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Sustainable Development in Coastal Regions: Integrating Blue Economy and Community Ecotourism for Poverty Eradication

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Abstract The Blue Economy concept promotes sustainable marine resource utilization, though its implementation in Indonesia often prioritizes profit over community involvement. Clungup Mangrove Conservation (CMC) in South Malang exemplifies a community-based Marine Protected Area that, while successful in environmental management, it faces challenges in technological expertise and language skills that limit its full potential. This study aims to identify the role of community-based management at Clungup Mangrove Conservation (CMC) in Malang coastal ecotourism management and analyse the relationship of capital (natural, social, built, and human capital) in supporting poverty alleviation. Using a quantitative method, this research uses SEM-PLS analysis to address the above mentioned issue. The findings reveal that social capital, particularly community involvement, significantly influences the success of CE initiatives, fostering shared ownership and responsibility in ecotourism management. Human capital, through skill development and training, and natural capital, through sustainable resource use, also play pivotal roles in maximizing ecotourism potential. Community-managed coastal ecotourism (CMC) models are shown to create employment opportunities, increase household income, and promote the growth of micro and small enterprises, thereby reducing poverty levels in coastal regions. However, challenges such as limited technological skills and foreign language proficiency hinder market expansion and the attraction of international tourists. To address these limitations, the study underscores the importance of strengthening the stakeholders' collaboration while enhancing management capacity and human resource development. These measures are essential for optimizing ecotourism potential, fostering economic resilience, and supporting the blue economy. This model not only advances poverty reduction but also addresses broader socio-economic challenges in coastal areas.

Keywords Blue Economy, Community-Based Management, SEM-PLS, Sustainability

1. Introduction

Sustainable Development Goals (SDGs) 14 focuses on protecting ocean ecosystems and promoting the responsible use of marine resources to ensure environmental and economic sustainability. One of the efforts to encourage sustainable economic growth is through the Blue Economy (BE), which is an industrial activity that utilises the resources in the oceans, and pays attention to environmental sustainability to improve human welfare and social equality [1]. The intense activities of the blue economy lead to trade-offs between the economy and the environment, with both direct and indirect impacts [2]. Some of the trade-offs that occur are the decline in marine habitat populations as a result of overfishing [3] and over-tourism as a result of undirected ecotourism development [4]. This condition poses a serious challenge for coastal communities to optimise income through sustainable marine ecosystem tourism management [5].

Through the BE concept, coastal and marine areas are an important part of the growing marine tourism and blue economy sectors [6]. However, in general in Indonesia, the blue economy concept puts more emphasis on efforts to bring in investments that generate a lot of profit from the potential of the sea and beaches. Meanwhile, local residents who tend to be politically weak cause them not to have much access to manage and utilise existing marine resources [7].

Blue economy based on ecosystem community-based management is one of the crucial efforts in developing Marine Protected Areas (MPAs). MPA or Marine Protected Area is an instrument specifically designed to control natural resources through the designation of an area as a conservation area [8]. The area contains protected marine zones, spatial planning in the sea and coastal areas, and livelihood improvement to ensure the fisheries sector and marine tourism industry sustainability in the surrounding area [9]. This condition is interesting because communities usually have a better understanding for the management of their surrounding areas [10]. Therefore, they can implement more ecotourism than researchers or policymakers in the blue economy area [11].

But in reality, the potential of the local community has not been explored, integrated, or optimised for the development of the blue economy in the region. The development of coastal ecotourism provides an important livelihood alternative for many rural and low-resource communities. An earlier study at the Kapoposang Marine Nature Tourism Park shows the engagement of nearby populations in marine tourism for ecological and economic sustainability can improve coral reef conservation and increase local incomes [12].

Tourism creates extra income opportunities for seasonal workers like fishers and farmers. This sector allows them to expand their earnings so they do not depend only on one occupation. Seasonal workers still can continue their regular livelihoods while generating additional revenue by developing and offering tourist experiences, activities, and attractions during their off-seasons [13]. Besides being influenced by natural resources, factors such as traditional, and sociocultural activities, and a collaborative management system through collaboration between community members, public officials and business sectors are essential for implementing marine ecotourism [14].

In Malang Regency, there is a Marine Protected Area (MPA) that is managed on a community-based basis by POKMASWAS. The area is managed into ecotourism in accordance with the BE concept, namely Clungup Mangrove Conservation (CMC) in South Malang. From an economic perspective, CMC creates jobs, which has the potential for economic development, and provides additional income for the community. After running CMC in recent years, there are positive attributes that support the competitiveness of CMC ecotourism, namely in its management which includes the dimensions of the environment, cleanliness, tourist attraction, and regional arrangement. However, some problems must be overcome, namely low management knowledge and skills in technology and limited English language skills. The lack of technological skills has an impact on the marketing of CMC, which has not been maximised, especially in the domestic market. However, CMC already has a positive image in the community, even famous in foreign countries. The positive image is an attraction for foreign tourists to visit CMC. Unfortunately, the manager of CMC and the community involved have low English language skills, hindering their communication with foreign tourists.

