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The Role of Productivity in the Relationship Between Ergonomics and Sustainable Performance of Food MSMEs

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A B S T R A C T

Food-based MSMEs face challenges in improving productivity and sustainability due to production processes that remain dominated by manual activities. The application of ergonomics is one approach to supporting increased productivity and business sustainability. This study aims to analyze the effect of ergonomics on sustainable performance through the role of productivity in food MSMEs in Payakumbuh City. This study uses a quantitative approach involving 92 food MSME operators, analyzed using *Partial Least Squares Structural Equation Modeling* (PLS-SEM). The results show that ergonomics positively affects productivity and sustainable performance. Productivity also mediates the relationship between ergonomics and sustainable performance in food MSMEs. Implementing ergonomics and improving productivity need to be part of efforts to develop sustainable food MSMEs.

Contribution to Sustainable Development Goals (SDGs):
SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation and Infrastructure
SDG 12: Responsible Consumption and Production

1. INTRODUCTION

1.1. Research Background

Sustainable performance has become one of the primary goals of organizations in the face of increasingly dynamic business competition. For micro, small, and medium-sized enterprises (MSMEs), sustainability is determined not only by economic performance but also by the ability to maintain a balance between social and environmental aspects [1]. Therefore, improving sustainable performance is critical to maintaining competitiveness and ensuring the long-term viability of businesses [2].

One approach that can support sustainable performance is the application of ergonomics. Ergonomics focuses on adapting work systems to human characteristics to improve safety, comfort, and work efficiency [3]. In addition to reducing occupational risks, the application of ergonomics has also been proven to increase productivity and support organizational sustainability [4][5].

Food MSMEs that still rely on manual and labor-intensive production systems are likely to face various ergonomic issues that can affect productivity and business sustainability [5]. The city of Payakumbuh was selected as the research context because it is one of the centers for traditional food MSMEs in West Sumatra, where the majority of production activities are still carried out manually [6]. Based on preliminary observations conducted by the researchers at ten food SMEs in Payakumbuh, most production processes—such as ingredient processing, cooking, packaging, and product handling—are still carried out manually, thereby exposing workers to the risks of non-ergonomic work postures, repetitive movements, and high physical workloads. These conditions indicate potential ergonomic issues that could affect worker productivity and hinder sustainable business performance [5].

The application of ergonomics has long been viewed as an approach capable of improving organizational performance through various mechanisms. Some studies emphasize increased productivity as the primary outcome of ergonomics

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implementation [7], while others highlight its contribution to organizational performance and business sustainability [4][5]. Additionally, job satisfaction has been identified as an outcome of ergonomics implementation [9]. These differing findings indicate that the relationship between ergonomics and sustainable performance still requires further study in the context of food-based SMEs.

Most previous studies were conducted in the manufacturing sector and large-scale organizations; therefore, they do not fully represent the operational characteristics of food SMEs, which still rely on manual production systems [4]. Increased productivity is seen as a key factor in explaining how ergonomics can support sustainable performance by improving the efficiency of work processes [8]. The city of Payakumbuh was selected as the research context because it is a major hub for food SMEs, where the majority of production activities are still carried out manually, and its operational characteristics are also common among food SMEs in other regions.

1.2. Literature Review

1.2.1. Ergonomics and Sustainable Performance

Ergonomics is a discipline that focuses on optimizing the interaction between humans and work systems to improve human well-being and overall system performance [3]. In food-related MSMEs that still rely on manual and labor-intensive production systems, the application of ergonomics plays a role in creating a safe, comfortable, and efficient work environment that supports the effectiveness of work processes.

Sustainable performance reflects an organization's ability to achieve a balance between economic, social, and environmental aspects in a sustainable manner [1]. Previous research has shown that the proper application of ergonomics contributes to improved organizational performance through enhancements to work systems and increased operational efficiency [4][5]. Therefore, the application of ergonomics has the potential to support sustainable performance, particularly in food MSMEs that still rely on manual production.

