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The Application of the Total Ergonomics (SHIP) Method in Science and Technology for the Regional Development (PIPK): Case Study at Munduk Village, Bali

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ABSTRACT: Empowerment is a fundamental effort aimed at enhancing community capabilities and fostering greater participation in decision-making processes related to uplifting living standards. For example, Munduk is one of the tourist villages in Bali with several challenges such as the lack of appropriate tourist attraction areas to be used as an economic center and low productivity from community work. The problems have led to less optimal competitiveness in providing original income for community in the village. Therefore, community empowerment method was required to manage the potential of the village as a conservation, agricultural, coffee, and clove processing area and also tourism destination. This led to the implementation of SHIP (systemic, holistic, interdisciplinary, and participatory) ergonomics method to promote active participation of all parties in identifying problems to be fixed and determining the appropriate technology to be used. The process focused on a thorough analysis of the technology based on six criteria, including technical, economical, ergonomics, socio-cultural, energy efficiency, and environmental friendliness aspects. The method was used to provide a conducive working mechanism and quality products in accordance with the demands of the times. Moreover, ergonomics method implemented with the participation of all parties led to an increase in knowledge and understanding of community entrepreneurship by 25.3%, clove post-harvest processing productivity 22.7%, and tourist visits 5.6%.

KEYWORDS: SHIP Method, Community Empowerment, and Productivity

I. INTRODUCTION

The Regional Development Science and Technology Implementation Scheme Program (PIPK) was designed by the Ministry of Education and Culture of Indonesia through the Directorate of Vocational Higher Education. It was proposed to be initiated in 2021 due to the decline in the economy of the country after the Covid-19 pandemic which led to losses for several SMEs/business groups, an increase in unemployment, and a decrease in economic growth at the regional, national, and international levels [1]. An example was community empowerment implemented in Munduk Village, Buleleng, Bali, as a capacity-strengthening program to ensure independence and success for rural community. The program was designed to explore the potential of the village towards ensuring more productivity in terms of agriculture and human resources, as well as to develop innovation in collaboration with other institutions and community groups [2]. It was also intended to improve the regional potential in order to drive the village economy, increase the role of cooperatives and SMEs, foster new entrepreneurs, and provide employment opportunities. The PIPK was designed in line with Law Number 6 of 2014 concerning Villages to provide life support to the villages and ensure social, cultural, economic, and political independence. This was intended to ensure the villages could compete effectively without waiting for instructions. The launch of ASEAN Economic Community (AEC) also slowly influenced the wheels of development in the villages. This was shown by the contribution of several successful village empowerment programs such as Village Community Development and Empowerment Program (P3MD) in West Aceh Regency to the welfare of rural community through a resource optimization method with the participation of wider target groups [3]. Moreover, sustainable food programs were also implemented through direct practice in Bolu Village, Bojonogoro, to improve community knowledge and skills in managing sustainable food gardens [4].

Munduk is a village with five natural tourist attractions, including (a) flora in the form of rice fields, (b) fauna through forest bees to produce honey, (c) Red Coral and Golden Valley Waterfalls, (d) Lake Tamblingan, and (e) Protected Forest with an estimated area of 1,056,100 Ha [5]. The village

mostly offers tourism in the form of the natural beauty associated with the conservation areas. This can be identified in the trekking designed for visitors in the plantation areas and forests followed by a visit to a waterfall. The activity is usually conducted with the local community providing supporting facilities such as food and coffee shops as well as serving as tour guides [6]. However, the village is sensitive to strategic issues related to security, natural disasters, and health. It was also observed to have been affected more by the Covid-19 pandemic compared to the Bali bombings and Mount Agung eruption. Therefore, strategic efforts are required to increase the economic recovery of the village. This has led to the development of Munduk Tourism Smart Village (MODESTA) model in previous research in 2021 using Ergo-Infocom method. The output was in the form of MODESTA Munduk smart village application (Copyright No. 000304683) and a recommendation of some developmental policies based on Community 5.0 concept to speed up the economic recovery due to the impact of the Covid-19 pandemic. The application was used to assist community in the village to solve economic problems intelligently by empowering agro-business with a tourism nuance. An example was the designation of coffee plantations as an agro-tourism object to serve the dual role of tourism destination and production of exportable products that could please and inspire tourists. The efforts were also made to provide additional benefits related to the conservation of groundwater resources and the prevention of landslides. The results of the policy recommendations, through community service activities with the PIPK scheme, further led to the implementation of several activities including the 1) improvement of the entrepreneurial ecosystem through human resources development, 2) use of TTG for post-harvest processing of agricultural products, and 3) provision of assistance with second home accommodation models.

