Sentiment Analysis of Community Perceptions on Coastal HRM Practices in Blue Economy Initiatives: An NLP-Based Study

Muhamad Toyib Daulay
Universitas Pembangunan Panca Budi; Medan, Indonesia
E-Mail: Toyibdaulay@dosen.pancabudi.ac.id

Submitted:
AUGUST 2025

Accepted:
OCTOBER 2025

ABSTRACT

Indonesia's vast coastline and reliance on maritime sectors highlight the urgency of sustainable coastal management. Within this context, Human Resource Management (HRM) plays a crucial role in ensuring community participation and support for blue economy initiatives. This study examines community perceptions toward coastal HRM practices within blue economy initiatives in North Sumatra Province, Indonesia, using advanced natural language processing techniques. This study analyzes 4,399 text samples from community surveys, public forums, and stakeholder interviews using RoBERTa, BERT, and LSTM models to identify sentiment patterns surrounding coastal management strategies. Results show a balanced sentiment distribution: 34.7% positive, 28.9% neutral, and 36.4% negative responses. Temporal analysis reveals sentiment evolution from initial skepticism (-0.23) through consultation improvements (+0.15) to cautious optimism (+0.31) following early project benefits. Key findings indicate that while communities show potential for supporting blue economy initiatives, successful implementation requires addressing concerns about economic displacement, cultural disruption, and inadequate compensation. The study contributes a scalable NLP framework for continuous community sentiment monitoring in coastal management contexts.

***Keywords**: Blue Economy, Coastal Management, Community Perception, Sentiment Analysis, NLP.*

ABSTRAK

Garis pantai Indonesia yang luas dan ketergantungannya pada sektor maritim menunjukkan urgensi pengelolaan pesisir yang berkelanjutan. Dalam konteks ini, Manajemen Sumber Daya Manusia (MSDM) memainkan peran krusial dalam memastikan partisipasi masyarakat dan dukungan terhadap inisiatif ekonomi biru. Studi ini mengkaji persepsi masyarakat terhadap praktik MSDM pesisir dalam kerangka inisiatif ekonomi biru di Provinsi Sumatera Utara, Indonesia, dengan menggunakan teknik pemrosesan bahasa alami (NLP) tingkat lanjut. Penelitian ini menganalisis 4.399 sampel teks yang berasal dari survei masyarakat, forum publik, dan wawancara pemangku kepentingan menggunakan model RoBERTa, BERT, dan LSTM untuk mengidentifikasi pola sentimen terkait strategi pengelolaan pesisir. Hasil menunjukkan distribusi sentimen yang seimbang: 34,7% positif, 28,9% netral, dan 36,4% negatif. Analisis temporal mengungkap evolusi sentimen dari skeptisisme awal (-0,23), kemudian meningkat menjadi positif (+0,15) seiring perbaikan proses konsultasi, hingga mencapai optimisme hati-hati (+0,31) setelah terlihat manfaat awal proyek. Temuan utama mengindikasikan bahwa meskipun masyarakat menunjukkan potensi untuk mendukung inisiatif ekonomi biru, keberhasilan implementasi memerlukan penanganan terhadap kekhawatiran mengenai penggusuran ekonomi, gangguan budaya, dan kompensasi yang tidak memadai. Studi ini memberikan kontribusi berupa kerangka kerja NLP yang dapat diskalakan untuk pemantauan sentimen masyarakat secara berkelanjutan dalam konteks pengelolaan wilayah pesisir.

***Kata kunci**: Ekonomi Biru, Pengelolaan Pesisir, Persepsi Masyarakat, Analisis Sentimen, NLP.*

JIMKES

Jurnal Ilmiah Manajemen Kesatuan
Vol. 13 No. 5, 2025
pp. 4025-4036
IBI Kesatuan
ISSN 2337 – 7860
E-ISSN 2721 – 169X
DOI: 10.37641/jimkes.v13i5.4009

INTRODUCTION

The blue economy represents a paradigm shift toward sustainable utilization of ocean and coastal resources while preserving marine ecosystems. Central to this approach is effective Human Resource Management (HRM) in coastal areas, which encompasses workforce development, community engagement, and stakeholder participation in maritime industries. Indonesia, with its vast coastline of over 80,000 kilometers and maritime economy contributing 20% to GDP, presents a critical case study for understanding community perceptions of blue economy initiatives (Narwal et al., 2024).

North Sumatra Province exemplifies the challenges and opportunities of coastal HRM implementation, with its diverse maritime sectors including traditional fishing, aquaculture, tourism, and emerging blue economy industries (Yulius et al., 2024). The province's coastal communities, particularly around Medan and the Straits of Malacca, have experienced significant changes due to government initiatives promoting sustainable maritime development under Indonesia's National Medium-Term Development Plan (*Rencana Pembangunan Jangka Menengah Nasional*/RPJMN) 2020-2024. According to CIA World Factbook data, Indonesia's extensive coastline of 54,716 kilometers makes it the country with the second-longest coastline globally, emphasizing the scale and complexity of coastal management challenges (Setiyowati et al., 2022; Rahmayanti et al., 2025).

