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Optimization Model for Marine Ecotourism Development to Achieve Sustainability and Inclusivity: A Case Study of Coastal Villages in Malang Regency

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Abstract

Research aims to develop an optimization model for marine ecotourism development to achieve sustainability and inclusivity: a case study of coastal villages in Malang Regency, including: Ampelgading, Bantur, Donomulyo, Gedangan, Sumbermanjing Wetan, and Tirtoyudo. This research is a quantitative study using primary data. Quantitative research is research that produces findings that can be achieved (obtained) using statistical procedures or other means of quantification. The GeSCA method will be used to develop a model for marine tourism area development. Out of the 6 tested hypotheses, five were accepted and one was rejected. Here are the results of the tests: Contribution to biodiversity conservation (O1) affects the Use of New and Renewable Resources (O6) can be accepted. Include Interpretation or Learning Experience (O3) affects the Use of New and Renewable Resources (O6)" is rejected. Use of New and Renewable Resources (O6) affects the Development of Small-Scale Enterprises (O5) can be accepted. Development of Small-Scale Enterprises (O5) affects the Sustainable Community Well-being (O2) can be accepted. Development of Small-Scale Enterprises (O5) affects the Community Participation, Ownership, and Business Opportunities (O7) can be accepted. Sustainable Community Well-being (O2) affects the Involve Responsible Action by Tourists and the Tourism Industry (O4) can be accepted.

Keywords: *Ecotourism;* coastal villages; *optimization; sustainability; optimization*

A. INTRODUCTION

Tourism is one of the largest and fastest-growing industries in the world, and it is an increasingly important source of income, employment, and wealth in many countries. However, its rapid expansion has had adverse environmental (and socio-cultural) impacts in many regions. (Frederico Neto, 2003). Therefore, the promotion of tourism has been identified as a key strategy that can boost the economy, community development, and poverty alleviation in developing countries. (Tony Binns, et al, 2002). Tosun (2001) found that the factors emerging as challenges for sustainable tourism development are related to national economic policy priorities, public administration structure, emerging environmental issues, excessive commercialization, and the structure of the international tourism system. He concluded that although the principles of sustainable tourism development are beneficial, their implementation is a highly challenging task to achieve due to the existing socio-economic and political conditions in developing countries.

After sustainable development was popularized as an environmental management concept with the publication of 'Our Common Future' by the World Commission on Environment and Development (WCED) in the late 1980s (WCED, 1987), an increasing number of tourism research literature has focused on the principles and practices of sustainable tourism development. "The term sustainable tourism has come to represent and encompass a set of principles, policy prescriptions, and management methods" (Hunter, 1997).

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However, according to Tisca, Istrat, Dumitrescu & Cornu (2016), as the fastest-growing sector in the tourism industry, ecotourism offers various benefits of the comparative advantages of developing countries in terms of pristine natural environments. By definition, such development should be more beneficial to destinations in terms of involving small-scale local communities with fewer adverse impacts. Opportunities for developing countries to enhance development potential by utilizing their natural resources without damaging them. However, it is crucial to recognize that without adequate understanding of the underlying factors and careful planning and management, ecotourism can encompass unsustainable aspects. Therefore, sustainable tourism without the concept of ecotourism will face difficulties in achieving the goals of environmental protection, awareness, socio-cultural protection, and economic development. Ecotourism can be seen as a tool to strengthen sustainable tourism because it emphasizes the principles of sustainable tourism. Hence, understanding the role of ecotourism in achieving sustainable tourism is of vital and strategic importance. To achieve this goal, understanding the importance of the role of ecotourism in supporting the development of sustainable tourism becomes the main pillar. Three main themes emerge, including: economic, environmental, and socio-cultural aspects. Proper implementation of ecotourism can help destinations economically, socially, and environmentally by creating more jobs, developing investment opportunities, and protecting the destination's culture, environment, and natural resources.

Malang Regency has 114 (one hundred and fourteen) tourist villages, many of which still lack a model for developing into marine ecotourism areas to achieve sustainability and inclusivity. Therefore, the tourist village areas in Malang Regency need to be encouraged to develop into tourist village areas that prioritize the concept of public-private partnership. However, according to Bramantyo, Sistrantiani, Harmono, Priyanto & Kusuma (2012), the broader impact of integrated and sustainable development is expected to create extensive job opportunities for the community and spur the growth of productive enterprises for the community, based on innovation in Malang Regency.

