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Strengthening the Role of Coastal Women in the Blue Economy Ecosystem

Ika Puspa Satrianny[1], Irwadi[2], Manda Dwipayani Bhastary[3*], Robin[4], Yogie Pratama[5]

[1,3,4] Institut Bisnis Informasi Teknologi dan Bisnis, Medan, Indonesia
[2] Sekolah Tinggi Manajemen Bisnis Multi Sarana Manajemen Administrasi dan Rekayasa, Medan, Indonesia
[5] Universitas Deztron Indonesia, Medan, Indonesia
Correspondence Author Email: dwipayanimanda@gmail.com

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ABSTRACT

Fishermen Village, Medan Belawan Sub-district, is one of the strategic coastal areas but also faces complex challenges, such as environmental degradation, limited infrastructure, and low community access to sustainable economic empowerment programs. Women in this area have high capacity and participatory spirit, but have not been involved in many blue economy-based empowerment programs. The urgency of this research is because Kampung Nelayan in Medan Belawan Sub-district is one of the strategic areas with great marine and fisheries potential, but there is no model and systematic approach that elevates the role and potential of coastal women in blue economy-based development in this area. In fact, strengthening the capacity and participation of women is very important not only to improve the welfare of fishing families but also as a driver of an inclusive and sustainable local economy. The purpose of this study is to analyze the influence of knowledge about the blue economy, access to resources and training, active participation in coastal economic activities, and community and family support on the level of contribution/role of coastal women in the blue economy ecosystem in Kampung Nelayan, Medan Belawan Subdistrict. This study uses a quantitative approach using Structural Equation Modeling with Partial Least Squares (SEM-PLS). This research is important for designing inclusive and sustainable coastal women's empowerment policies based on the blue economy, to support improving the welfare of fishing families and the local economy. The results showed that knowledge of the blue economy has a positive and significant effect on the level of contribution/role of coastal women in the blue economy ecosystem. This research is important for designing inclusive and sustainable coastal women's empowerment policies based on the blue economy, to support improving the welfare of fishing families and the local economy.

Keywords: Strengthening; Coastal; Women; Blue; Economy

1. Introduction

Indonesia, as an archipelagic country, has enormous potential for marine resources, which, if managed sustainably, can become the backbone of the national economy. (1). The concept of the blue economy is present as a development approach that emphasizes the sustainability of marine resource utilization, efficiency, and inclusiveness in the management of the marine sector.(Elston et al., 2024). One important aspect of blue economy implementation is the active involvement of coastal communities, including women in marine-based economic activities ((Ujianti et al., 2024) (Sikhunyana and Mishi, 2023).

Kampung Nelayan in Medan Belawan Sub-district is one of the strategic coastal areas, but it also faces complex challenges, such as environmental degradation, limited infrastructure, and low community access to sustainable economic empowerment programs. Women in this area have high capacity and participatory spirit, but have not been involved in many blue economy-based empowerment programs.

Fig. 1. Infrastructure limitations in the area of Fisherman Village Settlement

* Corresponding author
E-mail addresses: dwipayanimanda@gmail.com

Fig. 2. Trash scattered above the water surface under the stilt house.

The picture above illustrates the complex challenges faced by the people of Kampung Nelayan related to the environment and limited infrastructure. In addition, most of the people in Kampung Nelayan still have a low level of education, with many residents only finishing elementary school, and some not finishing elementary school. Data from the Regional Research and Innovation Agency of Medan City shows that 17.73% of the population did not graduate from elementary school, 22.50% graduated from elementary school, the level of secondary education and high school is 26.80%, while Diploma III and Bachelor Strata I are only 1.6% (https://brida.medan.go.id/). This is also an obstacle to increasing capacity and access to economic empowerment programs. In this context, strengthening the role of women is very important as agents of change who can encourage the realization of an inclusive and sustainable blue economy ecosystem. (Nurul and Nur, 2024)(Bohler-Muller et al., 2019)((Joleen et al., n.d.).

Based on the background outlined, the research questions in this study are as follows: (1) How does knowledge about the blue economy influence the level of contribution/role of women in the coastal community within the blue economy ecosystem in Kampung Nelayan, Medan Belawan District? (2) How does access to resources and training influence the level of contribution/role of women in the coastal community within the blue economy ecosystem in Kampung Nelayan, Medan Belawan District? (3) How does active participation in coastal economic activities influence the level of contribution/role of women in the coastal community within the blue economy ecosystem in Kampung Nelayan, Medan Belawan District? (4) What role does community and family support as a moderating variable play in either strengthening or weakening the level of contribution/role of women in the coastal community within the blue economy ecosystem in Kampung Nelayan, Medan Belawan District?