The background information led to the development of a program for community related to science and technology through ergonomics method. This was required due to the need to holistically integrate several factors influencing village development through the application of ergonomics concepts [7]. Therefore, the purpose was to develop the total ergonomics method based on SHIP [8],[9] which was further explained as systemic, holistic, interdisciplinary, and participatory [10]. The process also focused on the application of environmentally friendly, efficient, and productive technology. Ergonomics method was used to harmonize humans with task demands, work organization, and the environment [11]. The systemic aspect was used to identify and organize systems and relevant elements as well as to connect the tourism-cultural-processing-agricultural and industrial systems in order to achieve a sustainable conservation tourism goal. The holistic considered the local economic, social, and cultural aspects. The interdisciplinary focused on analyzing the tourism-environmental-social, cultural, and economic science field through ergonomics method. Meanwhile, the participatory discussed the participation of community and all relevant parties to improve sustainable development.

II. METHODOLOGY

This research was conducted in Munduk Village, Buleleng, Bali, for the 2022-2023 period. The preference for the village was due to the implementation of the PIPK program by the government. Therefore, qualitative descriptive methods were applied to thoroughly describe the implementation of SHIP ergonomics in order to determine the new impacts and consequences [12]. Respondents were 30 recipients of the program with a comprehensive understanding of the problems observed in implementing SHIP ergonomics method. The individuals were selected based on their expertise, knowledge, and participation in the empowerment activities conducted in the research period. Moreover, data were collected through interviews, observation, and documentation. The interviews were in-depth to determine the valuable insights and experiences of respondents regarding the application of SHIP ergonomics method in the PIPK program. Observations were in the form of visual assessment of the actual implementation process and the impact on local community while documentation included official reports, records, as well as additional information and context. The data collected were analyzed using an interactive qualitative analysis model [13] which was focused on data reduction, data presentation, and drawing of conclusions or verification [14].

III.RESULTS AND DISCUSSION

A. Creative Economy Entrepreneurship Assistance

The application of SHIP ergonomics method to Creative Economy Entrepreneurship activities and Entrepreneurship Technical Guidance was started from the systemic and holistic planning aspects [8]. This was achieved by identifying the materials, resources, and entrepreneurial potential to be developed. Moreover, entrepreneurship assistance was provided through an interdisciplinary method, including the management as well as environmentally friendly and appropriate technology disciplines. Respondents also participated actively in the mentoring model by analyzing the entrepreneurship plan and implementing the training facilitated by the mentor. The participation was to ensure a better understanding of entrepreneurship material through the harmonization of the theory with practical.

Technical guidance was implemented to cultivate a young entrepreneurial spirit as well as ensure the participants boldly and innovatively explore new opportunities [15]. The purpose was to add value to the agricultural development and product processing as well as the tourism industry in Munduk Village.

This was considered necessary to ensure young generations equipped with entrepreneurial skills had better ability to face the challenges of a rapidly changing work market [16]. The training was implemented through an 'andragogy' method that prioritized the participation of the participants in effective teaching and learning [17]. The material was presented as a form of reinforcement, with a larger portion provided through discussions, assignments, simulations, and/or practice. Moreover, the instructor requested that all individual and group assignments or practices be fulfilled as part of the process of achieving competency. The materials were delivered through 1. tutorial or lecture, 2. simulation, 3. discussion, questions, and answers, 4. participant presentation, and 5. evaluation or reflection. The training was conducted in a conducive manner through the provision of intermittent breaks and relaxation to restore concentration and fitness which led to enthusiasm for respondents.

The entrepreneurial ecosystem was required to be developed towards ensuring the connection and provision of mutual support among the actors. The purpose was to provide stimulation and positive influence for micro and small businesses. The effort was necessary because the overall business environment had a statistically significant relationship with the performance of these businesses [18]. Entrepreneurship can be a strategic method for overcoming unemployment and poverty in Indonesia because it has the ability to reduce the reliance of community on the government to solve economic problems. Meanwhile, technological progress is usually required to support creativity and innovation [19] in order to foster an entrepreneurial spirit [20]. There are also other internal factors in the entrepreneur that can influence entrepreneurial behavior. These include psychological factors in the form of personality traits as well as socio-demographic factors such as age, gender, work experience, family background, and others. Moreover, there are some other influential external factors from the outside such as the elements of the surrounding environment and contextual conditions as well as economic factors in the form of lack of capital, legal issues, and human resources [21]. It is also important to state that an individual with strong self-efficacy, subjective norms, and a need for achievement usually has a greater interest in entrepreneurship [22]. According to the National Development Planning Agency and the Coordinating Ministry for Economic Affairs, the entrepreneurial ecosystem is built from easily accessible markets, availability of human resources or workforce, sources of financing, support systems such as mentors, consultants, BDS, incubators, and entrepreneurial networks, framework regulations and infrastructure, education and training systems, availability of catalysts in the form of universities, and cultural support.