Based on the above background, the research aims to develop an optimization model for marine ecotourism development to achieve sustainability and inclusivity: a case study of coastal villages in Malang Regency, including: Ampelgading, Bantur, Donomulyo, Gedangan, Sumbermanjing Wetan, and Tirtoyudho.

B. RESEARCH METHOD

This research is a quantitative study using primary data. Quantitative research is research that produces findings that can be achieved (obtained) using statistical procedures or other means of quantification. This study falls under the category of causal research design. Causal research is useful for measuring the relationship between research variables, or for analyzing how one variable influence another. The research method used is the correlational method, which is designed to determine the degree of relationship between different variables within a population. For this purpose, the GeSCA method will be used to develop a model for marine tourism area development.

The description of respondents refers to a detailed explanation of the characteristics or profile of respondents in a research or survey. The aim is to provide a comprehensive picture of the research participants' profile so that readers can understand the context or perspective brought by the respondents in providing answers or data. The respondents of this study are residents of the coastal villages in Tirtoyudho District, totaling 90 respondents. The respondent data was obtained from the distribution of questionnaires. The research was conducted by distributing the research questionnaires from October 6-16, 2024. This description contains relevant information about the characteristics of the respondents (Table 1).

Table 1. Respondents Characteristics

No	Characteristic	Total Sample n=90	
		Count	Percentage (%)
1.	**Jenis Kelamin**		
	Male	65	72.2
	Female	25	27.8
2.	**Age**		
	21 - 30 years	13	14.4
	31 - 40 years	28	31.1
	41 - 50 years	26	28.9
	51 - 60 years	23	25.6
3.	**Education**		
	No Schooling	3	3.3
	Elementary School	28	31.1
	Middle School	27	30.0
	High School	21	23.3
	Vocational School	9	10.0
	Bachelor's Degree	2	2.2
4.	**Ocupation**		
	Teacher	2	2.2
	Housewife	7	7.8
	Government Section Head	1	1.1
	Village Head	2	2.2
	Fisherman	15	16.7
	Fish Packer	1	1.1
	Merchant	11	12.2
	Village Official	5	5.6
	Farmer	31	34.4
	Odd Jobs	4	4.4
	Staff	1	1.1
	Private Sector	10	11.1
5	**Income**		
	< 1 million	41	45.6
	1 - 3 million	38	42.2
	3 - 6 million	10	11.1
	> 6 million	1	1.1

Source: Data processed with GeSCA Pro (2024)

Descriptive analysis is a statistical analysis technique used to describe and summarize the basic characteristics of the collected data. Its main objective is to provide an initial overview of patterns or trends in the data, enabling an understanding of the data's distribution and properties before proceeding to more complex analyses.

Goal 1: Contribution to biodiversity conservation Goal 2: Sustainability of community welfare Goal 3: Include interpretation or learning experience Goal 4: Involve responsible actions from tourists and the tourism industry Goal 5: Development of small-scale enterprises Goal 6: Use of new and renewable resources Goal 7: Focus on community participation, ownership, and business opportunities The description of variables is grouped into 3 categories, namely: low category, score = 1.00 – 2.33; medium category, score = 2.34 – 3.66; and high/good category, with a score of 3.67 – 5.00. The complete description of the variables can be seen in the Table 2.

Table 2. Description of Research Variables

Variabel	Indikator	Mean	Std. Deviation
Objective 1: Contribution to biodiversity conservation	I.1	4.37	0.53
	I.2	4.34	0.48
	I.3	4.32	0.65
	I.4	4.38	0.49
	I.5	4.39	0.53
	I.6	4.17	0.69
	I.7	4.20	0.66
	Mean Variabel	4.31	
Objective 2: Sustainable Community Well-being	II.1	4.61	0.55
	II.2	4.59	0.62
	II.3	4.18	0.63
	II.4	4.58	0.56
	II.5	4.34	0.56
	II.6	4.38	0.49
	II.7	4.51	0.50
	Mean Variabel	4.46	
Objective 3: Include Interpretation or Learning Experience	III.1	4.67	0.47
	III.2	4.72	0.45
	III.3	3.67	0.70
	III.4	4.08	0.55
	III.5	4.28	0.56
	III.6	4.64	0.48
	III.7	4.20	0.67
	Mean Variabel	4.32	
Objective 4: Involve Responsible Action by Tourists and the Tourism Industry	IV.1	4.19	0.52
	IV.2	4.31	0.51
	IV.3	4.08	0.60
	IV.4	4.52	0.52
	IV.5	4.43	0.60
	IV.6	4.68	0.47
	Mean Variabel	4.37	
Objective 5: Development of Small-Scale Enterprises	V.1	4.44	0.54
	V.2	4.30	0.59
	V.3	4.73	0.51
	V.4	4.39	0.53
	V.5	4.30	0.53
	Mean Variabel	4.43	
Objective 6: Use of New and Renewable Resources	VI.1	4.22	0.47
	VI.2	4.42	0.50
	VI.3	4.17	0.57