1.2.2. Productivity in Supporting Sustainable Performance

Productivity is an organization's ability to generate output effectively and efficiently through the utilization of available resources [7]. In food SMEs, productivity is not only related to increased output but also reflects a business's ability to optimize work processes to ensure business sustainability.

Previous research indicates that increased productivity contributes to organizational performance through improved operational efficiency and business competitiveness [8]. Increased productivity also enables more optimal resource utilization, thereby supporting the achievement of sustainable performance. Thus, productivity is seen as playing a role in explaining how the application of ergonomics can translate into sustainable performance in food SMEs.

1.2.3. Job Satisfaction as an Outcome of Ergonomic Practices

Job satisfaction is an emotional state that reflects an individual's level of satisfaction with their work and can be influenced by various factors, including work environment conditions [9]. The implementation of an ergonomic work system has the potential to increase workers' comfort and positive perceptions of their work environment, thereby supporting the more effective performance of work activities.

Various studies indicate that job satisfaction is one outcome that can be influenced by the implementation of ergonomics [9]. Therefore, job satisfaction is included in the research model to provide a more comprehensive understanding of the impact of ergonomics implementation on food MSMEs.

1.3. Research Objective

This study aims to analyze the influence of ergonomics on sustainable performance through the role of productivity in food MSMEs in Payakumbuh City. The findings of this study are expected to provide additional empirical evidence on the application of ergonomics to support productivity and sustainable performance in food MSMEs with similar operational characteristics.

2. MATERIALS AND METHODS

2.1. Designing the Framework

This study developed a conceptual model that explains the relationship between ergonomics, productivity, job satisfaction, and sustainable performance in food MSMEs characterized by manual and labor-intensive production systems. Productivity is positioned as a mediating variable in explaining the relationship between ergonomics and sustainable performance, while job satisfaction is considered a supporting variable to provide a more comprehensive picture of the impact of ergonomics implementation on food MSMEs. Sustainable performance is measured through economic, social, and environmental dimensions. The research framework used in this study is shown in Figure 1.

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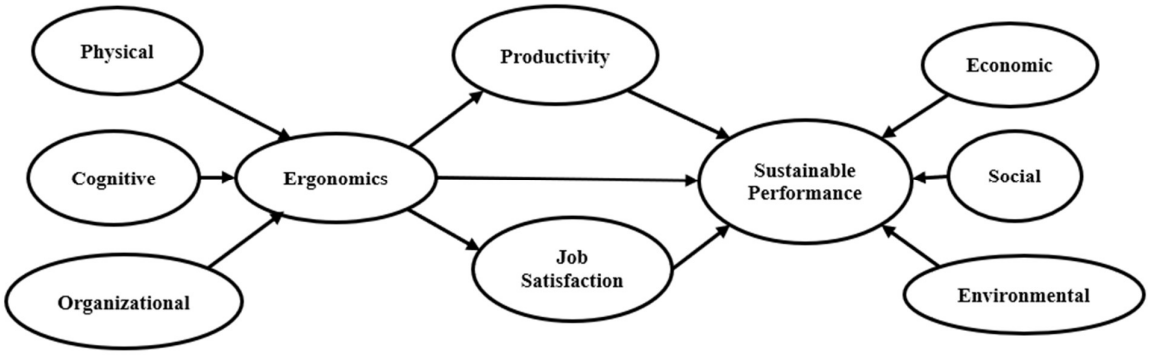

Fig 1. Research Framework

Based on the research framework used, the implementation of ergonomics is viewed as having the potential to support sustainable performance, both directly and through improvements in productivity and job satisfaction. Increased productivity enables food MSMEs to utilize resources more effectively and efficiently, thereby supporting the achievement of sustainable performance [8]. Additionally, implementing ergonomic work systems has the potential to increase job satisfaction by improving working conditions [9]. Thus, the relationship between variables in the research model are formulated into the following research hypotheses:

Hypothesis 1. Ergonomics has a positive effect on productivity.
Hypothesis 2. Ergonomics positively affects job satisfaction.
Hypothesis 3. Ergonomics positively affects sustainable performance.
Hypothesis 4. Productivity positively affects sustainable performance.
Hypothesis 5. Job satisfaction positively affects sustainable performance.
Hypothesis 6. Productivity mediates the relationship between ergonomics and sustainable performance.
Hypothesis 7. Job satisfaction mediates the relationship between ergonomics and sustainable performance.