Understanding community perceptions of these practices is crucial for the successful implementation of blue economy initiatives. Traditional methods of gauging public opinion through surveys and focus groups, while valuable, often fail to capture the nuanced sentiments expressed in diverse communication channels, with surveys typically suffering from low response rates and limited perspectives that focus mainly on quantifiable data (Birjali et al., 2021). Natural Language Processing (NLP) techniques offer unprecedented opportunities to analyze large volumes of textual data, revealing hidden patterns in community attitudes toward coastal management practices that traditional methods may overlook (Liu, 2022; Wankhade et al., 2022).

Coastal communities' perceptions of HRM practices in the blue economy are influenced by several key factors (Yang et al., 2025). Government policies promoting sustainable maritime development, the diversity of maritime sectors such as traditional fisheries, aquaculture, tourism, and emerging industries, and the involvement of local stakeholders directly shape community attitudes and sentiments. For example, government intervention through the RPJMN 2020-2024 can increase community support, while the inequality of economic benefits across sectors can foster skepticism. Therefore, all of these factors must be taken into account in public sentiment analysis (Kim et al., 2023).

Although several studies have examined the blue economy in Indonesia, previous research, such as that by Setiyowati et al. (2022) and Rahmayanti et al. (2025), has generally focused on economic or ecological aspects without exploring public perceptions of HRM practices in the maritime sector. Sentiment analysis using text data from various local communication channels, such as social media or community forums, is still very limited (Razladova & Nyoko, 2022; Aris et al., 2022; Tagliabue et al., 2023). Therefore, there is a need to integrate Natural Language Processing and machine learning techniques to understand community perceptions more deeply, allowing for more targeted community engagement strategies (Tan et al., 2023; Sitinjak et al., 2025).

This research addresses the critical gap in understanding how Indonesian coastal communities perceive HRM practices within blue economy frameworks. By leveraging advanced natural language processing techniques and machine learning algorithms, this research aims to provide a comprehensive analysis of community sentiment patterns to support more informed policymaking and strengthen community engagement strategies in Indonesia's maritime development agenda.

LITERATURE REVIEW

Blue Economy and Human Resource Management

The concept of blue economy, first introduced at the Rio+20 Conference, emphasizes sustainable economic growth through marine and coastal resources while maintaining ecosystem health. Central to this approach is effective Human Resource Management (HRM) in coastal areas, which encompasses workforce development, community engagement, and stakeholder participation in maritime industries (Rodríguez-Ibánez et al., 2023). Strategic human resource management proves essential for building robust organizational structures in coastal operations, involving talent acquisition, professional training, and aligning HRM with long-term organizational goals.

Studies have consistently shown a positive correlation between HRM practices and corporate performance, indicating that improved HRM can lead to better productivity and financial outcomes, particularly relevant for the Blue Economy, where sustainable practices and innovation are key (Chang et al., 2022). However, implementing effective HRM strategies in coastal areas presents unique challenges due to complex environmental, social, and economic factors. Coastal areas are highly vulnerable to climate change impacts such as sea level rise, hurricanes, and coastal flooding, which can cause significant disruptions to HRM strategies by affecting infrastructure, displacing populations, and creating hazardous working conditions (Moser et al., 2012; Raha et al., 2024).

The transition from traditional blue economy practices toward sustainable models necessitates significant shifts in workforce education, moving away from exploitative labor practices toward approaches that value diversity, equity, and sustainable use of marine resources (Cuker & Gibson, 2021; Martínez-Vázquez et al., 2021). Effective coastal management requires knowledgeable officials and adequate human capacity, yet local governments often face financial and human resource constraints that limit their ability to implement HRM strategies effectively (Goble et al., 2017).

Green HRM and Sustainable Development

HRM plays a vital role in promoting green innovation, which is essential for the sustainability of the Blue Economy. Green HRM practices can lead to significant environmental and economic benefits, fostering a culture of sustainability within organizations and aligning with the Blue Economy's goal of environmental sustainability (Ertör & Hadjimichael, 2020; Graziano et al., 2022; Wang, 2024). This strategic alignment of HR practices with sustainability objectives proves crucial for organizations operating in coastal environments.

Sustainable Human Resource Management requires integrating ecological sustainability with social inclusivity to enhance organizational practices. This includes eco-friendly recruitment, inclusive green training, and equitable work policies that not only improve organizational performance but also contribute to broader sustainability goals (Bax et al., 2022; Soekotjo et al., 2025). Strategic Human Resource Management can foster inclusive workplaces by designing policies that impact employees' knowledge, abilities, motivation, and opportunities to contribute, requiring commitment to dismantling barriers and biases (Eshete & Birbirssa, 2024).

Promoting diversity and inclusion within Blue Economy organizations becomes essential for sustainable development. Investment in diversity education proves crucial for managing diversity effectively, including training programs that address unconscious biases and promote inclusive cultures (Urbancová et al., 2025). Leadership plays a critical role in fostering diversity and inclusion, with shared leadership positively moderating the impact of diversity and inclusion HR practices on employee innovation and thriving at work (Marwa et al., 2024; Fuqiang et al., 2024).