Variabel	Indikator	Mean	Std. Deviation
	VI.4	3.41	0.63
	VI.5	4.13	0.56
	VI.6	4.09	0.51
	Mean Variabel	4.07	
Objective 7: Focus on Community Participation, Ownership, and Business Opportunities	VII.1	4.48	0.57
	VII.2	4.02	0.56
	VII.3	4.52	0.55
	VII.4	4.41	0.54
	VII.5	4.28	0.54
	VII.6	3.89	0.63
	Mean Variabel	4.27	

Source: Data processed with GSCA Pro (2024)

Table 2. shows that the mean value of the data overall falls within the high category range (3.67 – 5.00). This means that, in general, respondents have a favorable view regarding the development of marine ecotourism. The variable with the highest mean value is Goal 2: Sustainability of Community Welfare (4.46), and the lowest is Goal 6: Use of New and Renewable Resources (4.07).

C. RESULTS AND ANALYSIS

Convergent Validity

Evaluation of the measurement model of latent variables with reflective indicators is analyzed by looking at the convergent validity of each indicator. Convergent validity describes the correlation measure between the scores of reflective indicators and the scores of their latent variables. For this, a loading of 0.5 to 0.6 is considered sufficient. Another approach is to look at the test results; if significant ($p<0.05$), it is considered valid. In this study, the measurement of the interpersonal communication variable is reflected through three indicators. Based on the results of the convergent validity test on each variable above, it can be concluded that all indicators are declared valid, and therefore can be used as measures for the variables in this study.

Discriminant Validity

Discriminant validity is a measure that shows that a latent variable is different from other constructs or variables theoretically and empirically proven through statistical testing. Discriminant validity is measured using HTMT. The Heterotrait-Monotrait Ratio (HTMT) test is a technique used to assess discriminant validity in Structural Equation Modeling (SEM). Discriminant validity indicates the extent to which a construct differs from other constructs in the model. The validity test using the Heterotrait-Monotrait ratio (HTMT) criterion is conducted by examining the HTMT matrix. The accepted HTMT criterion is below 0.9, indicating that the evaluation of discriminant validity is accepted. The test results for each variable can be explained as follows (Table 3).:

Table 3. Discriminant Validity Test Value with Criteria *Heterotrait-monotrait ratio (HTMT)*

	Value	SE	95%CI	
O1: Contribution to biodiversity conservation ↔ O2: Sustainable Community Well-being	0.601	0.144	0.104	0.956
O1: Contribution to biodiversity conservation ↔ O3: Include Interpretation or Learning Experience	0.869	0.098	0.532	1.042