The knowledge and understanding level of respondents were measured before and after the training through pre-test and post-test. The purpose is to determine the achievement of the training objectives and the results obtained are presented in the following table:

Table 1. Results of knowledge and *understanding level*

	Average value	elementary school	Increased Knowledge and understanding
Pre-test	5.75	1.16	47.27%
Post-test	8.20	1.20	

The information presented in Table 1 showed that the average value of knowledge and understanding of entrepreneurship increased after the training. This was identified from a score of 5.75 recorded during pre-test compared to 8.20 for post-test, showing an increase of 47.27%. The increase was observed to be in line with the minimum of 10% targeted to be recorded in relation to the advancement of knowledge for respondents.

B. Use of Appropriate Technology for Post-Harvest Processing of Agricultural Products

SHIP ergonomics method was applied through the integration of an appropriate technology to process superior agricultural products identified in Munduk Village, including coffee and cloves. The process was initiated from the identification as well as continuous review and refinement of the appropriate technology application models through an iterative process based on input from stakeholders [23]. This was intended to produce a model for an energy-efficient, easy-to-use, and environmentally friendly clove flower stalk thresher machine. The next stage was to design the machine with due consideration for the users and environmental factors as well as the economics and mechanical engineering aspects to ensure it is economically feasible and ergonomically comfortable. Moreover, employees were fully included in the process of designing and testing the machine to ensure safe, comfortable, healthy, and productive usage [24], [25]. Clove flower stem thresher machine designed was tested in one of the meetings of clove farmer groups attended by Subak members, coffee business actors, and other members of the public. The categories of stripping materials were determined through certain important parameters including (1) the working capacity of clove flower stem thresher machine (Kp) and (2) the quality of clove flower (Kw). Furthermore, the working capacity was calculated 10 times at an average threshing time of 0.065 hours, and the result was presented as follows:

$$Kp = \frac{10 \text{ (kg)}}{0.19 \text{ (hour)}} = 52.63 \text{ kg/hour}$$

The average manual threshing capacity was found to be 42.89 kg/hour with a workforce of 2 people but the application of

the machine led to 52.63 kg/hour which was a 22.70% increase. Meanwhile, the quality of clove flower (Kw) was determined based on the separated weight divided by the weight of quality flowers. The trial conducted 10 times on 10 kg of clove flower showed that the average was 5.4 Kg and those with good quality were 4.9 Kg. The Kw was calculated using these figures as presented in the following relationship:

$$Kw = \frac{4.9\ (kg)}{5.4\ (kg)} \times 100\ \% = 90.74\ \%$$

C. Second Home Accommodation Model Assistance

The application of SHIP ergonomics to assist the development of second home accommodation model was initiated through the identification of the homes to be developed. The process was conducted systemically by considering different cultural and environmental systems as well as the historical value of the home. Moreover, the holistic aspect was applied to ensure the development was in accordance with local culture. The model was also made to be economically profitable, easily technically applied, environmentally friendly, and implemented with the participation of owners, employees, and tourism awareness group organizations in the village.

The aim of the model was to increase the value of previously unused rooms in order to improve the profits for the residents concerned. Moreover, some differences were identified in relation to the quality standards in second home existing in each area in terms of cleanliness and health of the environment. This led to the need to ensure healthy and hygienic designs to satisfy the desires of guests looking for a clean, germ-free, and attractive environment [26]. Second home was also arranged to have appropriate workplaces and equipment as well as well-trained employees to reduce skeletal muscle complaints due to non-ergonomics and repetitive movements [27]. The arrangement was made through the consideration of ergonomics hazards in the hotel industry with the highest reported by room attendants found to be low back pain at 60% followed by wrists or hands at 41.5%, and knees at 36.9% [28]. The implementation of second home for tourists was also supported by daily activities such as lodging, trekking, culinary packages to enjoy the village atmosphere, visits to waterfalls, and trying traditional foods. These activities were made through the participation of the natives in order to ensure tourism directly affected community. The arrangement of second home was focused on the rooms, housekeeping, and supporting facilities. This was achieved through the application of the right materials, smart equipment, as well as efficient layout and design to avoid clashes between guest movement and service while ensuring a higher return on investment [29]. The impact of this assistance was also determined through pre-test and post-test and the results from the questionnaire distributed showed that there was a 15% increase in the understanding or competence of respondents in managing second home model. This was confirmed by the average pre-test score of 6.3 to the post-test score of 7.2 after the assistance was provided. Moreover, tourist visits increased by 5.6% and this was in line with the results of Vanessa Lizzette Barbosa-McCoy (2016) that guest satisfaction had a positive influence on employee performance and motivation through community participation [30].