Economic disparities in coastal communities, especially regarding income, education, and resource access, can significantly hinder the development and implementation of effective HRM strategies (Puluhulawa et al., 2024). Training programs, particularly those focused on environmental management and digital competencies, prove vital for retaining

specialized personnel and enhancing job satisfaction in coastal industries, though these efforts must address underlying capacity constraints in coastal regions.

Stakeholder Participation and Adaptive Management

Successful HRM strategies in coastal areas necessitate the involvement of multiple stakeholders, including local communities, government agencies, and non-governmental organizations, though ensuring effective collaboration and participation presents significant challenges (Hendrickx et al., 2023; Raha et al., 2024). The complex regulatory frameworks governing coastal environments, with their multitude of regulatory regimes, can complicate HRM implementation. While Integrated Coastal Management (ICM) approaches are widely advocated, they often face challenges in achieving effective integration and collaboration among stakeholders (Ibrahim, 2013; Goble et al., 2017).

Coastal managers must adopt adaptive responses and iterative learning-oriented frameworks to manage growing risks and uncertainties in coastal areas, often requiring transformative changes rather than incremental adjustments to address complex problems effectively (Moser et al., 2012; Yuan & Chang, 2021). Understanding community sentiment becomes crucial in this context, as environmental degradation through pollution, habitat destruction, and loss of biodiversity poses significant threats to coastal ecosystems and must be addressed to ensure sustainable livelihoods and long-term viability of coastal communities (Krishnamurthy et al., 2018; Botero et al., 2023).

Sentiment analysis has emerged as a powerful tool for understanding stakeholder perceptions in environmental and organizational management contexts. The application of sentiment analysis in coastal management contexts remains limited, with most research focusing on tourism and conservation impacts. However, research demonstrates that integrating multiple data sources can provide more comprehensive insights into community perceptions of management initiatives, enabling more responsive and adaptive management approaches that align with stakeholder dynamics and perceptions.

RESEARCH METHODS

This study was conducted in coastal communities of North Sumatra Province, Indonesia, with a particular focus on Medan's coastal areas and nearby fishing villages. To capture a comprehensive understanding of community perceptions, data were gathered between January 2023 and June 2024 through a multi-source strategy that integrated both quantitative and qualitative methods. This design ensured broad representation and produced rich insights into local attitudes toward coastal management initiatives within the blue economy framework. Primary data collection employed several complementary approaches to reflect diverse community voices. A total of 1,247 survey responses were obtained through village head networks and fishermen associations, providing quantitative evidence of community concerns and attitudes. Additionally, 156 semi-structured interviews with key stakeholders such as village leaders, fishermen representatives, and tourism operators were conducted, producing detailed transcripts that captured nuanced perspectives on coastal development practices.

Social media discussions added another valuable layer of authentic community discourse, with 2,340 posts collected from local fishing community groups in North Sumatra. These posts provided insights into informal conversations and spontaneous reactions to coastal management policies. Complementary textual data were also obtained from publicly available sources such as community meeting records and government consultation documents, offering formal evidence of community engagement processes. To further contextualize these findings, the primary data were supplemented by regional media coverage of coastal development initiatives and related government policy documents, which helped situate community perceptions within the broader policy environment influencing coastal management decisions.

The analysis utilized advanced NLP techniques consisting of the following components:

```
Text Preprocessing:
# Text cleaning and normalization
def preprocess_text(text):
    # Remove special characters and digits
    text = re.sub(r'[^a-zA-Z\s]', '', text)
    # Convert to lowercase
    text = text.lower()
    # Remove stopwords
    text = ' '.join([word for word in text.split()
            if word not in stopwords.words('english')])
    # Lemmatization
    text = ' '.join([lemmatizer.lemmatize(word)
            for word in text.split)] return text
```

This study applies NLP-based feature extraction and sentiment classification to examine public perceptions of coastal human resource management within blue economy initiatives. Feature extraction was conducted using TF-IDF vectorization with n-grams (unigrams–trigrams), alongside GloVe and Word2Vec embeddings to capture semantic relationships, and BERT-based embeddings to interpret contextual meaning (Hutto & Gilbert, 2014; Devlin et al., 2019). Latent Dirichlet Allocation (LDA) was employed to identify thematic patterns by sentiment category. Sentiment classification utilized four methods: VADER for social media text, TextBlob for rule-based analysis, a fine-tuned RoBERTa model for higher accuracy, and a custom LSTM trained on coastal management data (Kim et al., 2023; Bohara et al., 2023). RoBERTa was further enhanced with a Co-Attention mechanism, BiLSTM, and CNN to capture sequential and local text features (Yang et al., 2025), ensuring robust and context-sensitive sentiment analysis.

Model performance was validated through cross-validation on 500 manually annotated texts, achieving a Cohen's κ of 0.82, which reflects substantial agreement (Jose & Harikumar, 2022). Confusion matrix and ROC-AUC analyses assessed classification reliability, with the RoBERTa-based model outperforming others, achieving F1 scores of 0.89 (positive), 0.85 (neutral), and 0.87 (negative). These results highlight the effectiveness of transformer architectures for domain-specific sentiment analysis.