Various challenges such as limited technological skills and English language proficiency are obstacles in maximising this potential, especially in attracting foreign tourists and expanding marketing reach. Therefore, it is important to further explore how various forms of capital such as natural, social, built, and human capital contribute to applying the blue economy strategies at CMC in the south of Malang. In addition, the role of community-based management in mitigating social and environmental problems is expected to be a solution for poverty alleviation while supporting ecosystem sustainability in the South Malang Coastal Zone. Thus, this research aims to identify the role of community-based management in the management of ecotourism in CMC and analyse the relationship of capital (natural, social, built, and human capital) in formulating an effective community-based management-based ecotourism model to reduce poverty and promote lasting development across CMC South Malang.

Research on the blue economy has been widely developed and has become a potential source of poverty alleviation in various regions. However, research on the blue economy that integrates marine sustainability management through ecotourism based on Community-Based Management (CBM) has not yet been conducted. Therefore, this research will complete the existing gap to add to the literature review, contribute to developing the

CBM model, and become a policy recommendation for poverty alleviation in the coastal area of CMC in South Malang.

2. Literature Review

2.1. Blue Economy and Sustainable Economic Development

The blue Economy is a concept for improving human welfare, justice and socio-economy in line with the reduction of environmental and ecological risks [1]. In general, the blue economy represents an approach that utilizes marine-based resources to drive economic growth without compromising environmental sustainability, livelihood improvement, and marine ecosystem maintenance [14]. Developing countries with many Small Islands, for example, prioritize the use of marine resources to generate employment and economic opportunities. Specifically, this is achieved through small-scale fishing, tourist activities, and the development of aquaculture. Meanwhile, funding activities are also still conducted to minimize climate and environmental threats [14]. Unfortunately, this blue economy focuses a lot on how policymaking brings in investments that generate significant benefits from maritime. Meanwhile, politically less powerful locals do not have much access to manage and access their marine resources [15], [16], [17], [18]. This is interesting because people usually have a better understanding of the management of the area around them and can produce more ecotourism than researchers or policymakers in the blue economy area [11].

2.2. Community-Based Approach as a Solution for Poverty Eradication and Sustainable Development

Ecotourism management in CMC based on community-based management shows great potential in supporting the local economy and sustainable development in coastal areas. Various forms of capital such as natural, social, built, and human capital are important potentials to be explored further in order to support the achievement of the blue economy. Natural capital is a natural resource asset related to the marine environment, such as minerals, fossil fuels, and renewable ecosystems [19]. Social capital is the population, government, and institutions within it [20]. Furthermore, another researcher [21] describes social capital as the relationship between social elements consisting of social networks, norms, values, community participation, common beliefs and shared institutions that facilitate action and cooperation in society to achieve shared prosperity. The last form of capital is physical and human capital. Physical capital refers to the tangible assets that are used to produce goods and services to support economic and social activities. These include roads, bridges, telecommunication networks, power plants, and various public facilities [22]. Meanwhile, human capital comprises the personal competencies, expertise, capabilities, and attributes embodied in individuals [23]. Physical and human capital influence each other and are important components of sustainable development.

2.3. Sustainable Coastal Ecotourism as the Key Driver of Sustainable Blue Economy

Coastal and marine tourism represents a crucial sector within the expanding blue economy [7]. Tourism catalyzes economic growth in many countries. It offers ways to enhance living standards in communities facing development challenges [16], [24]. By 2030, coastal and marine tourism is expected to become the highest value-generating segment of the marine economy. This is due to their expected contribution being 26 percent of the total value [25]. In addition, the development of coastal ecotourism provides an important livelihood alternative for many rural and low-resource communities. Seasonal workers, such as those in fishing and agriculture, can diversify their incomes through tourism activities without abandoning their primary occupations [15]. These workers can develop tourism services and attractions as additional income streams side by side with primary livelihoods [26]. Community-Based Ecotourism (CBET) focuses on community empowerment and social, cultural, and environmental resource preservation [27]. Many scholars find that CBET effectively reduces rural poverty through targeted tourism initiatives [27], [28], [29]. Furthermore, CBET creates opportunities for small and medium businesses to expand sustainable tourism [11].

2.4. Linkage between Variables

In general, the blue economy represents the integration of balanced economic growth through ocean resources, enhances community welfare, and ensures ocean ecosystem conservation [4,5]. Developing countries with many small islands use this framework for marine resource utilization through small-scale fisheries, tourism, and aquaculture to address poverty reduction and strengthen food security. Those activities are performed simultaneously with investing in climate resilience and environmental risk mitigation [7]. The blue economy concept relies on nature as the main capital or called natural capital consisting of marine and coastal ecosystems [30]. Natural capital has a positive impact on tourism in coastal areas, where natural capital is the main attraction for tourists [31]. Attractive ecosystems and a supportive community environment through the development of community-based tourism will help increase community income while increasing active community participation in protecting the coastal environment [32].

Hypothesis 1: there is a positive relationship of natural capital on coastal ecotourism.

Social capital has a positive effect on tourism in coastal areas because it strengthens community involvement in marine resource management through community-based management (CBM). Social capital includes networks of cooperation, trust and social norms that enable local communities to work together in maintaining coastal ecosystems. With trust and collaboration between communities, government and tourism actors, Ecosystem Services Approach (ESA)-based conservation strategies can be effectively implemented to conserve ecosystems while increasing economic benefits [11]. Three ESA components are essential keys to sustainable ecotourism development, namely natural capital, social capital, and human resource development [9].