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

	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 homestay per day after assistance	167	1.20	

IV. CONCLUSIONS

Smart PIPK (Application of Science and Technology for in conclusion, the total ergonomics (SHIP) method was applied by the PIPK in Munduk Village, Buleleng, Bali. The process was used to achieve conducive work mechanisms and quality products through the participation of all relevant parties. Ergonomics method implemented led to an increase in knowledge and understanding of community entrepreneurship by 25.3%, clove post-harvest processing productivity 22.7%, and tourist visits 5.6%.

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REFERENCES

1. Academic Directorate of Vocational Higher Education, *Guide to Research and Community Service in Vocational Higher Education 1st Edition*, 1st ed., vol. 1. Jakarta: Academic Directorate of Vocational Higher Education Directorate General of Vocational Education Ministry of Education, Culture, Research and Technology, 2021. Accessed: Feb. 18, 2024. [Online]. Available:

https://simlitabmas.kemdikbud.go.id/unduh_berkas/Panduan%20Penelitian%20dan%20Pengabdian%20kepada%20Masyarakat%20Pendidikan%20Tinggi%20Vokasi%20Edition%201.pdf

2. M. Nalikan, A. Mochammad Rozikin MPA, A. Sumartono, A. Suryadi, and B. Slamet Riyadi SHMHMM, "The Implementation of Village Community Empowerment in Indonesia: A Social Capital Perspective," 2023.
3. N. Sari *et al.*, "Implementation of the Village Community Development and Empowerment Program through Priorities of the Use of Village Funds in the Coastal Area, Aceh Barat Regency," *Media Thought & Applications*, vol. 17, no. 1, pp. 172–180, 2023, doi: 10.24815.jsu.v17i1.32804.
4. DF Eprilianto, YE Kartika Sari, MF Ma'ruf, GW Pradana, Lasmijan, and E. Febrianti, "Village Community Empowerment through Sustainable Food Program in Realizing Sustainable Agriculture," in *IOP Conference Series: Earth and Environmental Science*, Institute of Physics, 2023. doi: 10.1088/1755-1315/1275/1/012022.
5. Made Surya Sasmika, MS Dra. Risa Panti Ariani, and S. Pd., MP Luh Masdarini, "Potential for Natural Tourism in Munduk Village, District. Banjar Regency Buleleng," *Bosaparis, Family Welfare Education*, vol. 8, no. 2, 2017.
6. P. Eka, W. Sekolah, T. Wisata, and B. International, "Characteristics of Farming and Trekking Tour Packages In North Bali," *JBHOST*, vol. 1, pp. 339–345, 2016.
7. L. Sudiajeng *et al.*, "Modesta - Munduk Smart Village Tourism Model: An Ergo-Infocom Approach for Economic Recovery Acceleration from Covid-19 Pandemic," in *Proceedings of the 5th International Conference on Applied Science and Technology on Engineering Science*, Scitepress - Science and Technology Publications, 2022, pp. 164–175. doi: 10.5220/0011729900003575.
8. A. Manuaba, "Total Approach is a Must for Small and Medium Enterprises to Attain Sustainable Working Conditions and Environment, with Special Reference to Bali, Indonesia," 2006.
9. E. Suparti, AT Wahyudi, and A. Fitrianingsih, "Total ergonomics approach to analyze work systems and propose improvements for increasing worker productivity," *OPSI*, vol. 16, no. 2, p. 174, Dec. 2023, doi: 10.31315/opsi.v16i2.9009.
10. S. Hignett, J.R. Wilson, and W. Morris, "Finding ergonomic solutions - Participatory approaches," *Occupational Medicine*, vol. 55, no. 3. pp. 200–207, May 2005. doi: 10.1093/occmed/kqi084.
11. A. Manuaba, "Total Approach is a Must for Small and Medium Enterprises to Attain Sustainable Working Conditions and Environment, with Special Reference to Bali, Indonesia," 2006.
12. H. Taherdoost, "Data Collection Methods and Tools for Research; A Step-by-Step Guide to Choosing Data Collection Techniques for Academic and Business Research Projects," *International Journal of Academic Research in Management (IJARM)*, vol. 2021, no. 1, pp. 10–38, 2021, [Online]. Available: https://hal.science/hal-03741847
13. A. Ananth and S. Maistry, "Invoking interactive qualitative analysis as a methodology in statistical education research," *The Journal for Transdisciplinary Research in Southern Africa*, vol. 16, no. 1, Nov. 2020, doi: 10.4102/td.v16i1.786.
14. "Qualitative Data Analysis: An Overview of Data Reduction, Data Display and Interpretation," *Research on Humanities and Social Sciences*, Nov. 2020, doi: 10.7176/rhss/10-21-02.
15. Muh. I. Said Ahmad, MI Idrus, and S. Rijal, "The Role of Education in Fostering Entrepreneurial Spirit in the Young Generation," *Journal of Contemporary Administration and Management (ADMAN)*, vol. 1, no. 2, pp. 93–100, Aug. 2023, doi: 10.61100/adman.v1i2.28.
16. "Entrepreneurial soft skills for the future: Executive summary Acknowledgments."
17. Y. Oparinde, O. Emmanuel, and OM Olarewaju, "Pedagogical Approach for Effective Teaching of English Language in Nigerian Secondary Schools," *Journal of Asian Multicultural Research for Educational Study*, vol. 1, no. 2, pp. 12–17, Nov. 2020, doi: 10.47616/jamres.v1i2.47.
18. MC Wube and H. Atwal, "The entrepreneurial ecosystem and the performance of micro and small enterprises (MSEs) in Amhara region, Ethiopia: the political–legal perspective," *Journal of Innovation and Entrepreneurship*, vol. 12, no. 1, Dec. 2023, doi: 10.1186/s13731-023-00334-8.
19. NO Juliana, HJ Hui, M. Clement, EN Solomon, and OK Elvis, "The Impact of Creativity and Innovation on Entrepreneurship Development: Evidence from Nigeria," *Open Journal of Business and Management*, vol. 09, no. 04, pp. 1743–1770, 2021, doi: 10.4236/ojbm.2021.94095.
20. A. Mardiana, E. Zahra Solikahan, M. Ardi, A. Sahabi, and A. Latif, "Enrichment: Journal of Management The influence of entrepreneurship education and training in building youth entrepreneurial spirit in Gorontalo province," 2023.