This research is conducted because Kampung Nelayan in Medan Belawan District is a strategically significant area with vast marine and fisheries potential. However, there has yet to be a systematic concept or approach that highlights the role and potential of coastal women in blue economy-based development in this region. Strengthening the capacity and participation of women is essential not only to improve the welfare of fishing families but also as a driver for inclusive and sustainable local economic growth.

Previous studies on the role of coastal women have been conducted, such as by Wulandari et al. (2022). Their research highlighted the active participation of coastal women in social activities organized by the SPPK (Sekolah Perempuan Puger Kreatif), their involvement in marketing fish-based products, and their increasing independence in managing family documents at the village office, such as managing family cards, birth certificates, and other documents. The participation of coastal women from Puger in SPPK has had a positive impact on enhancing their social roles in the community. Furthermore, Hamid's (2024) study on the role of coastal women in improving family economies in Lampulo, Banda Aceh, through trade, factory work, and services, has shown how such activities can enhance family income, thus meeting daily household economic needs. This research will fill the gap by integrating the social, economic, and environmental roles of coastal women in the context of the Blue Economy, offering a sustainability perspective rather than merely focusing on social participation or income improvement, and providing a relevant empowerment model for developing community-based blue economy policies.

The research gap in this study lies in the lack of a systematic and comprehensive model that addresses the role of coastal women in blue economy-based development, particularly in coastal areas facing infrastructure and resource access challenges. While there are several studies related to women's empowerment in the marine-based economy,(Rahmawati et al., 2022)(Nirmasari & Bibin, 2021)(Hidayati, 2024)This study fills the gap in terms of the influence of knowledge about the blue economy, access to training, and community support on women's contributions to the blue economy ecosystem. Furthermore, there are still a few studies that empirically examine the influence of these factors using a quantitative approach and Structural Equation Modeling (SEM-PLS) in the context of Indonesian coastal areas, making this study relevant to fill this gap.

The research gap in this study lies in the lack of a systematic and comprehensive model that addresses the role of coastal women in blue economy-based development, particularly in coastal areas facing infrastructure and resource access challenges. While there are several studies related to women's empowerment in the marine-based economy (Hidayati, 2024), this study fills the gap in terms of the influence of knowledge about the blue economy, access to training, and community support on women's

contributions to the blue economy ecosystem. Furthermore, there are still a few studies that empirically examine the influence of these factors using a quantitative approach and Structural Equation Modeling (SEM-PLS) in the context of Indonesian coastal areas, making this study relevant to fill this gap.

Knowledge of the blue economy refers to the extent to which individuals, in this case, coastal women, understand the concepts, principles, benefits, and practices related to the blue economy. (Marwiyah and Lailatul Fitria, 2022). Meanwhile, access to resources and training refers to the availability and accessibility of facilities, means, and training that can support the capacity building of coastal women in blue economy-based economic activities(Andrews et al., 2021). This support is very important because it activates the extent to which women can actively participate, make decisions, and be economically and socially empowered. (W et al., 2021) (Hughes and Munoz-Guzman, 2015).

Active participation in coastal economic activities refers to the extent to which individuals, particularly coastal women, are actively involved in economic activities related to marine and coastal resources. (Cadoret and Jones, 2024).

Based on the theory and several previous studies, the hypothesis in this study is that Knowledge about the blue economy influences the level of Contribution/role of Coastal Women in the Blue Economy Ecosystem (H1), Access to resources and training influences the level of Contribution/role of Coastal Women in the Blue Economy Ecosystem (H2), Active Participation in Coastal Economic Activities influences the level of Contribution/role of Coastal Women in the Blue Economy Ecosystem (H3), and Community and family support influences the level of Contribution/role of Coastal Women in the Blue Economy Ecosystem (H4)

This research contributes to empirical insights into the crucial role of coastal women in the blue economy ecosystem, particularly in the Fishermen's Village of Medan Belawan District. It also introduces a blue economy-based women's empowerment model that can serve as a reference in developing inclusive and sustainable maritime economic policies. Furthermore, the findings contribute to the growing literature on coastal women's empowerment by highlighting the factors influencing their participation in maritime-based economic activities.