For example, communities can run ecotourism programmes such as mangrove forest management, snorkelling guides, or community-based homestays, where economic benefits are shared fairly and sustainably. Solid cooperation also encourages local innovation and strengthens the capacity of human resources (HR) [33]. Social capital also can ensure the sustainability of tourism development because the local community respects the social culture and values. The strategy which involves social capital is proven to become a driving force in tourist attractiveness. The possibility of increasing people's income and local government taxes is higher [34]. Thus, social capital is an important foundation for building sustainable coastal ecotourism, improving community welfare [35], and alleviating poverty without damaging the environment [36].

Hypothesis 2: shows a significant positive relationship between social capital on coastal ecotourism.

Furthermore, built and human capital are believed to have a positive influence on the success of tourism in coastal areas [37]. Adequate infrastructure, such as transport access, tourist facilities, and environmental management systems, significantly contributes to improving the quality of service to tourists. On the other hand, the quality of human resources, including the skills, knowledge and awareness of local communities, serves as a crucial driver in ensuring that coastal ecotourism is well-managed and sustainable [38]. The synergy between these two capitals can increase the attractiveness of tourist destinations, expand employment, and maintain coastal ecosystems.

Hypothesis 3: demonstrates a significant positive relationship between built and human capital on coastal ecotourism.

Furthermore, the role of the community is also an external support that greatly determines the success of sustainable development. Community-based coastal ecotourism acts as the instrument in income diversification strategy for rural communities that face resource constraints. Seasonal workers who face income instability can fulfil their basic needs from another source of income in particular in tourism activities [20]. They have a wide range of options rather than depending on their single source of income by offering services in the tourism sector [18], [21]. The extra income from tourism activity is proven to alleviate rural poverty effectively [7], [24]. This activity is alongside the development of small-medium scale businesses in sustainable tourism [9].

Hypothesis 4: indicates a significant positive relationship between coastal ecotourism with poverty reduction in coastal areas.

Hypothesis 5: exhibits a significant positive relationship between natural capital, social capital, and built and human capital on poverty reduction mediated by coastal ecotourism.

3. Materials and Methods

3.1. Research Design

This study used a rigorous quantitative methodology to examine variable relationships and test hypotheses through a systematic process. The research began by establishing clear objectives and hypotheses, followed by developing a theoretical model (Figure 1) and validating measurement instruments. Structural Equation Modelling - Partial Least square (SEM - PLS) was employed to test the proposed hypotheses. It is utilizing SPSS 22.0 for initial analysis and SmartPLS 3.2.9 for structural modelling.

3.2. Data Collection and Respondents

This study was performed in the Clungup Mangrove Conservation (CMC) area, Tambakrejo Village, Malang Regency. Tambakrejo Village was chosen because it has a beach that already has an MPA in it. The primary data used is obtained from the population, namely the community around CMC and POKMASWAS involved in CMC management. The study participants consisted of stakeholders who participate directly or indirectly in ecotourism management within the Marine Protected Area (MPA). The participants consist of farmers, fishermen, innkeepers, traders, and private employees. Determination of respondents was taken using a purposive sampling technique with criteria, namely (1) is the head of the family, (2) native or migrant with a minimum length of stay for 5 years. These criteria were formulated based on the consideration that the head of the family generally is fundamental in making household decisions, while the duration of stay of migrants is at least five years because they are assumed to have understood the social, economic and environmental conditions around their place of residence, and even been involved in it.

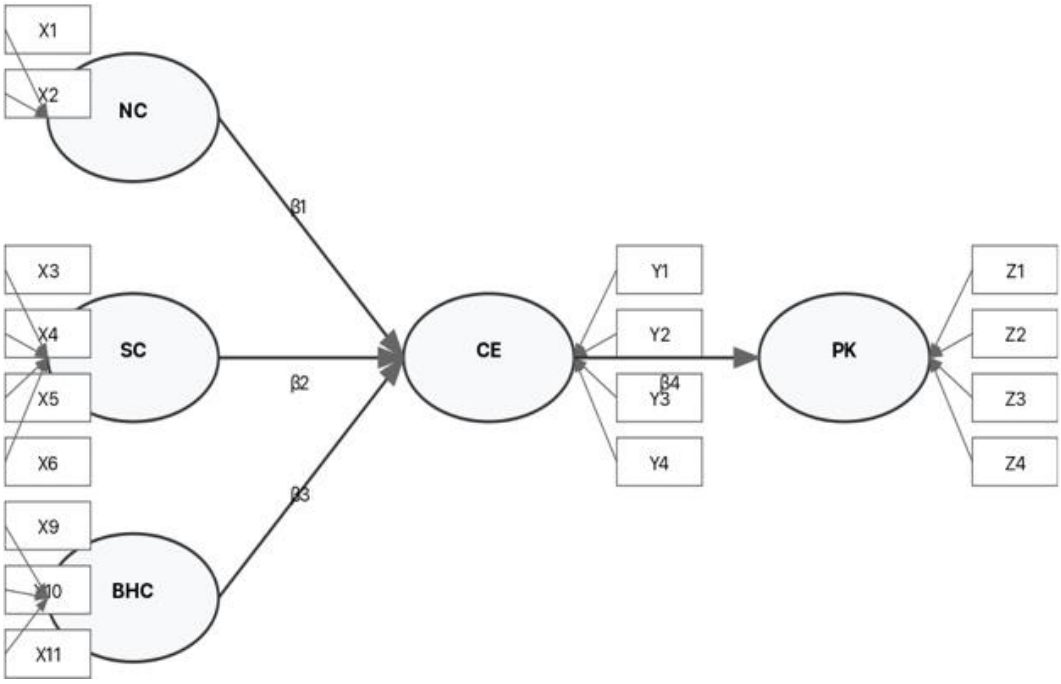

Figure 1. Research Design Source: Authors (2024)

Data collection was conducted through one-on-one questionnaires distributed to the community around CMC and POKMASWAS involved in CMC management. The sample size was determined based on preliminary literature. For complex models, the necessity is 100 participants minimum sample size [39]. This resulted in a target of 145 participants. The research team distributed 200 questionnaires using cluster purposive sampling, ultimately collecting 160 valid responses. The research instruments received ethical approval from the Universitas Negeri Malang ethics committee.