O1: Contribution to biodiversity conservation ↔ O4: Involve Responsible Action by Tourists and the Tourism Industry	0.394	0.145	0.002	0.762
O1: Contribution to biodiversity conservation ↔ O5: Development of Small-Scale Enterprises	0.669	0.12	0.331	0.999
O1: Contribution to biodiversity conservation ↔ O6: Use of New and Renewable Resources	0.676	0.153	0.332	1.025
O1: Contribution to biodiversity conservation ↔ O7: Focus on Community Participation, Ownership, and Business Opportunities	0.375	0.132	0.033	0.702
O2: Sustainable Community Well-being ↔ O3: Include Interpretation or Learning Experience	0.85	0.139	0.202	1.067
O2: Sustainable Community Well-being ↔ O4: Involve Responsible Action by Tourists and the Tourism Industry	0.544	0.137	0.094	0.82
O2: Sustainable Community Well-being ↔ O5: Development of Small-Scale Enterprises	0.672	0.134	0.155	0.937
O2: Sustainable Community Well-being ↔ O6: Use of New and Renewable Resources	0.201	0.139	0.008	0.593
O2: Sustainable Community Well-being ↔ O7: Focus on Community Participation, Ownership, and Business Opportunities	0.714	0.152	0.349	1.145
O3: Include Interpretation or Learning Experience ↔ O4: Involve Responsible Action by Tourists and the Tourism Industry	0.399	0.165	0.024	0.768
O3: Include Interpretation or Learning Experience ↔ O5: Development of Small-Scale Enterprises	0.472	0.178	0.086	0.936
O3: Include Interpretation or Learning Experience ↔ O6: Use of New and Renewable Resources	0.608	0.188	0.208	1.058
O3: Include Interpretation or Learning Experience ↔ O7: Focus on Community Participation, Ownership, and Business Opportunities	0.417	0.17	0.074	0.944
O4: Involve Responsible Action by Tourists and the Tourism Industry ↔ O5: Development of Small-Scale Enterprises	0.643	0.123	0.216	0.871
O4: Involve Responsible Action by Tourists and the Tourism Industry ↔ O6: Use of New and Renewable Resources	0.523	0.105	0.303	0.822
O4: Involve Responsible Action by Tourists and the Tourism Industry ↔ O7: Focus on Community Participation, Ownership, and Business Opportunities	0.684	0.117	0.403	0.971
O5: Development of Small-Scale Enterprises ↔ O6: Use of New and Renewable Resources	0.512	0.122	0.22	0.801
O5: Development of Small-Scale Enterprises ↔ O7: Focus on Community Participation, Ownership, and Business Opportunities	0.53	0.147	0.187	0.837
O6: Use of New and Renewable Resources ↔ O7: Focus on Community Participation, Ownership, and Business Opportunities	0.216	0.143	0.005	0.606

Source: Data processed with GSCA Pro (2024)

Table 3. above shows that the HTMT values in the model range from 0.201 to 0.869, so there are no values greater than 0.9. This means that the model indicates that the evaluation of discriminant validity can be accepted. From the results of the discriminant validity test, it can be seen that the HTMT criteria have been met, so all constructs in the estimated model meet the good discriminant validity criteria, meaning the data analysis results can be accepted.

Reliability Test

A reliability test is a statistical method used to assess the consistency and stability of a measurement instrument in measuring a specific variable or construct. Reliability testing is important to ensure that the measurement instrument is reliable and produces consistent data. In GSCA analysis, reliability testing is presented in the construct quality measures. This test is important to ensure the validity and reliability of the model used. The test is conducted by examining the values of Proportion of Variance Extracted (PVE), Cronbach's Alpha, and Rho (Composite Reliability). The following is the output of the GSCA Pro calculation from the research data (Table 4).

Table 4. Results of Construct Quality Measures

	O1: Contribution to biodiversity conservation	**O2: Sustainable Community Well-being**	**O3: Include Interpretation or Learning Experience**	**O4: Involve Responsible Action by Tourists and the Tourism Industry**	**O5: Development of Small-Scale Enterprises**	**O6: Use of New and Renewable Resources**	**O7: Focus on Community Participation, Ownership, and Business Opportunities**
PVE	0.492	0.493	0.539	0.438	0.458	0.65	0.489
Alpha	0.739	0.649	0.57	0.68	0.708	0.729	0.65
Rho	0.827	0.793	0.775	0.795	0.807	0.847	0.79

Source: Data processed with GSCA Pro (2024)

Proportion of Variance Explained (PVE) Test in Generalized Structured Component Analysis (GSCA) is a technique used to assess the extent to which variance in indicators can be explained by latent constructs in the model. PVE provides an overview of the predictive strength of latent constructs on their indicators. If one component explains 70% or more of the total variance of the indicator block, this may indicate unidimensionality for the block (Hwang & Cho, 2023). The output results from data processing show a small PVE value of less than 70%, indicating that the research variables do not provide strong predictive values for the indicators.

Cronbach's Alpha Test in the context of Generalized Structured Component Analysis (GSCA) refers to the internal reliability testing of a construct using Cronbach's Alpha. Cronbach's Alpha is a measure of internal consistency that indicates how well a set of items measures the same construct. In GSCA, Cronbach's Alpha can be used to assess the reliability of indicators that measure latent constructs. An acceptable construct reliability value is when the Cronbach's Alpha value is ≥ 0.60. The results in the table above show that the Cronbach's Alpha values of all constructs are greater than 0.60, except for the variable O3: Include Interpretation or Learning Experience (0.57). However, based on Triton's explanation in Sujianto (2009, p. 97), it is stated that an Alpha Cronbach value between 0.41 - 0.60 is considered sufficiently reliable.

