Assessing Community Perceptions Of Sustainable Coastal HRM Using NLP Approaches

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Abstract

As one of the largest archipelagos in the world, Indonesia's extensive coastal areas provide both opportunities and challenges for the development of sustainable blue economy initiatives. For effective Human Resource Management (HRM) to be implemented within this context, it is essential that local communities participate actively and benefit equally from the implementation of blue economy initiatives. This research uses Natural Language Processing (NLP) based sentiment analysis to investigate how local communities perceive coastal HRM practices in North Sumatra.

***Keywords**:* Blue Economy, Coastal Management, Human Resource Management, Sentiment Analysis, NLP.

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Introduction

Sustainable use of marine and coastal resources while protecting ecosystems and promoting equitable social outcomes is the focus of the Blue Economy. Indonesian coastal areas have a total length of over 80,000 kilometers of coastline and also generate a significant amount of its national income through the maritime sector. Therefore, Indonesia has the challenging task of balancing ecosystem protection, community well-being, and resource management, all occurring in rapidly changing coastal lifestyles [2], [7]. In North Sumatra, current blue economy projects related to fishery, aquaculture, and tourism, have greatly increased the level of socio-economic transition and created intense debate regarding who receives the advantages and who is at risk, as well as who will manage these trade-offs. In contexts where HRM serves as both a coordination mechanism and a social contract by providing the capability-building and fairness in access to opportunities for various coastal stakeholders, the study of community perception is important [3].

Although conventional surveys and town-hall meetings are useful they can be limited in capturing the texture of daily perceptions particularly from marginalized groups, since perceptions travel informally via speech, local dialect, and on-line conversation that do not lend themselves easily to being categorized. Recent advances in natural language processing (NLP) offer an additional perspective in analyzing large volumes of unorganized data and identifying sentiment changes over time, space, and among different stakeholders [13], [6]. This research applies sentiment analysis and NLP models to analyze community perception of HRM practices in coastal programs in North Sumatra. Additionally, by tracking how sentiment evolves as policy announcements are made, as consultation occurs, and as initial results of programs occur, the study offers actionable signals to adapt HRM to provide transparency in communication, inclusive and participatory planning processes, and fair compensation to coastal communities. In doing so, the study provides an evidence-based framework for continuous community feedback in coastal governance, which responds to the call for co-creation and collaboration for coastal issues that have multiple complexities [8].

Literature Review

The blue economy has been portrayed primarily as an attempt to achieve ecological integrity, economic vitality and social equity in all forms of development that depend on the ocean and therefore, effective governance of the blue economy should be able to provide a fair balance among these three aspects in conditions of great uncertainty and conflicting interests [2]. Integrated coastal management is designed to coordinate efforts across sectors and spatial scales to ensure that resource extraction, resource protection, and human livelihoods support each other, rather than undermining them [3].

Therefore, Human Resource Management (HRM) plays a critical role in governing the blue economy through its ability to shape how capabilities are developed, how participation is structured, and how costs and benefits are distributed among stakeholders. The evidence from organizational research indicates that organizations with well-integrated and coherent HRM systems tend to have higher levels of productivity and performance, which implies that how organizations manage their employees will be a major factor in determining whether they are successful in their sustainability goals [1]. Additionally, Indonesia's experience with implementing blue economy programs indicates that the establishment of blue economies can help stimulate local economic growth; however, they also expose the limitations of an

organization's capacity to implement their programs, which underscores the importance of HRM in ensuring the success of blue economy programs [10].

However, there are some specific challenges related to managing HRM in coastal environments, including the need for temporary workers during seasonal employment periods; the prevalence of informality in many coastal labor markets; the increased vulnerability of coastal workers to environmental hazards; and the historical inequities in access to education, job training, and labor market opportunities that affect the distribution of skills and resources in coastal regions. Green HRM provides a conceptual framework for connecting green goals to daily HRM activities such as recruitment, training, evaluation, and leadership, by providing a mechanism to link day to day employee management decisions to longer term environmental goals [11]. Designing technical solutions alone will not suffice. Participation and co creation of blue economy programs, treating communities as partners rather than simply as passive recipients of government services, are consistently identified as key factors to establishing both durable legitimacy and adaptive capacity in complex coastal systems [8].

From a practical perspective, this suggests that HRM must be responsive to local knowledge, cultural ties to the land, and the distributional impacts of changes in coastal regions; if not, then HRM based initiatives may undermine trust and provoke opposition even when aggregated metrics suggest improved outcomes. However, measuring these social dynamics is difficult. Standardized survey instruments typically only capture a snapshot of public attitudes toward policy issues and fail to account for how attitudes about policies evolve over time relative to policy milestones or among different stakeholder groups. Sentiment analysis offers a complementary approach to analyzing social dynamics, as it allows researchers to analyze large amounts of unstructured text data to determine how public attitudes regarding blue economy policies evolve in near-real-time [6], [9].

While rule-based approaches to sentiment analysis such as VADER are adequate for capturing the tone of short, informal statements common on social media platforms [4], the complexity and nuance inherent in domain-specific language, code-switching, and sarcasm require the application of deep neural models such as RoBERTa fine-tuned with co-attention and hybrid BiLSTM/CNN layers to provide better contextual understanding and classification accuracy [5], [12]. Despite rapid advances in methodologies used in sentiment analysis, the number of studies that apply sentiment analysis to examine the relationship between HRM and coastal governance remains small, creating opportunities for additional research that links sentiment analysis to empirical HRM levers (e.g., training programs, participation mechanisms, compensation designs) in blue economy programs.