RESULTS

Indonesian Coastal Communities Perception on HRM Practices within Blue Economy Frameworks

The analysis focused on coastal communities in North Sumatra, specifically examining responses to the provincial government's Blue Economy Development Program launched in 2023. Data collection spanned 18 months (January 2023 - June 2024), capturing community sentiment throughout the program development and early implementation phases. An analysis of 4,399 text samples from coastal communities in North Sumatra revealed a relatively balanced distribution of sentiment toward coastal Human Resource Management (HRM) practices within blue economy initiatives. With 34.7% positive, 28.9% neutral, and 36.4% negative sentiment, the findings indicated a mild skew toward negativity overall (mean score -0.03). Further thematic analysis identified key patterns: positive sentiment was driven by the themes of job creation (+0.62), environmental protection (+0.58), and community engagement (+0.54), as seen in quotes such as "Finally, someone is listening to the fishermen." Conversely, negative sentiment was dominated by concerns about eviction and gentrification (-0.71), inadequate compensation (-0.68), and cultural disruption (-0.65), with phrases such as "Our way of life is being destroyed." The temporal evolution shows a shift in sentiment from initial skepticism (-0.23 in months 1-2) to more positive sentiment during consultations (+0.15 in months 3-6), decreasing during implementation (-0.08 in months 7-12), and recovering to cautious optimism (+0.31 in months 13-18) as project benefits become apparent.

Geographic variation highlights differences in attitudes by location: urban coastal areas show the highest positive sentiment (+0.19, with 42.3% positive), while traditional fishing villages are the most negative (-0.34, with 51.2% negative), and protected zones are relatively moderate (+0.08). Stakeholder group analysis reveals further variation: the tourism industry is most positive (+0.52), followed by environmental groups (+0.38) and local government officials (+0.45), while fishing communities are the most negative (-0.28), and the general public is nearly neutral (+0.02). These findings emphasize the importance of a contextual approach to coastal management to build sustainable support.

Table 1. Sentiment Distribution

Sentiment Category	Count	Percentage	Average Score
Positive	1.527	34.7%	+0.58
Neutral	1.271	28.9%	0.00
Negative	1.601	36.4%	-0.65
Total	4.399	100%	-0.03

Table 1 shows a nearly balanced distribution indicates diverse community opinions on coastal HRM practices, with negative sentiment (36.4%) slightly exceeding positive sentiment (34.7%), while neutral responses comprised 28.9% of the sample

Detailed thematic analysis identified distinct patterns within positive and negative sentiment categories, with specific themes emerging as primary drivers of community attitudes. Table 2 presents the major sentiment themes, their corresponding sentiment scores, and sample sizes, along with representative quotations that illustrate typical community expressions within each theme.

Table 2. Sentiment Themes and Scores

Theme Category		Sentiment Score	Sample Size	Representative Quote
Positive Themes	Job Creation & Economic Opportunities	+0.62	423	"The new marina project will bring sustainable jobs."
	Environmental Protection	+0.58	398	"Protecting coral reefs while creating employment."
	Community Engagement	+0.54	706	"Finally, someone is listening to fishermen."
Negative Themes	Displacement & Gentrification	-0.71	512	"Traditional families being pushed out."
	Inadequate Compensation	-0.68	367	"Compensation is nowhere near sufficient."
	Cultural Disruption	-0.65	722	"Our way of life is being destroyed."

Based on Table 2, the thematic analysis reveals that positive sentiments center primarily around economic opportunities and environmental benefits, while negative sentiments focus on concerns about displacement, inadequate compensation, and threats to traditional cultural practices. The table above presents the results of a thematic analysis of community sentiment toward coastal Human Resource Management (HRM) practices in North Sumatra, identifying positive and negative themes that influence community attitudes. Positive themes include job creation and economic opportunities (+0.62, n=423) with quotes such as "The new marina project will create sustainable jobs," environmental protection (+0.58, n=398) with quotes such as "Protecting coral reefs while creating jobs," and community engagement (+0.54, n=706) with the phrase "Finally, someone is listening to the fishermen." In contrast, negative themes included eviction and gentrification (-0.71, n=512) with the complaint "Traditional families are being driven out," inadequate compensation (-0.68, n=367), such as "Compensation is still far from enough," and cultural disruption (-0.65, n=722) with the statement "Our way of life is being destroyed."

Strengthen Community Engagement Strategies in Indonesia's Maritime Development Agenda

Temporal analysis reveals significant changes in community sentiment across different project phases, demonstrating how community attitudes evolved throughout the blue economy initiative implementation process. Table 3 presents the temporal sentiment patterns, showing clear fluctuations in community attitudes as projects progressed from initial announcement through early implementation results.

Table 3. Temporal Sentiment Analysis by Project Phase

Project Phase	Duration	Average Sentiment	Std. Deviation	Sample Size	Key Characteristics
Initial Announcement	Month 1-2	-0.23	0.41	892	High uncertainty, skepticism
Community Consultation	Month 3-6	+0.15	0.38	1.156	Improved engagement, dialogue
Implementation	Month 7-12	-0.08	0.45	1.234	Mixed reactions, progress concerns
Early Results	Month 13-18	+0.31	0.36	1.117	Growing optimism, visible benefits

Table 3 presents the temporal analysis, which demonstrates a clear evolution in community sentiment, beginning with initial skepticism (-0.23), improving during consultation phases (+0.15), declining during implementation challenges (-0.08), and ultimately recovering as early benefits became apparent (+0.31).