In coastal areas such as Kampung Nelayan, Medan Belawan Sub-district, the potential for marine resources is abundant, but women are still often marginalized in decision-making and access to training, capital, and business facilities. This reality creates gender inequality and weakens the socioeconomic resilience of coastal communities (Siscawati et al., 2020). Lack of family and community support, lack of relevant training, and women's limited knowledge of the blue economy concept are serious challenges that must be addressed (Rahmiyati and Rachmawati, 2023).

2. Research Methods

This research uses a quantitative approach using Structural Equation Modeling with Partial Least Squares (SEM-PLS). Where the results of the study are expected to be able to empirically examine the direct and indirect effects of variables, such as Knowledge of the blue economy, Access to resources and training, Community and family support and Active participation in coastal economic activities on the level of contribution/role of coastal women in the blue economy ecosystem in the Fishermen's Village of Medan Belawan District.

Population and Sample

Table 1. Total Population in Medan Belawan Sub-district (2024)

Kelurahan *Locality*	Penduduk/*Population*		
	Laki-Laki/*Male*	Perempuan/*Female*	Total
(1)	(2)	(3)	(4)
Belawan Pulau Sicanang	9 355	8 721	18 076
Belawan Bahagia	6 973	6 837	13 810
Belawan Bahari	6 830	6 532	13 362
Belawan II	12 623	12 141	24 764
Bagan Deli	9 753	9 012	18 765
Belawan I	12 039	11 641	23 680
Medan Belawan	57 573	54 884	112 457

Source: Medan Belawan Sub-district in Figures (2024)

Based on data from the Medan Belawan Sub-district Office, the number of female residents in Kampung Nelayan, Belawan 1 Village is 11,641; the total population in this study is 11,641. The sampling technique uses the Slovin formula (18), namely:

$$n = N/(1+Ne^2)$$

Where:

n = number of samples

N = population size

E = standard error

Based on the Slovin formula, it can be seen that the number of research samples is:

n = 11641/(1+11641(0.05))

n = 386.8

n = 387

The results of the sample calculation obtained a sample of 387 women. This approach was chosen to obtain more comprehensive and representative data to analyze the level of contribution/role of coastal women in the blue economy ecosystem in Kampung Nelayan, Medan Belawan Sub-district.

No	Variable	Operationalization of Variables	Indicator
1	Knowledge about Blue Economy (X1)	The level of understanding of individuals, particularly coastal women, regarding the concepts, principles, benefits, and practices of the blue economy, which emphasizes the sustainable, inclusive, and environmentally conscious use of marine resources to improve community well-being without damaging marine and coastal ecosystems. Dwyer, L. (2018)	1. Understanding the Blue Economy concept 2. Knowledge of sustainable marine resources 3. Awareness of the environmental impacts of marine economic activities 4. Knowledge of the role of women in the blue economy 5. Understanding the benefits of the blue economy for coastal communities 6. Knowledge of regulations/policies regarding the blue economy
2	Access to Resources and Training (X2)	The level of accessibility for coastal women to facilities, information, skills, and mentoring that support their involvement in blue economy activities. This access includes opportunities for training, business capital, technology, market networks, and institutional support to sustainably increase their capacity and productivity. Sachs, J. D., et al. (2019)	1. Availability of training and counseling 2. Access to information and technology 3. Access to capital and business assistance 4. Participation in business groups or cooperatives 5. Institutional or government support 6. Sustainable access to training
3	Active Participation in Coastal Economic Activities (X3)	This refers to the concrete involvement of coastal women in various economic activities directly or indirectly related to marine and coastal resources, whether as primary actors, business partners, or members of business groups. This reflects a contribution to increasing family income and the sustainability of the local economy based on the blue economy. Nieves, I., & Segovia, L. (2018)	1. Involvement in marine/coastal livelihoods 2. Involvement in processing or marketing marine products 3. Role in coastal economic business groups 4. Decision-making in family economic activities 5. Frequency and consistency of involvement 6. Contribution to family income from coastal activities (Likert scale)
4	Community and family support (X4)	The emotional, social, moral, and practical support received by coastal women from their families and communities in carrying out their roles and economic activities based on blue economy principles. This support includes approval, motivation, cooperation, access to networks, and direct assistance in business or productive activities in coastal areas. UN Women (2021)	1. EMotivational support from family 2. The role of a spouse in encouraging involvement 3. Involvement of family members in business activities 4. Social support from the local community 5. Access to community networks or business groups 6. The presence of supportive community leaders
5	Level of contribution/role of coastal women in the blue economy ecosystem (Y)	The extent to which coastal women are actively involved and make tangible contributions to sustainable marine-based economic, social, and environmental activities. These contributions include their roles in production, processing, distribution, environmental conservation, and decision-making within the blue economy in coastal areas. Siar, S. V. (2013).	1. Role in marine/coastal-based economic activities 2. Contribution to family income from coastal activities 3. Role in preserving the coastal environment 4. Role in business innovation or marine product processing 5. Involvement in economic or community decision-making 6. Participation in coastal economic networks or institutions