3.3. Model and Variable

This research uses SEM-PLS-based quantitative methods to formulate a Blue Economy model through community-based ecotourism to encourage sustainable development and poverty alleviation in coastal South Malang. SEM-PLS is used due toits ability to address the limitations in regression models. This research is classified as a non-parametric model because the data does not follow the normal distribution and has a small size sample. Therefore, this study uses SEM-PLS which enables analysis across various data types [40]. The data analysis is using SmartPLS 3.2.9 software. The test was conducted to examine the influence between natural capital (NC), social capital (SC), built and human capital (BHC), coastal ecotourism (CE), and poverty reduction (PR) variables. The equation model used in this analysis is as follows:

$$NC = \alpha + \beta 1X1 + \beta 2X2 + \varepsilon \quad (1)$$

where:
NC = natural capital
X1 = ecosystem
X2 = ecosystem maintenance

$$SC = \alpha + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6 + \beta 7X7 + \beta 8X8 + \varepsilon \quad (2)$$

SC = social capital
X3 = social values and behaviour
X4 = traditional knowledge
X5 = partnerships
X6 = coastal management
X7 = community empowerment
X8 = social innovation

$$BHC = \alpha + \beta 9X9 + \beta 10X10 + \beta 11X11 + \beta 12X12 + \beta 13X13 + \beta 14X14 + \varepsilon \quad (3)$$

BHC = Built and Human Capital
X9 = infrastructure
X10 = transport
X11 = conservation
X12 = tourism
X13 = livelihood from fishing
X14 = education, skills, training

$$CE\ (Y) = \alpha + \beta 1Y1 + \beta 2Y2 + \beta 3Y3 + \beta 4Y4 + \beta 5Y5 + \beta 6Y6 + \varepsilon \quad (4)$$

CE = Coastal ecotourism
Y1 = additional income due to coastal tourism
Y2 = increased benefits to local communities from coastal tourism
Y3 = innovation
Y4 = access to markets
Y5 = waste management
Y6 = plastic-free programme for MPA area

$$PK(Z) = \alpha + \beta 1Z1 + \beta 2Z2 + \beta 3Z3 + \beta 4Z4 + \varepsilon \quad (5)$$

PK = Poverty Alleviation
Z1 = income from ecotourism
Z2 = basic needs of clothing, food, shelter
Z3 = social psychological needs
Z4 = savings needs

3.4. Instrument and Measurement

This study's measurement instruments are adapted from various existing scholars' literature. Data collection used a 7-point Likert scale questionnaire. The participants indicated their level of agreement with each statement ranging from 1 (strongly disagree) to 7 (strongly agree). To measure natural capital (NC), we used six adapted items from several studies [41], [42], [43]. Furthermore, social capital (SC) was measured with a 6-item adopted scale [44]. The built and human capital (BHC) was calculated using a 5-item scale [45]. The 5-item scale was also used to assess Coastal Ecotourism (CE) [45]. Finally, Poverty Alleviation (PE) consists of 4 item questions, which are measured by Wei-Xiang et al. [46]. A sample item is "I joined a neighbourhood watch group because I care about social justice in my neighbourhood".

4. Results and Discussions

Community-Based Management (CBM) in CMC Malang critically affects ecotourism management in coastal areas, especially in ensuring economic sustainability and inclusiveness for local communities. Such CBM is also important in realizing a sustainable Blue Economy. CBM facilitates community involvement in making choices, planning, and implementing ecotourism activities, thereby increasing a sense of ownership and responsibility for environmental sustainability [32].

Descriptive statistical tests in Table 1 show that the majority of participants observed are in the age range of 21-40 years, namely 34.6%. Then based on ethnicity or tribe, it shows that the ethnicity distribution of participants is Javanese. Furthermore, the participant's level of education is elementary school graduates with the number of 60 participants.

The results of the description of the respondent's income characteristics are earning 12-24 million rupiah. Then, the number of family members compositions of study participants is 4-6 people. Furthermore, mostly 1-2 people in the family participate in the tourism business profile. The demographic occupation age profile of participants is 40 people working as fishers.

From the existing findings, ecotourism coastal communities on the South Malang Coast, especially in the CMC Tambakrejo area reveal a fairly varied picture of the local economy. Most families in this area depend on the fishery sector, with 25% of respondents stating fishing as their main source of income. In addition, 18.75% of them combine work as fishermen with part-time activities in the agricultural sector.

The contribution of fishers is also seen in the 9.40% of respondents who are involved in small-scale retail businesses as a side activity. Small-scale food and beverage businesses accounted for 10.60% of the source of income, with an additional 17.50% variation showing a combination of fishermen with businesses in the same field. Meanwhile, agriculture, small and medium enterprises (SMEs), and tourism each contributed 6.25 percent to family income. This analysis highlights the dominance of fisheries and variation in the combination of income sources, reflecting the economic dynamics of coastal communities influenced by traditional sectors and local business opportunities in the South Malang Coastal Area.