21. SM Jonnius, "Developing an Entrepreneurial Culture in Society," *Menara*, vol. 12, no. 1, pp. 48–55, Jan. 2013.
22. AK Wardhani, L. Rospida, and AK Wardhani, "Factors Influencing Interest In Entrepreneurship Among Bengkulu University Students Using The Theory Of Planned Behavior," *EKOMBIS REVIEW: Scientific Journal of Economics and Business*, vol. 12, no. 1, p. 12, 2024, doi: 10.37676/ekombis.v12i1.
23. S.E. Peters, H.D. Trieu, J. Manjourides, J.N. Katz, and J.T. Dennerlein, "Designing a participatory total worker health® organizational intervention for commercial construction subcontractors to improve worker safety, health, and well-being: The 'arm for subs' trial," *Int J Environ Res Public Health*, vol. 17, no. 14, pp. 1–15, Jul. 2020, doi: 10.3390/ijerph17145093.
24. DM Licht, DJ Polzella, KR Boff, and HG Armstrong, "Human Factors, Ergonomics, and Human Factors Engineering: An Analysis of Definitions."
25. W. Karwowski and WS Marras, "Occupational Ergonomics: Design and Management of Work Systems," Boca Raton New York, 2003. Accessed: Jul. 27, 2023. [Online]. Available: https://ftp.idu.ac.id/wp-content/uploads/ebook/ip/BUKU%20ergonomi/Buku%20inggris/Occupational%20Ergonomics%20Design%20and%20Managementof%20Work%20Systems.pdf
26. V. Singh, A. Ambardar, and A. Singh, "Barriers on Implementing Ergonomic Practices in Hotel Housekeeping." [On line]. Available: https://www.researchgate.net/publication/371450379
27. R. Mitra, SB Mukhopadhyay, M. Sohini, and B. Mukhopadhyay, "The impact of ergonomics on the productivity and performance of hotel housekeepers."
28. M. Nasrull, A. Rahman, M. Syahir, and M. Jaffar, "Musculoskeletal Symptoms and Ergonomic Hazards Among Room Attendants in Hotel Industries," 2017.
29. R. Sethi, "Ergonomic Design and Lean Management in the Hospitality Industry in India," 2020.
30. V. Lizzette Barbosa-Mccoy and A. Uk, "Scholar Works Hotel Managers' Motivational Strategies for Enhancing Employee Performance CORE View metadata, citations and similar papers at core." [On line]. Available: https://scholarworks.waldenu.edu/dissertations