2.2 Population and Sample

The study population consisted of 1,075 food-related MSMEs registered with the Payakumbuh City Department of Labor and Industry in 2024. The sample size was determined using the Slovin formula with a 10% margin of error, resulting in 92 respondents. The research sample was selected using *proportionate stratified random sampling* to ensure a representative proportion of respondents from each subdistrict in Payakumbuh City. The sample size was deemed adequate for PLS-SEM analysis, as it was calculated using the Slovin formula based on the study population and was consistent with the characteristics of the research model, which involved latent constructs and mediating relationships between variables. The PLS-SEM approach is also widely used in predictive research and is capable of simultaneously analyzing research models involving second-order *constructs* [11].

2.3 Data Collection

Research data were collected using a structured questionnaire designed around the indicators for each research variable: ergonomics, productivity, job satisfaction, and sustainable performance. All questionnaire items were measured using a five-point Likert scale, ranging from strongly disagree to strongly agree. The questionnaires were distributed directly to food MSME operators in Payakumbuh City, who served as the study's respondents.

2.4. Data Analysis

The research data were analyzed using the *Partial Least Squares Structural Equation Modeling* (PLS-SEM) approach with the assistance of SmartPLS 4.0 software [11]. This approach was chosen because it is suitable for analyzing relationships among latent constructs in a research model involving mediating effects and second-order *constructs*. Model evaluation was conducted by testing *the measurement and structural models*. The measurement model was evaluated through tests of construct validity and reliability, while the structural model was evaluated through tests of multicollinearity, the coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2), *Standardized Root Mean Square Residual* (SRMR), as well as tests of direct and indirect effects among the research variables using the *bootstrapping* procedure [11].

3. RESULT AND DISCUSSION

3.1. Measurement Model Evaluation

The measurement model was evaluated to ensure that all research constructs met the recommended validity and reliability criteria before conducting the structural model tests [11]. Given that this study uses *a Hierarchical Component Model* (HCM) with first-order reflective and second-order formative constructs, the measurement model was tested based on the characteristics of each construct.

3.1.1. First-Order Construct Testing

The results of the evaluation of first-order reflective constructs are presented in Table 1. The testing was conducted using *outer loading* values, *Average Variance Extracted* (AVE), *Composite*

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Reliability (CR), and *Cronbach's Alpha* (CA) to ensure the convergent validity and reliability of the research constructs [11].

Table 1. Evaluation of First-Order Reflective Constructs

Construct		Loading Factor	AVE	CR	CA
Ergonomics (Physical)	EP	0.671 – 0.894	0.660	0.852	0.736
Ergonomics (Cognitive)	EC	0.733 – 0.801	0.593	0.853	0.771
Ergonomics (Organizational)	EO	0.826 – 0.865	0.706	0.878	0.791
Productivity	P	0.613 – 0.834	0.590	0.877	0.823
Job Satisfaction	JS	0.708 – 0.873	0.615	0.826	0.718
Sustainable Performance (Economic)	SPE	0.720 – 0.851	0.601	0.857	0.777
Sustainable Performance (Social)	SPS	0.904 – 0.940	0.850	0.919	0.826
Sustainable Performance (Environment)	SPV	0.765 – 0.816	0.634	0.838	0.718

Discriminant validity testing was conducted using *the Heterotrait-Monotrait Ratio* (HTMT) and *the Fornell-Larcker Criterion* to ensure that each research construct could be empirically distinguished from one another. The results of the discriminant validity testing are presented in Table 2.