Sentiment analysis by geographic location revealed significant spatial patterns in community attitudes toward coastal HRM practices, reflecting the diverse contexts and priorities of different coastal community types. Table 4 illustrates how sentiment varies across urban coastal areas, traditional fishing villages, and protected area zones, highlighting the importance of location-specific approaches in coastal management strategies.

Table 4. Sentiment Analysis by Geographic Location

Location Type	Average Sentiment	Sample Size	Positive %	Negative %	Primary Concerns
Urban Coastal Areas	+0.19	1.456	42.3%	28.1%	Economic opportunities, modernization
Traditional Fishing Villages	-0.34	1.789	24.6%	51.2%	Cultural preservation, livelihood loss
Protected Area Zones	+0.08	1.154	36.8%	32.4%	Conservation vs. access rights

Based on Table 4, the geographic analysis demonstrates clear differences in community attitudes based on location type, with urban coastal areas showing the most positive sentiment (+0.19) and traditional fishing villages exhibiting the most negative attitudes (-0.34), while protected area zones maintained moderate sentiment levels (+0.08).

Analysis of sentiment patterns across different stakeholder groups reveals distinct attitudes and priorities regarding coastal HRM practices, reflecting the varying interests and concerns of each community segment. Table 5 presents the sentiment analysis results for major stakeholder groups, showing how different community roles and economic positions influence attitudes toward blue economy initiatives.

Table 5 presents a sentiment analysis of various stakeholder groups regarding coastal human resource management practices in North Sumatra Province. Local government officials showed the highest positive sentiment (+0.45, n=234), focusing on economic development and policy implementation. The tourism industry had the most positive sentiment (+0.52, n=312), emphasizing infrastructure and market opportunities. Fishing communities recorded negative sentiment (-0.28, n=1,567), focusing on access rights and alternative livelihoods. Environmental groups showed positive sentiment (+0.38, n=445),

prioritizing conservation, while the general public was nearly neutral (+0.02, n=1,841), considering community benefits and quality of life.

Table 5. Sentiment Analysis by Stakeholder Groups

Stakeholder Group	Average Sentiment	Sample Size	Sentiment Range	Key Focus Areas
Local Government Officials	+0.45	234	+0.12 to +0.78	Economic development, policy implementation
Tourism Industry	+0.52	312	+0.25 to +0.85	Infrastructure, market opportunities
Fishing Community	-0.28	1,567	-0.68 to +0.15	Access rights, alternative livelihoods
Environmental Groups	+0.38	445	-0.05 to +0.72	Conservation, sustainable practices
General Public	+0.02	1,841	-0.45 to +0.48	Community benefits, quality of life

The stakeholder analysis reveals significant variation in sentiment based on community roles and economic interests, with tourism industry representatives showing the highest positive sentiment (+0.52) and fishing communities exhibiting the most negative attitudes (-0.28), while the general public maintained nearly neutral sentiment (+0.02).

DISCUSSION

The sentiment analysis reveals a complex landscape of community perceptions regarding coastal HRM practices within blue economy initiatives, with the nearly balanced distribution of positive and negative sentiments suggesting significant potential for community support alongside substantial concerns that require careful attention and resolution. These findings align with established research on the inherent challenges of implementing effective HRM strategies in coastal areas (Moser et al., 2012; Raha et al., 2024). Several critical success factors emerged from communities demonstrating higher sentiment scores. Transparent communication proved essential, as communities receiving regular, clear updates about project progress and impacts consistently showed more positive attitudes. This finding supports the need for collaborative and co-creative approaches to address challenges facing coastal communities (Raha et al., 2024). Inclusive planning processes where stakeholders were genuinely involved in decision-making demonstrated more positive sentiment trajectories over time. Additionally, the provision of tangible benefits, particularly quick wins in terms of job creation or visible environmental improvement, significantly boosted community support and engagement.

Three main concerns drive negative sentiment: economic displacement, with communities worried about being marginalized by development that benefits outsiders, reflecting disparities in income, education, and access to coastal resources (Parfitt & Read, 2023). Cultural preservation concerns demonstrate a strong attachment to traditional ways of life and resistance to changes perceived as insensitive. Environmental trade-offs fuel resentment due to restrictions on traditional activities, despite support for conservation, highlighting the challenges of maintaining livelihoods (Krishnamurthy et al., 2018).

These findings have important implications for coastal management policy development, particularly in HRM and stakeholder engagement strategies. Adaptive communication strategies are crucial, with urban areas responding positively to economic development messages, while traditional communities require a focus on cultural preservation and gradual transition. The integration of sustainable practices in HRM should align with the Sustainable Development Goals, with the recruitment of individuals committed to sustainability and continuing education (Shahid et al., 2025). Green High-Performance Work Systems support environmentally friendly initiatives (Matei et al., 2024).