This study uses primary data obtained through the distribution of questionnaires directly to respondents who are the research sample. The questionnaire was designed based on indicators from each research variable. Before being distributed, the questionnaire has gone through the validity and reliability test stages to ensure that this research instrument can measure the variables under study accurately and consistently.

Data Sources and Data Collection Techniques

This study uses primary data obtained through the direct distribution of questionnaires to respondents who serve as the research sample. The questionnaire was designed based on the indicators of each research variable. Before distribution, the questionnaire underwent validity and reliability testing to ensure that the research instrument could measure the variables accurately and consistently.

2.1 Basic Research Framework

State of the Art and Novelty

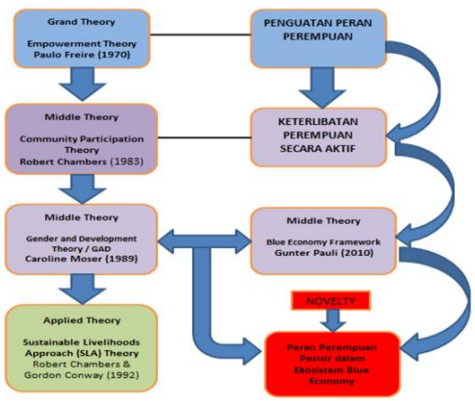

Fig. 3. State of the art and Novelty

The grand theory underlying this research is Empowerment Theory. This theory was developed by thinkers such as Paulo Freire (1970) in the context of social liberation and expanded into development and gender studies. This theory explains how marginalized individuals or groups (in this case, coastal women) can gain access to economic and social resources, decision-making capacity, and influence in society. (Surya Darma, 2022)

Theoretically, this research presents novelty by combining several conceptual perspectives in an integrative manner, namely, Empowerment Theory as a grand theory, and Gender and Development. (Miller, 2016) and Community Participation (Rani Kusumo Wardani and Putu Suarthana, 2021) (Sastro et al., 2023) as middle theories, and the Sustainable Livelihoods approach (Sapkota, 2021) and Participatory Rural Appraisal as applied theories (Megayanti and Fitria, 2020). This approach forms a strong conceptual foundation for formulating the role of coastal women in an inclusive, equitable, and sustainable blue economy ecosystem.

Furthermore, no research has integrated a women's empowerment approach into the blue economy framework, which has tended to be dominated by technical and macroeconomic perspectives. Studies on the blue economy in Indonesia generally focus on aspects of natural resource and marine management, while the active involvement of women, particularly coastal women, in marine-based economic systems has rarely received serious attention in the academic literature. This is evident in previous research

3. Results and Discussion

3.1 Validity Test

The validity test is used to determine whether a questionnaire is valid or not. A questionnaire is said to be valid if the questions on the questionnaire can reveal something that will be measured by the questionnaire. (Taherdoost, 2018). The validity test on the results that have been carried out in this study uses the Structural Equation Modeling method with Partial Least Squares (SEM-PLS). The criteria for determining the validity of a questionnaire are as follows: If the correlation is positive and r> 0: 186, which is determined from the number of respondents, namely 387 respondents, then the instrument item is declared valid. Invalid question items are not included in hypothesis testing.