Table 2. Discriminant Validity Assessment

HTMT

Cons.	EP	EC	EO	SPE	SPS	SPV	JS	P
EP								
EC	0.437							
EO	0.109	0.241						
SPE	0.366	0.422	0.256					
SPS	0.272	0.089	0.270	0.294				
SPV	0.165	0.143	0.365	0.425	0.159			
JS	0.112	0.250	0.187	0.198	0.169	0.199		
P	0.239	0.377	0.224	0.813	0.173	0.355	0.267	

Fornell Lacker

Const.	EP	EC	EO	SPE	SPS	SPV
EP	0.813					
EC	0.334	0.770				
EO	0.074	0.190	0.840			
SPE	0.257	0.303	0.199	0.775		
SPS	0.209	0.031	0.213	0.238	0.922	
SPV	0.096	0.079	0.286	0.340	0.137	0.796

Based on Table 2, all reflective constructs met the HTMT and Fornell-Larcker criteria for discriminant validity. These results indicate that each research construct is sufficiently distinct to be empirically distinguished from the others [11].

3.1.2. Pengujian Second Order Construct

The second-order formative construct test was conducted using *outer weights*, *the Variance Inflation Factor* (VIF), and significance values to ensure that each dimension adequately represents the second-order construct [11]. The results of *the second-order* formative construct evaluation are presented in Table 3.

Table 3. Evaluation of Second-Order Formative Constructs

Construct	Outer Weight	OuterVIF	t-stat.	p-val.
EP	0.282	1.125	2.011	0.044
EC	0.683	1.161	3.365	0.001
EO	0.439	1.037	2.274	0.023
SPE	0.946	1.181	34.16	0.000
SPS	0.008	1.064	1.550	0.121
SPV	0.132	1.135	2.918	0.004

Based on Table 3, all dimensions of the ergonomics construct have VIF values below the recommended threshold, indicating no multicollinearity.

The physical ergonomics, cognitive ergonomics, and organizational ergonomics dimensions have significant outer weights, meaning they all contribute to the ergonomics construct. In the sustainable performance construct, the economic and environmental dimensions show significant contributions, while the social dimension has *a p-value* of 0.121 and is therefore not statistically significant. Nevertheless, the social dimension is retained in the model because it is conceptually an integral part of the sustainable performance construct and remains theoretically relevant in line with the *triple bottom line* concept. Therefore, the social dimension is retained to more comprehensively represent the sustainable performance construct [9].

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3.2 Structural Model Evaluation

A structural model evaluation was conducted to assess the quality of the structural model developed in this study. The evaluation included *an assessment of collinearity* among constructs, *model fit*, *the coefficient of determination*, *effect size*, and *specific indirect effects* within the research model [11].

3.2.1. Collinearity and Model Fit Assessment

Collinearity was assessed using the *inner variance inflation factor* (Inner VIF) to ensure no multicollinearity among the constructs in the structural model. Additionally, model fit was evaluated using the *standardized root mean square residual* (SRMR), where the model is considered to meet *the goodness-of-fit* criteria if it has an SRMR value less than 0.08 [11]. The results of the collinearity test among constructs are presented in Table 4.

Table 4. Results of the Collinearity Assessment (Inner VIF)

Hypothesis	Inner VIF	Decision
Ergonomic → Productivity	1.000	Supported
Ergonomic → J. Satisfaction	1.000	Supported
Ergonomic → Sustainable Performance	1.115	Supported
Productivity → Sustainable Performance	1.134	Supported
J. Satisfaction → Sustainable Performance	1.043	Supported

Based on Table 4, all relationships between constructs have inner VIF values that meet the recommended maximum, indicating no multicollinearity in the structural model.

The test results show that the research model has an SRMR value of 0.082 for *the saturated model* and 0.091 for *the estimated model*. These values indicate that the research model remains within acceptable limits (*an acceptable model fit), so the structural model is considered adequate for use in the subsequent hypothesis-testing* stage [11].

3.2.2. Coefficient of Determination and Effect Size

The coefficient of determination (R^2) measures the ability of exogenous constructs to explain variation in endogenous constructs in the research model, whereas the effect size (f^2) quantifies the magnitude of each relationship's contribution in the structural model [11]. The results of the coefficient of determination (R^2) test for the endogenous constructs are presented in Table 5.