Rho Test, usually referring to Composite Reliability (CR) or Dillon-Goldstein's rho, is a technique used to assess the internal reliability of a construct in Generalized Structured Component Analysis (GSCA). Table 4. shows that the rho (composite reliability) values of each construct are > 0.7, indicating good reliability values and suitability for subsequent research processes. Based on the results of the evaluation of convergent validity and discriminant validity of the variables as well as the reliability of the variables, it can be concluded that the indicators used are valid and reliable as measures of the research variables.

Goodness of Fit

A theoretical model in the conceptual framework of the research is said to be fit if supported by empirical data. The results of the overall model goodness of fit test, based on the GSCA analysis in the appendix, are used to determine whether the hypothetical model is supported by empirical data. The results of the goodness of fit test are provided in the Table 5. below.

Table 5. Results of the Goodness of Fit Overall Model Test

FIT	AFIT	GFI	SRMR
0.429	0.414	0.873	0.107

Source: Data processed with GSCA Pro (2024)

a. **FIT = 0.429** FIT indicates the total variance of all variables (indicators and components) explained by a specified model. Like R Squared in linear regression, FIT values range from 0 to 1. The higher this value, the more variance in the variables accounted for by the specified model. A FIT value of 0.429 indicates that the model explains 42.9% of the data variance, with the remaining 57.1% explained by other factors outside the research model.
b. **AFIT = 0.414** AFIT (Adjusted FIT) is similar to adjusted R squared in regression analysis. AFIT can be used for model comparison. The model with the highest AFIT value can be chosen as the better model. Based on AFIT, the model explains 41.4% of the variance, with the remaining 58.6% influenced by other variables. This means the model is quite good at explaining the phenomenon being studied.
c. **GFI = 0.873** GFI (Unweighted Least Squares) is comparable to the difference between sample covariance and covariance produced by the GSCA parameter estimation. A good GFI value is close to 1. According to Hwang (2023), if the sample size is 50-100, a GFI value of 0.84 can be used to indicate an acceptable model fit. The goodness of fit test results in Table 5 show a GFI value of 0.873 > 0.84, thus meeting the cutoff value, and the model is considered good.
d. **SRMR = 0.118** According to Hwang (2023), if the sample size is 50-100, an SRMR value of 0.13 can be used to indicate an acceptable model fit. The goodness of fit test results in Table 5 show an SRMR value of 0.107 < 0.13, thus meeting the cutoff value, and the model is considered good and appropriate.

Structural Model Evaluation

The structural model evaluation involves examining the relationships between latent constructs by reviewing the estimated path coefficient parameters and their significance levels. Data processing is conducted using the GSCA-pro v 1.2 software. The results of the data processing are shown in the following Figure 1:

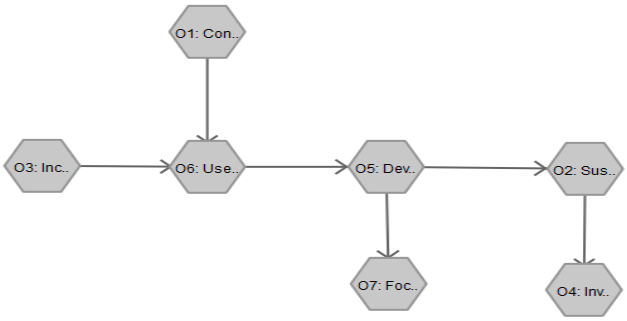

Figure 1.
Path Diagram of the Marine Tourism Development Model with SEM-GSCA

Description: 1). Contribution to biodiversity conservation; 2). Sustainability of community welfare; 3). Include interpretation or learning experience; 4). Involve responsible actions from tourists and the tourism industry; 5). Development of small-scale enterprises; 6). Use of new and renewable resources; 7). Focus on community participation, ownership, and business opportunities

Multicollinearity Test

Multicollinearity is a condition where there is a correlation between independent variables or where independent variables are not mutually independent. A multicollinearity test can be conducted by examining the Variance Inflation Factor (VIF). GSCA Pro also provides the variance inflation factor (VIF) for the structural model if there is a component influenced by more than one component. According to Hwang & Cho (2023), citing Hair et al. (2011), a VIF value greater than 5 or 10 (Myers, 1990) is often considered evidence of multicollinearity in the model. Based on the test results, it is known that the VIF value is below 5. This means that there is no multicollinearity problem in the formed model.