4.1. Measurement Model

The statistical analysis used two-stage procedures in SEM-PLS. It begins with measurement model assessment. Then structural model assessment follows. The model validation uses a convergent validity test (factor loadings >0.7, AVE >0.5, and CR >0.7) [39], [47], [48], discriminant validity (using the Fornell-Lacker criterion) [48], and reliability analysis (Cronbach's alpha >0.7) [40], 49]. The structural model assessment examined R-squared values [51], effect sizes (f^2) [52], and predictive relevance (Q2) [52].

4.2. Convergent Validity Test

Convergent validity measures the extent of relationships between measurement items related to their constructs. The measurement is through standardized loading factors. Strong validity is indicated by standardized loading factors above 0.7. Meanwhile, outer loadings between 0.5 and 0.6 are acceptable [39], [47], [48].

Table 2 provides convergent validity testing the relationship between natural capital (NC), social capital (SC), built and human capital (BHC), coastal ecotourism (CE), and poverty reduction (PR) demonstrated loading values exceeding 0.700. This means that all variable indicators meet the convergent validity criteria [38] as shown in Table 2 column 3.

Meanwhile, the Average Variance Extracted (AVE) as shown in Table 3 column 2 surpassed the required criterion of 0.50 [40]. Therefore, each natural capital (NC), social capital (SC), built and human capital (BHC), coastal ecotourism (CE), and poverty reduction (PR) variable has met the construct validity.

Table 1. Description of Respondent Characteristics

Demographic	Category	Count (n)	Percent (%)
Age	<20 y.o	50	31.4%
	21-40 y.o	55	34.6%
	41-60 y.o	45	28.3%
	over 60 y.o	10	6.3%
Ethnicity	Javanese	70	44.0%
	Maduranese	30	18.9%
	Bugis	50	31.4%
	Others	10	6.3%
Education level	Not graduate from elementary school	30	18.9%
	Elementary school	60	37.7%
	Junior high school	50	31.4%
	Senior high school	20	12.6%
Per capita annual income	< Rp 12.000.000	20	12.6%
	Rp 12.000.000 - 24.000.000	80	50.3%
	Rp 24.000.001 - 48.000.000	55	34.6%
	> Rp 48.000.001	5	3.1%
Total family population	1 - 3 people	35	22.0%
	4 - 6 people	85	53.5%
	> 6 people	40	25.2%
Number of participants in the tourism industry within a family	1 - 2 people	95	59.7%
	3 - 4 people	55	34.6%
	> 4 people	10	6.3%
Main source of family income	Fisherman	40	25.2%
	Fisherman and part time on farming	30	18.9%
	Fisherman and part time in small scale retail business	15	9.4%
	Fisherman and part time on business in small scale food and beverage business	17	10.7%
	Fisherman and part time on business in tourism	28	17.6%
	Farmers	10	6.3%
	Small scale Business	10	6.3%
	Tourism	10	6.3%

Source: Processed Research Data (2024)

Table 2. Convergent Validity Test

Variable	Indicator	Loading	Acceptance Level	Notes
Natural Capital	NC1	0.846	>0.70	Fit
	NC2	0.839	>0.70	Fit
	NC3	0.891	>0.70	Fit
	NC4	0.906	>0.70	Fit
	NC5	0.882	>0.70	Fit
Social Capital	SC1	0.856	>0.70	Fit
	SC2	0.840	>0.70	Fit
	SC3	0.872	>0.70	Fit
	SC4	0.841	>0.70	Fit
	SC5	0.891	>0.70	Fit
	SC6	0.878	>0.70	Fit
Built and Human Capital	BHC1	0.823	>0.70	Fit
	BHC2	0.820	>0.70	Fit
	BHC3	0.794	>0.70	Fit
	BHC4	0.800	>0.70	Fit
	BHC5	0.835	>0.70	Fit
Coastal Ecotourism	CE1	0.803	>0.70	Fit
	CE2	0.737	>0.70	Fit
	CE3	0.731	>0.70	Fit
	CE4	0.790	>0.70	Fit
	CE5	0.755	>0.70	Fit
Poverty Reduction	PR1	0.878	>0.70	Fit
	PR2	0.860	>0.70	Fit
	PR3	0.853	>0.70	Fit
	PR4	0.708	>0.70	Fit

Source: Processed Research Data (2024)

Table 3. Construct Validity Test

Variable	AVE	Acceptance Level	Notes
Natural Capital	0.762	>0.50	Fit
Social Capital	0.745	>0.50	Fit
Built and Human Capital	0.664	>0.50	Fit
Coastal Ecotourism	0.583	>0.50	Fit
Poverty Reduction	0.685	>0.50	Fit

Source: Processed Research Data (2024)

4.3. Discriminant Validity Test

The cross-loading measurement between constructs is reflected in discriminant validity [39], [40]. A construct demonstrates strong discriminant validity when its correlation with the measurement items exceeds the other constructs. Additionally, discriminant validity can be assessed by comparing the square root values of the average variance extracted (AVE).