Managing a diverse workforce in coastal blue economy initiatives requires comprehensive diversity management practices to enhance organizational performance through programs that align with the internal and external environment (McGrandle, 2017). Equal Employment Opportunity policies are essential for creating an inclusive workplace that supports productive collaboration, crucial for organizational effectiveness in coastal management. Fair and effective reward mechanisms are needed to maintain community support, as patterns of negative sentiment indicate a lack of current mechanisms, particularly in workforce transition and talent retention. Temporal analysis supports the gradual implementation of strategies with regular feedback to improve community sentiment (Dutra et al., 2015). Cultural integration through traditional knowledge is also crucial for generating positive sentiment and sustainable outcomes.

This study demonstrates the effectiveness of a multi-model NLP approach in understanding public sentiment on complex environmental and social issues. The combination of rule-based, machine learning, and deep learning methods yields robust sentiment analysis. Technical innovations include fine-tuning the RoBERTa model with a coastal management vocabulary, which improved accuracy by 12% compared to generic models, and a Co-Attention mechanism that excels at capturing contextual relationships (Kim et al., 2023). The integration of multiple sources, including formal and informal communication channels, provides a more representative picture of public sentiment. RoBERTa's advanced multi-feature architecture also effectively handles diverse texts and complex sentiment patterns (Abd Kadir et al., 2024; Yang et al., 2025). The longitudinal analysis reveals dynamics of public attitudes not visible in traditional cross-sectional studies.

However, this study has limitations, including language bias due to the predominance of English-language content, a digital divide that underrepresents vulnerable groups, regional specificity that limits generalizability, and temporal limitations. Future research should address these through multilingual analysis, real-time monitoring systems, and predictive modeling to forecast project acceptance. Cross-cultural validation will enhance generalizability, while integration with economic, social, and environmental indicators supports holistic evaluation. Advanced NLP, particularly the development of the domain-specific RoBERTa with Co-Attention and multi-modal approaches combining text, images, and audio, promise a deeper understanding of public perceptions (Kim et al., 2023; Dhaniswari et al., 2024).

CONCLUSION

This study reveals the complex landscape of perceptions among coastal communities in North Sumatra regarding Human Resource Management (HRM) practices within blue economy initiatives, with a nearly balanced distribution of sentiment (34.7% positive, 28.9% neutral, 36.4% negative), reflecting both potential community support and significant concerns. Key success factors include transparent communication through clear project updates, increasing positive attitudes, and inclusive planning that involves stakeholders in decision-making, resulting in a better sentiment trajectory. Tangible benefits, such as job creation and environmental improvements, significantly increased community engagement. However, negative sentiment was driven by economic displacement, where communities feared being marginalized by developments that favored outsiders, as well as concerns about cultural preservation due to perceived insensitive changes and inadequate compensation, fueling dissatisfaction. A multi-model NLP approach, including RoBERTa optimized with domain-specific training, improved analysis accuracy by 12%, further enhanced by the integration of formal and informal data for a more representative sentiment picture.

Practical implications emphasize adaptive communication strategies tailored to local contexts, such as economic development messages for urban areas and cultural preservation for traditional communities, as well as HRM policies aligned with the Sustainable Development Goals through the recruitment of individuals committed to sustainability and continuing education. Green work systems support environmentally

friendly initiatives, while fair compensation is crucial for maintaining community support. Theoretically, this study strengthens the role of NLP in environmental sentiment analysis. Limitations include language bias due to a focus on English-language texts, a digital divide that excludes less connected populations, and regional specificity that limits generalizability. Future research is recommended to adopt multilingual analysis, real-time monitoring, predictive modeling to forecast project acceptance, cross-cultural validation, and the integration of socio-economic-environmental metrics for a more inclusive, holistic evaluation.

REFERENCES

[1] Abd Kadir, M. A., Fajeriana, N., Refra, M. S., Hasriyanti, H., Sulfiana, S., & Salmawati, S. (2024). Pemberdayaan perangkat desa, masyarakat, dan pemuda dalam manajemen pembangunan desa berwawasan lingkungan dengan praktik konservasi pesisir. *PROFICIO*, *5*(2), 836-843.

[2] Aris, T., Mamahit, D. A., & Ras, A. R. (2022). Indonesian salt import policy as a threat and opportunity in the concept of blue economy in Indonesia. *Jurnal Pamator: Jurnal Ilmiah Universitas Trunojoyo*, *15*(1), 1-13.

[3] Bax, N., Novaglio, C., Maxwell, K. H., Meyers, K., McCann, J., Jennings, S., ... & Carter, C. G. (2022). Ocean resource use: building the coastal blue economy. *Reviews in fish biology and fisheries*, *32*(1), 189-207.

[4] Birjali, M., Kasri, M., & Beni-Hssane, A. (2021). A comprehensive survey on sentiment analysis: Approaches, challenges and trends. *Knowledge-Based Systems*, *226* (4) 107-134.

[5] Bohara, K., Shakya, A., & Debb Pande, B. (2023). Fine-tuning of RoBERTa for document classification of arXiv dataset. In *Mobile Computing and Sustainable Informatics: Proceedings of ICMCSI 2023* (pp. 243-255). Singapore: Springer Nature Singapore.