Table 5. Coefficient of Determination (R^2)

Endogenous Variable	R^2
Productivity	0.097
Job Satisfaction	0.018
Sustainable Performance	0.464

Based on Table 5, the R^2 values indicate that ergonomics explains 9.7% of the variation in productivity, while 46.4% of the variation in sustainable performance can be explained by the constructs in the research model. These results show that the model's ability to explain endogenous constructs varies according to the characteristics of the proposed relationships among variables.

Next, the results of *the effect size* tests, based on f^2 values for each relationship between constructs, are presented in Table 6.

Table 6. Results of Effect Size (f^2)

Hypothesis	f^2	Decision
Ergonomic → Productivity	0.107	Weak
Ergonomic → J. Satisfaction	0.018	Negligible
Ergonomic → Sustainable Performance	0.058	Weak
Productivity → Sustainable Performance	0.579	Strong
J. Satisfaction → Sustainable Performance	0.001	Negligible

Based on Table 6, the relationships between constructs in the research model show varying effect sizes. The relationship between productivity and sustainable performance shows a large effect size, whereas the relationships between ergonomics and productivity and between ergonomics and sustainable performance show small effect sizes. Meanwhile, the relationships between ergonomics and job satisfaction, and between job satisfaction and sustainable performance, show negligible *effect* sizes based on the f^2 values obtained.

3.2.3. Mediation Analysis

Mediation analysis was conducted to test the specific indirect effects between constructs in the research model and to evaluate the role of mediating variables in explaining the relationships among the variables under study [11]. The results of the specific indirect effect tests are presented in Table 7.

Table 7. Indirect Effect Results

Hypothesis	Path (β)	t-stat.	p-val.	Decision
Ergonomic → Productivity → Sustainable Performance	0.185	2.768	0.006	Supported
Ergonomic → J. Satisfaction → Sustainable Performance	0.004	0.152	0.879	Not Supported

Based on Table 7, the test results indicate that productivity significantly mediates the relationship between ergonomics and sustainable performance. Conversely, job satisfaction does not show a significant mediating effect on this relationship, based on the test results.

3.3 Hypothesis Testing

Hypothesis testing was conducted using bootstrapping to evaluate the significance of the relationships among constructs in the research model, based on the obtained *t-statistics* and *p-values* [11]. The results of the hypothesis testing on the relationships between constructs are presented in Table 8.

Table 8. Results of Hypothesis Testing

Hypothesis	Path (β)	t-stat.	p-val.	Decision
Ergonomic → Productivity	0.311	2.936	0.003	Supported
Ergonomic → J. Satisfaction	-0.133	0.745	0.456	Not Supported
Ergonomic → Sustainable Performance	0.187	1.962	0.050	Supported
Productivity → Sustainable Performance	0.593	8.095	0.000	Supported
J. Satisfaction → Sustainable Performance	-0.027	0.269	0.788	Not Supported

Based on Table 8, the test results indicate that most relationships among constructs in the research model are supported by empirical data. Ergonomics had a significant effect on productivity, and productivity had a significant effect on sustainable performance. Conversely, the relationships between ergonomics and job satisfaction, and between job satisfaction and sustainable performance, did not show a significant effect based on the test results.

3.4 Discussion

Ergonomics contributes to increased productivity in food MSMEs. Improvements in working conditions and systems allow production activities to be carried out more efficiently. In food MSMEs, which are still dominated by manual production processes, increased productivity is a critical factor in supporting the business's operational sustainability. Previous studies have also shown that the application of ergonomics contributes to increased productivity in labor-intensive work environments and MSMEs [5][8]. The application of ergonomics should be an integral part of efforts to improve the operational productivity of food MSMEs.

Ergonomics contributes to sustainable performance improvement in food MSMEs. The application of ergonomics supports the effectiveness of work processes and better utilization of resources in the operational activities of MSMEs. These conditions are crucial for food MSMEs to maintain business sustainability amid resource constraints and demands for improved performance. Previous research has also shown that the application of ergonomics contributes to the achievement of sustainable performance in organizations and SMEs [1][4]. Ergonomics plays a role in achieving sustainable performance in food SMEs.