As shown in Table 4, the square root values of AVE (displayed in bold) were larger than the correlations between latent variables. It confirms the discriminant validity criteria. Therefore, natural capital (NC), social capital (SC), built and human capital (BHC), coastal

ecotourism (CE), and poverty reduction (PR) have met discriminant validity (validity 0.85 is a stringent criterion, and 0.90 is a conservative criterion) [53].

4.4. Construct Reliability Test

Construct reliability is evaluated using composite reliability metrics. It incorporates both Cronbach's alpha and composite reliability measurement [39], [40]. A value exceeding 0.70 indicates high reliability [40]. Cronbach's alpha testing provides additional validation of composite reliability results.

The reliability test results in Table 5 using Cronbach's Alpha (column 2) and Composite Reliability (column 3) showed that the test results are more than 0.70, thus each variable - natural capital (NC), social capital (SC), built and human capital (BHC), coastal ecotourism (CE), and poverty reduction (PR) - has met the construct reliability requirements.

4.5. Inner Model Test

The inner model was evaluated to examine the theoretical relationships between latent variables [51]. This analysis uses R-square values for dependent constructs. Changes in R-square values demonstrate the influence of independent latent variables on dependent ones. This coefficient of determination (R^2) demonstrates the structural model's predictive capability. This value can explain the magnitude of influence on endogenous variables [52]. Then, Q-square (Q^2) values were calculated to assess the structural model's overall predictive relevance [52]. It is calculated using equation (6) below

$$Q^2 = 1 - (1 - R_1^2)(1 - R_2^2) \quad (6)$$

Then, using the R^2 result from Table 6, the (Q^2) values are below

$$Q^2 = 1 - (1 - 0.763)(1 - 0.477) \quad (7)$$

$$Q^2 = 1 - 0.124 \quad (8)$$

$$Q^2 = 0.876 \quad (9)$$

The obtained Q-square value of 0.876 is greater than 0.35, indicating that the overall structural model has strong predictive relevance. Furthermore, the effect size test results show that the influence between variables yielded an f^2 value greater than zero, indicating a moderate effect at the structural level.

The assessment of the inner model or structural model illuminates the relationships or influences between latent variables. The tested research model was divided into two equations: (1) the influence on coastal ecotourism (CE) and (2) the influence on poverty reduction (PR). The modelling results indicated positive correlations among the research variables.

Table 4. Discriminant Validity Test Using Fornell-Larcker Criterion

Variable	NC	SC	BHC	CE	PR	Notes
Natural Capital	0.873					Fit
Social Capital	0.803	0.863				Fit
Built and Human Capital	0.804	0.726	0.815			Fit
Coastal Ecotourism	0.831	0.852	0.794	0.864		Fit
Poverty Reduction	0.715	0.723	0.671	0.691	0.828	Fit

Source: Processed Research Data (2024)

Table 5. Construct Reliability Test

Variable	Cronbach's Alpha	Composite Reliability	Acceptance Level	Notes
Natural Capital	0.922	0.941	>0.70	Fit
Social Capital	0.932	0.946	>0.70	Fit
Built and Human Capital	0.873	0.908	>0.70	Fit
Coastal Ecotourism	0.822	0.875	>0.70	Fit
Poverty Reduction	0.845	0.896	>0.70	Fit

Source: Processed Research Data (2024)

Table 6. The Coefficient of Determination

Variable	R Square	R Square Adjusted
Coastal Ecotourism	0.763	0.758
Poverty Reduction	0.477	0.474

Source: Processed Research Data (2024)

Table 6 provides the results of the coefficient of determination. The coefficient of determination (R^2) analysis revealed substantial explanatory power for the model's endogenous variables. Coastal Ecotourism demonstrated a strong R^2 value of 0.763 (adjusted R^2 = 0.758), indicating that approximately 76.3% of its variance is explained by its predictor variables. For Poverty Reduction, the model showed moderate predictive power with an R^2 value of 0.477 (adjusted R^2 = 0.474), suggesting that about 47.7% of its variance is accounted for by its predictors. The minimal differences between R^2 and adjusted R^2 values indicate the model's efficiency in parameter estimation.

Moreover, Table 7 displays the analysis of effect sizes (f^2). It reveals the varying levels of impact among the predictor variables. For Coastal Ecotourism, Social Capital demonstrated the strongest effect (f^2 = 0.118), followed by Built and Human Capital (f^2 = 0.070), and Natural Capital (f^2 = 0.050), all indicating small to medium practical significance. Notably, Coastal Ecotourism exhibited a substantial effect size on Poverty Reduction (f^2 = 0.913), suggesting a large practical importance in this relationship. These results align with the theory which mentioned that f^2 values of 0.02 as small, 0.15 as medium, and 0.35 as large effect sizes.

Table 7. Effect Size (f^2)

Variable	Coastal Ecotourism	Poverty Reduction
Natural Capital	0.050	
Social Capital	0.118	
Built and Human Capital	0.070	
Coastal Ecotourism		0.913

Source: Processed Research Data (2024)

4.6. Research Development Model

Natural capital (NC), social capital (SC), and built and human capital (BHC) are the exogenous variables, whilst the endogenous variables are coastal ecotourism (CE) and Poverty Reduction (PR). A model is considered good when the development of the hypothetical model is theoretically supported by empirical data. The complete testing results analysis using Partial Least Square (PLS) to determine the influence between variables can be seen in Figure 2.