The results of the validity test on the four variables, namely Knowledge of the blue economy, access to resources and training, active participation in coastal economic activities, and the role of community and family support, can be reviewed with the following table:

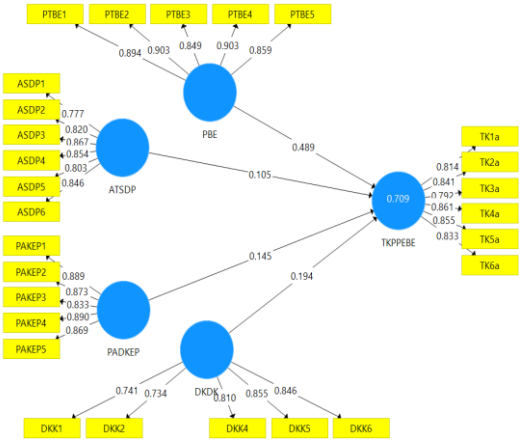

Fig. 4. Model with Outer Loading Value

The results of the first run of outerloading values below 0.7 are 3 indicators, namely DKK3 (involvement of family members in business activities), PAKEP6 (contribution to family income from coastal activities), and PTBE6 (knowledge of regulations/policies on the blue economy). So all three have been removed so that the outerloading value becomes above the standard 0.7. The test results above show that all variable indicators used in the second iteration already have an outer loading value greater than 0.70 and can be declared to have good convergent validity.

Table 2. Average Variant Extracted (AVE) Value

Variable	Average Variant Extracted (AVE)
Knowledge about Blue Economy (PTBE)	**0.931**
Access to Resources and Training (ASDP)	**0.686**
Active Participation in Coastal Economic Activities (PAKEP)	**0.920**
Community and Family Support (CCF)	**0.639**
Level of contribution/role of Coastal Women in the Blue Economy Ecosystem (TKPPEBE)	**0.694**

The test results show that all indicators have a greater correlation value to their latent variables than the correlation value to other latent variables. Each existing variable has an AVE value greater than 0.5, so that the existing variables can be declared to have good discriminant validity.

3.2. Reliability Test

Table 3. Composite Reliability Value

Variable	Composite Reliability	Cronbach's Alpha
Knowledge about Blue Economy (PTBE)	0.946	0.928
Access to Resources and Training (ATSDP)	0.929	0.908
Active Participation in Coastal Economic Activities (PAKEP)	0.940	0.920
Community and Family Support (CCF)	0.898	0.858
Level of contribution/role of Coastal Women in Blue Economy Ecosystem (TKPPEBE)	0.932	0.912

The test results show that each variable has a composite reliability value and Cronbach's Alpha greater than 0.70, so that it can be declared to have good composite reliability.

Table 4. R Square Value

Quality Criteria

R Square

	R Square	R Square Adjusted
TKPPEBE_	0.709	0.706

Based on the table above, it is known that the R-Square value = 0.709 means that the ability of the variables Knowledge of Blue Economy, Access to Resources and Training, Active Participation in Coastal Economic Activities, Community and Family Support in explaining the Level of Contribution/role of Coastal Women in the Blue Economy Ecosystem is 70.9% (high). While the remaining 29.1% is another variable not examined in this study.

Table 5. F Square Value

Independent Variable	Level of contribution/role of Coastal women in the Blue Economy Ecosystem (TKPPEBE)
Knowledge about Blue Economy (PTBE)	0.300
Access to Resources and Training (ATSDP)	0.014
Active Participation in Coastal Economic Activities (PAKEP)	0.019
Community and Family Support (CCF)	0.052

Table 6. Direct Effect Analysis

Hypothesis	Coefficient	P Value
Knowledge about Blue Economy: The level of contribution/role of coastal women in the Blue Economy Ecosystem	0.503	0.000
Access to Resources and Training Level of Coastal Women's Contribution/Role in the Blue Economy Ecosystem	0.107	0.049
Active Participation in Coastal Economic Activities→ Level of Coastal Women's Contribution/Role in the Blue Economy Ecosystem	0.140	0.0021
Community and Family Support (CCF) Level of Coastal Women's Contribution/Role in the Blue Economy Ecosystem	0.184	0.000

3.1 Discussion

Knowledge about the Blue Economy has a positive and significant effect on the level of contribution/role of coastal women in the Blue Economy ecosystem, with a coefficient of 0.503 and a P-value of 0.000. Thus, hypothesis H1 is confirmed.

Access to Resources and Training has a positive but insignificant effect on the level of contribution/role of coastal women in the Blue Economy ecosystem, with a coefficient of 0.107 and a P-value of 0.049. Therefore, hypothesis H2 is accepted.

Active participation in coastal economic activities has a positive but insignificant effect on the level of contribution/role of coastal women in the Blue Economy ecosystem, with a coefficient of 0.140 and a P-value of 0.0021. Therefore, hypothesis H3 is confirmed.