Productivity serves as a significant mediator in the relationship between ergonomics and sustainable performance in food-based SMEs. Improvements in ergonomics must be accompanied by increases in productivity to have an impact on achieving sustainable performance. In food SMEs, productivity is a crucial mechanism because it relates to a business's ability to optimize production processes and maintain operational sustainability. Previous research has also shown that productivity plays a vital role in supporting the achievement of sustainable performance in SMEs and organizations [2][10]. Productivity is the primary mechanism explaining the relationship between ergonomics and sustainable performance in food SMEs.

Job satisfaction does not exhibit a significant mediating role in the relationship between ergonomics and sustainable performance in food SMEs. Increased ergonomics implementation is not always followed by increased job satisfaction or by the achievement of sustainable performance through the job satisfaction mechanism. In the context of food SMEs, sustainable performance is more influenced by increased productivity than by job satisfaction in business operations. Previous research has also shown that the relationship between ergonomics, job satisfaction, and performance can be influenced by different work environments and organisational characteristics [7][9]. Job satisfaction still provides additional insight into the impact of ergonomics implementation, even though it is not the primary mechanism in explaining the relationship between ergonomics and sustainable performance.

The findings of this study indicate that productivity is the primary mechanism explaining the relationship between ergonomics and sustainable performance in food MSMEs. These results suggest that implementing ergonomics not only improves operational efficiency but also contributes to sustainable performance by increasing productivity. These findings can be applied to other food SMEs with similar operational characteristics, such as production processes still dominated by manual activities and limited resources. The results of this study reinforce the importance of productivity as a mechanism linking the implementation of ergonomics to sustainable performance in food SMEs.

3.5 Implications of the Study

The implications of this study indicate that improving sustainable performance in food SMEs must be pursued gradually through the implementation of ergonomics aimed at increasing productivity. Based on the study's findings, implementation can be carried out through ergonomic improvements in the short term (0–6 months), optimization of operational productivity in the medium term (6–18 months), and strengthening of sustainable performance in the long term (18–36 months). This approach can support the development of food MSMEs that are more productive, efficient, and sustainable, aligned with their operational characteristics. The implementation roadmap to support productivity improvements and achieve sustainable performance in food MSMEs is presented in Table 9.

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Table 9. Implementation Roadmap Based on Research Findings.

Time Frame	Focus	Implementation Strategy	Expected Outcome
0 – 6 months	Ergonomic improvement	Workstation redesign, ergonomic training, work-rest scheduling, workplace layout improvement, and development of standard operating procedures (SOPs) for production activities	Improved working conditions, operational efficiency, and ergonomic awareness among workers
6 – 18 months	Productivity optimization	Productivity monitoring, digital ergonomic monitoring, process standardization, quality control improvement, and resource utilization efficiency evaluation	Improved productivity, production consistency, and operational performance
18 – 36 months	Sustainable performance improvement	Sustainable production practices, waste management practices, sustainability performance monitoring, and integration of sustainable SMEs development programs through government and stakeholder support	Improved sustainable performance and strengthened sustainable SMEs development

4. CONCLUSION

Productivity plays a crucial role in the relationship between ergonomics and sustainable performance in food MSMEs. Increased productivity serves as a mechanism to support the implementation of ergonomics and achieve sustainable performance. Therefore, improvements in ergonomics must be accompanied by efforts to boost productivity to support the sustainability of food MSMEs. The implementation of ergonomics and productivity improvements must be part of a sustainable development strategy for food MSMEs. For MSME operators, improvements to working conditions and production processes can be implemented gradually to enhance operational efficiency and business sustainability. The findings of this study can also serve as a basis for local governments and stakeholders in designing MSME development programs that support productivity and sustainable performance. The research results remain limited to food MSMEs in Payakumbuh City and are more relevant to food MSMEs with similar operational characteristics. Future research could test this model across broader SME sectors or regions to gain a more comprehensive understanding of the relationship among ergonomics, productivity, and sustainable performance. Additionally, future studies could consider other factors that may influence sustainable performance, such as innovation, business digitalization, and organizational capabilities.

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