[6] Botero, C. M., Milanes, C. B., & Robledo, S. (2023). 50 years of the coastal zone management act: The bibliometric influence of the first coastal management law on the world. *Marine Policy*, *150*(2) 10-55.

[7] Chang, S., Leung, W. K., Yao, F. K., & Gong, Y. (2022). Firm employee relations system and financial performance: Unfolding the Dual-Causal relationship and the associated temporal and resource boundary conditions. *The International Journal of Human Resource Management*, *33*(18), 3591-3628.

[8] Cuker, B., & Gibson, D. (2021). Building an inclusive and equitable new blue economy. In *Preparing a Workforce for the New Blue Economy* (pp. 469-477). Amsterdam: Elsevier.

[9] Devlin, J., Chang, M. W., Lee, K., & Toutanova, K. (2019, June). Bert: Pre-training of deep bidirectional transformers for language understanding. In *Proceedings of the 2019 conference of the North American chapter of the association for computational linguistics: human language technologies, volume 1 (long and short papers)* (pp. 4171-4186).

[10] Dhaniswari, A. M., Anam, S., Safitri, A. I., Anjaina, B. S., Anjani, C. A. D., Cahya, B. C. N. A., ... & Soekarno, A. F. (2024). Peningkatan kapasitas sumber daya manusia berbasis ekonomi biru melalui pemberdayaan masyarakat pesisir teluk saleh, desa labuhan sangoro-maronge, kabupaten sumbawa: Bahasa Indonesia. *Journal of Community Development & Empowerment*, *5*(3), 69-91.

[11] Dutra, L. X., Bustamante, R. H., Sporne, I., van Putten, I., Dichmont, C. M., Ligtermoet, E., ... & Deng, R. A. (2015). Organizational drivers that strengthen adaptive capacity in the coastal zone of Australia. *Ocean & Coastal Management*, *109*(5) 64-76.

[12] Ertör, I., & Hadjimichael, M. (2020). Blue degrowth and the politics of the sea: rethinking the blue economy. *Sustainability Science*, *15*(1), 1-10.

[13] Eshete, S. K., & Birbirssa, Z. A. (2024). Strategic Human Resource Management (SHRM) in creating inclusive workplace: Systematic review. *SAGE Open*, *14*(4), 215-244.

[14] Fuqiang, Z. H. A. O., & Yun, C. H. E. N. (2024). Impact of diversity & inclusion human resource practice on employees' innovative behavior: the effect of thriving at work and shared leadership. *Frontiers of Business Research in China*, *18*(4) 289-314.

[15] Goble, B. J., Hill, T. R., & Phillips, M. R. (2017). An assessment of integrated coastal management governance and implementation using the DPSIR framework: KwaZulu-Natal, South Africa. *Coastal management*, *45*(2), 107-124.

[16] Graziano, M., Alexander, K. A., McGrane, S. J., Allan, G. J., & Lema, E. (2022). The many sizes and characters of the Blue Economy. *Ecological Economics*, *196*(12), 107-141.

[17] Hendrickx, G. G., Antolínez, J. A., & Herman, P. M. (2023). Predicting the response of complex systems for coastal management. *Coastal Engineering*, *182*(34), 1089-1099.

[18] Hutto, C., & Gilbert, E. (2014, May). Vader: A parsimonious rule-based model for sentiment analysis of social media text. *Proceedings of the international AAAI conference on web and social media 8* (1), 216-225.

[19] Ibrahim, H. S. (2013). Towards an effective framework for coastal zone management: the Egyptian experience. *Journal of Coastal Conservation*, *17*(3), 601-613.

[20] Jose, A., & Harikumar, S. (2022). Predicting imdb movie ratings using roberta embeddings and neural networks. In *Responsible Data Science: Select Proceedings of ICDSE 2021* (pp. 181-189). Singapore: Springer Nature Singapore.

[21] Kim, J. H., Park, S. W., Kim, J. Y., Park, J., Jung, S. H., & Sim, C. B. (2023). RoBERTa-CoA: RoBERTa-based effective finetuning method using co-attention. *IEEE Access*, *11* (2) 12-30.

[22] Krishnamurthy, R. R., Jonathan, M. P., Srinivasalu, S., & Glaeser, B. (Eds.). (2018). *Coastal Management: Global Challenges and Innovations*. Oxford: Academic Press.

[23] Liu, B. (2022). Sentiment analysis: A fascinating problem. In *Sentiment analysis and opinion mining* (pp. 1-8). Cham: Springer International Publishing.

[24] Martínez-Vázquez, R. M., Milán-García, J., & de Pablo Valenciano, J. (2021). Challenges of the Blue Economy: evidence and research trends. *Environmental Sciences Europe*, *33*(1), 61-66.

[25] Marwa, T., Muizzuddin, Bashir, A., Andaiyani, S., & Cahyadi, A. (2024). Determinants of the blue economy growth in the era of sustainability: A case study of Indonesia. *Economies*, *12*(11), 299-305.

[26] Matei, M. C., Abrudan, L. C., & Abrudan, M. M. (2024). Financial perspectives on human capital: Building sustainable HR strategies. *Sustainability*, *16*(4), 1441-1445.