Community and family support have a positive and significant effect on the level of contribution/role of coastal women in the Blue Economy ecosystem, with a coefficient of 0.184 and a P-value of 0.000. Therefore, hypothesis H4 is accepted.

The results of this study align with previous research, such as that conducted by Sori (2018), which emphasized the importance of women's roles in the coastal marine-based economic sector, where family and community support significantly influence their contributions. This study also supports the findings of Zal-zabila and Nur (2024), who showed that knowledge of the blue economy plays a crucial role in increasing coastal women's participation. However, this study broadens this perspective by empirically examining the factors influencing women's contributions to the blue economy ecosystem using Structural Equation Modeling (SEM-PLS), a model not widely used in similar studies. Furthermore, this study places greater emphasis on access to resources and training, factors not widely discussed in previous studies, making it a novel contribution to the literature on coastal women's empowerment.

4. Conclusion

From the test results obtained, the parameter coefficient and P value, it can be concluded that Knowledge of the Blue Economy has a positive and significant effect on the level of contribution/role of Coastal Women in the Blue Economy Ecosystem, with a coefficient of 0.503 and a P value of 0.000. Thus, hypothesis H1 is proven. If the value of Knowledge about the Blue Economy increases, the level of contribution/role of coastal women in the Blue Economy Ecosystem will also increase. The results of these findings are in line with previous research conducted by (Nurul and Nur, 2024)(Matovu et al., 2025)

Access to Resources and Training has a positive and insignificant effect on the level of contribution/role of Coastal Women in the Blue Economy Ecosystem, with a coefficient of 0. 107 and a P value of 0.049. Thus, hypothesis H2 is accepted. This means that if access to resources and training increases, the level of contribution/role of coastal women in the Blue Economy Ecosystem will also increase.

Active Participation in Coastal Economic Activities has a positive but insignificant effect on the level of contribution/role of coastal women in the Blue Economy Ecosystem, with a coefficient of 0.140 and a P value of 0.0021. Thus, hypothesis H3 is proven.

Community and Family Support has a positive and significant effect on the Level of Contribution/role of Coastal Women in the Blue Economy. Ecosystem with a coefficient of 0.184 and a P value of 0.000. Thus, hypothesis H4 is accepted. The results of this study are in accordance with previous research conducted by Sori (2018) (29), which shows that fisherwomen in Percut Sei Tuan Village have important roles in the domestic, public, and fishing sectors. Their involvement in economic activities, such as assisting their husbands in fishing and managing the catch, contributes significantly to the fulfillment of family needs. Support from their families and the local community strengthens their role in improving the welfare of fishing families.

This study found that knowledge about the blue economy has a positive and significant influence on coastal women's contribution to the blue economy ecosystem. Access to resources, training, and community and family support also contribute to their role, although the effects vary. Practical implications include the importance of providing greater training and support for coastal women to increase their involvement in marine-based economic activities, as well as developing more inclusive empowerment policies. A limitation of this study lies in its limited sample size, meaning the results may not be generalizable to all coastal areas in Indonesia. Suggestions for future research include expanding the scope of the study to various coastal areas and examining other factors that may influence women's contribution to the blue economy, as well as integrating qualitative perspectives to obtain a more holistic picture.

Acknowledgements

The level of contribution and role of coastal women in the Blue Economy ecosystem is increasingly gaining important attention in the study of sustainability and natural resource-based economy. Women in coastal areas are often directly involved in various economic activities related to the utilization of natural resources, such as fisheries, nature-based tourism, and coastal ecosystem management. Their role is crucial in maintaining the balance between economic exploitation and preservation of the environment that supports their lives and the surrounding community. Knowledge of the Blue Economy is a key factor in enhancing the role of coastal women. The Blue Economy, which focuses on the sustainable and environmentally friendly utilization of marine resources, requires a deep understanding of natural resource management practices, such as responsible fisheries, protection of coral reef ecosystems, and the development of environmentally friendly technologies to reduce marine pollution. Women involved in Blue Economy ecosystems usually possess valuable local knowledge, which is often not recorded in formal data but is very useful in planning and managing the sustainability of coastal resources. However, to enhance the role of coastal women in the Blue Economy, this knowledge needs to be strengthened through education and training. Many coastal women still lack access to information and technology related to more modern Blue Economy management. Therefore, initiatives that provide specialized training on marine resource sustainability, climate change, and ecosystem-based management techniques are very important.

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