Hypothesis Testing

Hypothesis testing with GSCA analysis does not provide t-tests (Estimate/SE) and p-values, because such testing is parametric with the assumption of normality of parameter estimation. Such parametric tests are not consistent with GSCA, which does not require distribution assumptions (Hwang & Cho, 2023). If the 95% CI of the parameter estimate does not contain zero, then the parameter estimate can be considered statistically significant at the 0.05 level. The results of the testing of the influence of each variable in this study can be presented as follows (Table 6):

Table 6. Path Coefficients

	Estimate	SE	95%CI		Decision
			Low	Upper	
O5: Development of Small-Scale Enterprises→O2: Sustainable Community Well-being	0.469	0.108	0.266	0.670	Accept
O2: Sustainable Community Well-being→O4: Involve Responsible Action by Tourists and the Tourism Industry	0.384	0.114	0.111	0.597	Accept
O6: Use of New and Renewable Resources→O5: Development of Small-Scale Enterprises	0.402	0.092	0.219	0.581	Accept
O1: Contribution to biodiversity conservation→O6: Use of New and Renewable Resources	0.385	0.124	0.203	0.684	Accept
O3: Include Interpretation or Learning Experience→O6: Use of New and Renewable Resources	0.221	0.155	-0.104	0.499	Rejected
O5: Development of Small-Scale Enterprises→O7: Focus on Community Participation, Ownership, and Business Opportunities	0.412	0.095	0.205	0.592	Accept

D. CONCLUSION

Based on the results of data processing through Generalized Structured Component Analysis (GSCA), the hypothesis testing conducted in this study yields several key findings regarding the relationships among the observed variables. The first hypothesis proposes that the Contribution to Biodiversity Conservation (O1) has a direct and significant influence on the Use of New and Renewable Resources (O6). The analysis supports this relationship, indicating that efforts made toward conserving biodiversity contribute positively to the implementation and adoption of sustainable energy sources and technologies in the context studied. This finding emphasizes the interconnection between ecological stewardship and sustainable resource utilization.

In contrast, the second hypothesis, which posits that Include Interpretation or Learning Experience (O3) has a significant effect on the Use of New and Renewable Resources (O6), is not

supported by the empirical data. The lack of a statistically significant relationship suggests that, while educational or interpretive experiences may be valuable in other aspects of sustainable development, they do not directly influence the adoption of new and renewable resource practices in this context. This finding may warrant further exploration to understand the conditions under which learning experiences effectively drive behavioral or systemic change.

Furthermore, the analysis demonstrates that the Use of New and Renewable Resources (O6) has a positive and statistically significant effect on the Development of Small-Scale Enterprises (O5). This supports the third hypothesis and suggests that integrating sustainable energy solutions facilitates entrepreneurial activity and the growth of local enterprises, likely due to increased efficiency, reduced operational costs, and enhanced innovation opportunities.

The fourth hypothesis, which examines the relationship between the Development of Small-Scale Enterprises (O5) and Sustainable Community Well-being (O2), is also accepted. The results indicate that the growth of these enterprises contributes meaningfully to improving the overall quality of life within the community through mechanisms such as job creation, income generation, and enhanced local services.

Additionally, the fifth hypothesis is validated by the data, confirming that the Development of Small-Scale Enterprises (O5) significantly influences Community Participation, Ownership, and Business Opportunities (O7). This suggests that entrepreneurial activity not only drives economic development but also acts as a catalyst for greater community engagement and empowerment, fostering a sense of ownership and encouraging active involvement in local economic initiatives.

Lastly, the sixth hypothesis is supported, showing that Sustainable Community Well-being (O2) has a significant effect on the Involvement of Responsible Action by Tourists and the Tourism Industry (O4). This finding underscores the notion that communities with higher levels of well-being are more likely to promote and encourage responsible behavior among stakeholders in the tourism sector, thereby contributing to more sustainable and ethical tourism practices.

Collectively, these findings provide a comprehensive understanding of the complex interrelationships that underpin sustainable community development and highlight the importance of integrating ecological, economic, and social dimensions in achieving long-term sustainability goals.

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