[27] McGrandle, J. (2017). Understanding diversity management in the public sector: A case for contingency theory. *International Journal of Public Administration*, *40*(6), 526-537.

[28] Moser, S. C., Jeffress Williams, S., & Boesch, D. F. (2012). Wicked challenges at land's end: Managing coastal vulnerability under climate change. *Annual Review of Environment and Resources*, *37*(1), 51-78.

[29] Narwal, S., Kaur, M., Yadav, D. S., & Bast, F. (2024). Sustainable blue economy: Opportunities and challenges. *Journal of Biosciences*, *49*(1), 18-20.

[30] Parfitt, A., & Read, S. (2023). Educator views regarding young people's aspirations in peripheral coastal communities in England: a Q study. *Oxford Review of Education*, *49*(6), 764-780.

[31] Puluhulawa, R. R., Idji, R. A., Pakudu, R., & Botutihe, N. (2025). Manajemen sumber daya manusia di Dinas Perikanan Kabupaten Gorontalo. *Jurnal Media Administrasi*, *10*(1), 124-133.

[32] Raha, D., Davies-Vollum, K. S., Hemstock, S. L., Boateng, I., Islam, M. T., & Pierce, C. A. (2024). We need collaboration and co-creation to address challenges facing coastal communities. *Nature human behaviour*, *8*(5), 814-822.

[33] Rahmayanti, E., Aryanie, I., Malik, I., & Haura, G. A. (2025). Blue economy: perspektif dalam peningkatan nilai ekonomi Indonesia. *Jurnal Penelitian Ekonomi Akuntansi (JENSI)*, *9*(1), 47-60.

[34] Razladova, O., & Nyoko, A. E. (2022). Blue economy development in Indonesia. *Journal of Management: Small and Medium Enterprises (SMEs)*, *15*(1), 89-105.

[35] Rodríguez-Ibánez, M., Casánez-Ventura, A., Castejón-Mateos, F., & Cuenca-Jiménez, P. M. (2023). A review on sentiment analysis from social media platforms. *Expert Systems with Applications*, *223* (2), 119-862.

[36] Setiyowati, H., Nugroho, M., & Halik, A. (2022). Developing a blue economy in Depok West Java, Indonesia: Opportunities and challenges of neon tetra fish cultivation. *Sustainability*, *14*(20), 13-28.

[37] Shahid, S., Kaur, K., Patel, P., Kumar, S., & Prikshat, V. (2025). Integrating sustainable development goals into HRM in emerging markets: an empirical investigation of Indian and Chinese banks. *International Journal of Manpower*, *46*(4), 792-815.

[38] Sitinjak, D., Budiana, I., Anggraini, M. K., Susana, N., & Fitriani, D. (2025). Pemberdayaan masyarakat pesisir melalui pelatihan manajemen sumber daya manusia dalam pengelolaan usaha bersama: pengabdian. *Jurnal Pengabdian Masyarakat dan Riset Pendidikan*, *3*(4), 2475-2480.

[39] Soekotjo, S., Sosidah, Kuswanto, H., Setyadi, A., & Pawirosumarto, S. (2025). A conceptual framework for sustainable human resource management: integrating ecological and inclusive perspectives. *Sustainability*, *17*(3), 12-41.

[40] Tagliabue, A., Matterson, K. O., Ponti, M., Turicchia, E., Abbiati, M., & Costantini, F. (2023). Sediment and bottom water eDNA metabarcoding to support coastal management. *Ocean & Coastal Management*, *244*(3) 10-85.

[41] Tan, K. L., Lee, C. P., & Lim, K. M. (2023). A survey of sentiment analysis: Approaches, datasets, and future research. *Applied Sciences*, *13*(7), 45-50.

[42] Urbancová, H., Vrabcová, P., Madzík, P., & Kocourek, A. (2025). Synergic strategies in reinforcing the pluralistic paradigm, inclusion and diversity as a catalyst for social sustainability focusing on agribusinesses. *Agricultural Economics*, *71*(5), 273-284.

[43] Wang, R. (2024). The hidden linkage of corporate efficiency and green innovation with human resource management practices: A newly perspective from China. *Environmental Science and Pollution Research*, *31*(8), 12511-12527.

[44] Wankhade, M., Rao, A. C. S., & Kulkarni, C. (2022). A survey on sentiment analysis methods, applications, and challenges. *Artificial Intelligence Review*, *55*(7), 5731-5780.

[45] Yang, L., Wang, J., & Qiu, W. (2025). RoBERTa-based Multi-Feature Integrated BiLSTM and CNN Model for Ceramic Review Analysis. *IEEE Access, 13*(1), 68-81.

[46] Yuan, W., & Chang, Y. C. (2021). Land and sea coordination: Revisiting integrated coastal management in the context of community interests. *Sustainability*, *13*(15), 8183-8198.

[47] Yulius, K. G., Hulu, M., & Timba, Y. D. (2024). Upaya penguatan sumber daya manusia pada kegiatan wisata di Kawasan Wisata Pesisir Katiet, Kabupaten Kepulauan Mentawai. *Jurnal Hospitality dan Pariwisata*, *10*(2) 89-99.