The examination of the outer model or measurement model elucidates the relationship between indicators or items that form latent variables, specifically how well these indicators or items explain the constructed variables [53]. Natural capital (NC) was measured using five indicators, with NC4 emerging as the principal indicator, demonstrating a factor loading value of 0.906. Social capital (SC) was assessed through six indicators, with SC5 as the primary indicator, exhibiting a factor loading value of 0.891. Built and human capital (BHC) was evaluated using five indicators, with BHC5 functioning as the leading indicator, showing a factor loading value of 0.835. The coastal ecotourism (CE) variable was measured through five indicators, with CE1 emerging as the prominent indicator, displaying a factor loading value of 0.803. Finally, poverty reduction (PR) was assessed using six indicators, with PR1 as the principal indicator, demonstrating a factor loading value of 0.878.

Following path analysis, hypotheses were tested using t-statistics and p-values. The critical t-value is 1.960 at the 5 percent significance level. Table 8 presents the results of hypothesis testing for all endogenous and exogenous variables. Column 2 delineates the influential relationships between each endogenous to exogenous variable and from exogenous 1 to exogenous 2. The hypothesis test results are presented in column 6. The findings indicate that all relationships between variables are statistically significant. Consequently, this research successfully addresses all proposed hypotheses.

4.7. The Influence of Natural Capital on Coastal Ecotourism

The test results in Table 8, column 2, row 3 demonstrate that natural capital (NC) positively and significantly influences coastal ecotourism (CE), indicating that higher natural capital corresponds to increased coastal ecotourism development in CMC along the southern Malang coast. Patil [19] defines marine natural capital as natural resource assets associated with the marine environment, such as minerals, fossil fuels, and renewable ecosystems. In the CMC context, natural capital comprises mangrove ecosystems serving tourist attractions.

Natural capital positively influences coastal ecotourism at Clungup Mangrove Conservation (CMC) by providing an exotic and sustainable environment as the primary tourist attraction [54]. The mangrove ecosystem also protects the coastline from erosion, supports biodiversity [54], acts as a carbon sink [54], and attracts tourists interested in conservation and educational experiences [55]. Consequently, the preservation of natural capital at CMC not only enhances tourist appeal but also stimulates local community economic growth through sustainable tourism [56].

These findings align with Hart [57], who posits that the natural resource-based view becomes an essential attraction in ecotourism. Moreover, Manoppo's [58] research in Bunaken National Park found that natural capital positively influences ecotourism performance. Environmental awareness also mediates the relationship between perceived negative impacts of land reclamation and support for coastal ecotourism, emphasising the importance of promoting environmental consciousness in sustainable development [59].

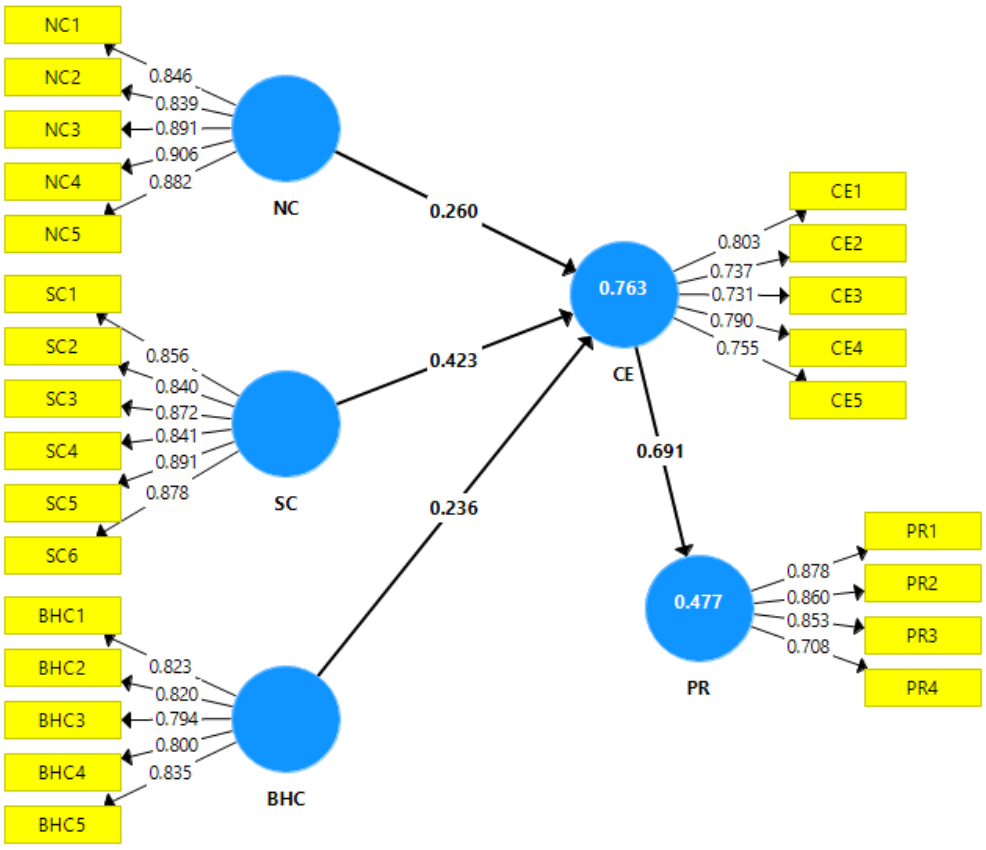

Figure 2. Model Development Source: Processed Research Data (2024)

