amounted to 40.04% and was built well rainwater recharge as many as 2 units up to in 2023.
 - c. Increased knowledge and understanding of disaster technical guidance participants of 60.51%
- (2). Strengthening the entrepreneurial ecosystem and young entrepreneurs.
- a. Enhancement knowledge and understanding of technical entrepreneurship guidance participants of 25.18%
 - b. Planning appropriate technology for flower harvesting clove “Clamp model child clove flower picking ladder”.
 - c. Redesigned design of the Dry Coffee Peeling Machine increases the capacity of the coffee bean peeling capacity original production averaged 85 kg per day to 110 kg per day or an increase of 29.41%, the working capacity of the dry coffee skin peeler (Kp) was 176.88%, and the quality of well-peeled coffee beans (Kw) increased by 6.24%.
 - d. Increasing number of tourists staying at Model Second Home by 5.6%.
- (3). Strengthening the village information system, on average the village website used the internet for 2.20 hours per day before mentoring, while after mentoring the village website internet usage averaged 3.50 hours per day or increased by 59.00%.

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