Table 8. The Hypothesis Test

No	Relationship	Path Coefficient	T	P	Notes
(1)	(2)	(3)	(4)	(5)	(6)
1	NC -> CE	0.260	2.553	0.011	Significant
2	SC -> CE	0.423	3.252	0.001	Significant
3	BHC -> CE	0.236	2.573	0.010	Significant
4	CE -> PR	0.691	14.863	0.000	Significant
5a	BHC -> CE -> PR	0.163	2.453	0.014	Significant
5b	NC -> CE -> PR	0.179	2.473	0.014	Significant
5c	SC -> CE -> PR	0.292	3.214	0.001	Significant

Source: Processed Research Data (2024)

4.8. The Influence of Social Capital on Coastal Ecotourism

The second hypothesis, regarding the influence of social capital (SC) on coastal ecotourism (CE), a path coefficient of 0.423, a t-statistic value of 3.252, and a significance value of 0.001, indicating that SC has a significant positive impact on coastal ecotourism. This suggests that higher social capital corresponds to increased coastal ecotourism development in CMC along the Southern Malang coast.

Social capital positively influences coastal ecotourism at CMC through collaboration, trust, and active local community participation [36]. Community involvement in CMC management, such as through POKMASWAS, creates a sense of ownership and shared responsibility for environmental stewardship. Social networks and cooperation amongst community members, government, and private institutions also promote ecotourism.

Additionally, local participation in tourism service development enhances tourist experiences whilst creating micro-business opportunities, such as homestay provision and culinary services [60]. Thus, social capital promotes ecotourism sustainability by creating synergy between environmental conservation and local community economic welfare.

These findings align with Kusuma et al [61], where

social capital, including trust, networking, and community involvement, significantly influences the success of ecotourism initiatives. This research reveals that social capital values have the highest significance, suggesting policymakers have greater potential to mobilise social capital in CMC development along southern Malang's coast. For instance, key areas requiring support for successful community-based ecotourism include waste management, hospitality skills, and market access [11].

However, development requires periodic evaluation as a preventive measure against varying social capital elements that potentially negatively affect ecotourism development [62]. An analysis of the social capital typology in CMC along South Malang's coast will determine balanced ecotourism governance patterns that avoid favouring select community powers at the expense of broader social relationships [63].

4.9. Built and Human Capital's Influence on Coastal Ecotourism

The third hypothesis demonstrates that built and human capital (BHC) has a positive and significant influence on coastal ecotourism (CE), indicating that higher built and human capital corresponds to increased coastal ecotourism development in CMC along the southern Malang coast. Beyond the crucial role of social capital and community in achieving sustainable development in marine protected areas through ecotourism [30], marine ecotourism development requires a balance between infrastructure and human resource development [64]. Human capital is a determinant of ecotourism sustainability [11], particularly in areas such as hospitality [11], [65], natural sustainability management [65], business supply chains, and efforts to respond to technological developments.

4.10. Impact of Coastal Ecotourism on Poverty Reduction

According to the analysis results in Table 8, column 2, row 6, coastal ecotourism (CE) positively correlates with poverty reduction (PR). The data supports that CMC's presence serves as a poverty reduction initiative in the Clungup Beach vicinity. CMC provides alternative employment opportunities during non-fishing seasons as a source of fishermen's income [66], [67]. Ecotourism development creates various job opportunities, including tour guides, homestay management, transportation services, and culinary and handicraft businesses. Furthermore, ecotourism encourages micro and small enterprise growth, directly involving community members as economic actors, thereby increasing their income. The community-based approach to ecotourism management also ensures equitable and sustainable distribution of economic benefits. Consequently, coastal ecotourism at CMC contributes to both environmental sustainability and community welfare.

4.11. Natural, Social, and Built and Human Capital's Influence on Poverty Reduction Mediated by Coastal Ecotourism

The hypothetical relationship between natural capital (NC), social capital (SC), and built and human capital (BHC) also reveals that natural capital exerts a significant positive effect on poverty reduction (PR). This study demonstrated a statistically significant positive correlation between Natural Capital and Poverty Reduction outcomes. This relationship is mediated through various socioeconomic mechanisms, including resource accessibility, ecosystem services, and sustainable livelihood opportunities. The findings underscore the importance of integrating environmental conservation with poverty reduction strategies [68], while acknowledging the synergistic interactions between different forms of capital in promoting sustainable development. This evidence-based analysis contributes to the literature on natural resource management in poverty alleviation frameworks.

5. Conclusions

The study findings indicate that social, natural, and human capital significantly influence coastal ecotourism (CE) development, indirectly affecting poverty reduction (PR) levels. Achieving sustainable ecotourism requires close collaboration between stakeholders. Community-based management approaches to ecotourism environmental conservation and poverty eradication in coastal regions. CMC creates employment opportunities, increases local community income, and facilitates micro and small enterprise growth. Furthermore, social capital and community involvement in ecotourism management strengthen shared ownership and responsibility.

However, several challenges exist, including limitations in technological skills and foreign language proficiency, which impede market expansion and international tourist visits. Therefore, enhancing management capacity, human resource skills training, and strengthening collaboration among community, government, and private sectors are essential for optimizing ecotourism potential and achieving economic sustainability. By effectively integrating natural capital and social capital, CMC can serve as a sustainable coastal ecotourism model supporting the blue economy whilst addressing socio-economic challenges in South Malang's coastal region.

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