Research Methodology

This research was conducted in North Sumatra Province on coastal districts of the province and cities around Medan and along the Malacca Strait. We used three complementary sources of data to articulate both formal and informal voices (1) community surveys resulting in 1,247 responses, (2) transcripts of stakeholder interviews yielding 156 documents, and (3) 2,340 social-media posts drawn from local fisher networks. The multiple channels provided a basis of comparison between structured inputs and impromptu, vernacular expressions that show evidence of concern earlier than those discussed in formal forums. Preprocessing included standard operations such as splitting text into word evel meanings, filtering functional words which provide little analytic value, reducing words to their base forms to minimize noise from

spelling variants and inflective differences to maximize the signal that is made available to deep-learning classifiers. We utilized both lexicon based and deep learning approaches for classifying sentiment. For the shorter, informal postings characteristic of social media we employed VADER which is very good with punctuation, intensifiers and the meanings of emojis [4].

As an additional method of comparison we also performed a lightweight heuristic analysis to check edge cases. In order to model the sequential dependencies of longer passages, we trained a Long Short-Term Memory network (LSTM). Our principal model was a fine-tuned RoBERTa transformer, enhanced with co-attention and BiLSTM layers to enrich its contextual understanding of switching among languages and in the application of idioms [5], [12]. This ensemble model utilizes the precision of neural encoders while providing a transparent baseline giving interpretable results. Ground truth labels were produced for 500 documents by independent annotators. Inter rater reliability was high (Cohen's $\kappa = .82$), suggesting good agreement in application of the coding scheme. In evaluation of the models, RoBERTa yielded the most stable and most accurate results yielding F1 values of some .89 (positive), .85 (neutral), and .87 (negative).

Based on these results we adopted RoBERTa as the primary engine that generated our results, but held results that were generated by the VADER and LSTM engines as checkpoints and as quality control. This layering of models permits robust inference about patterns of sentiment that have been analyzed without loss of clarity involving how these classifications were achieved.

Result

Of the 4,399 texts analyzed, attitudes toward human resource management (HRM) practices within blue economy programs in North Sumatra are distributed evenly: 34.7% positive, 28.9% neutral, 36.4% negative sentiment. It shows that the public is not polarized at the ends of the spectrum, but the level of confidence is not solidified. There is a synthesis of promise and friction, which is best managed with intention, rather than making blanket statements of approval. On the positive side, the theme is based on three themes creating jobs (topic score +0.62), environmental protection (+0.58) and meaningful community involvement (+0.54). Respond well when there are visible opportunities training that results in employment, recruitment that is locally accessible, and when environmental protections are not a rhetorical flourish, but substantial. What's more, participation seems to create good will sentiment is enhanced when the residents feel that there is a seat at the table rather than a seat in the audience.

The negative cluster is equally coherent themes are focused on economic dislocation (−0.71), which may be superficial due to lack of disdain for compensation (−0.68), or on cultural dislocation (−0.65). These are interdependent. The changes in livelihood practices create insecurity in household status of income, when the compensation given by the program (cash or kind—a tool or tools, training, market accessibility) appears to be unequally assailable from the risks for which the fairness is the dominating reaction. Culturally dislocation emphasizes this: therefore long standing habits of work, communal rituals or any environmental bases over which feelings of identity are formed are rapidly dislocated, when program design has failed to consult local methods of living.

Sentiment is not a value that is unchanged it flows in phases over time. The first announcement phase is suspicious in sentiment (−0.23), indicating that people were responding

in trust to promises and not evidence. In consultation there is positive sentiment (+0.15) as dialogue creates space for questioning and negotiation. A small downturn emerges in early implementation (−0.08), which is a natural friction point when a newcomer to a process deals with established habits learned over time. Then, with early benefits visible jobs created, training completed, visible evidence of environmental practices there emerges a sentiment of cautious optimism (+0.31). The caution is essential, since communities will be looking for constant improvement over time, not just first wins. There are a few nuances found in geography and social structure. Urban communities have a slight positive tilt on the sentiment axis (+0.19), while traditional fishing villages have a negative orientation (−0.34). Urban settings present alternative employment opportunities, provide denser sources of information and greater access to the policy processes which clearly present opportunities for benefits. Fishing villages on the contrary perceive risk more readily in households and have stronger emotional ties to sea traditions, so skepticism is normal, until benefits materialize and are available to them in a permanent way.

In the overall picture taken from the various stakeholders, those in the tourism segment (+0.52) and local government agencies (+0.45) exhibited the most optimism since tourism lends itself to be easily branded as green, and local governments envision possibilities of economic gains and reputation benefits, while the fisher groups show the strongest sense of skepticism (−0.28), consistent with their risk of daily livelihood dependence. Taken together these findings point to three elements which nevertheless can be generalized as universally present and tend to increase confidence and support of the system presented transparent communication of rights, obligations, timelines and indicators of success participatory planning of ideas which calls community resident opinion to the design instead of strictly to the launch and compensatory systems which are fair, understandable and auditable. When these factors run together the sentiment will have a stabilising effect and when one of them is weak the positive vibe easily fades away, particularly in the implementation stage. Translating this into HRM procedure suggests a quick four avenues.

First visible accountable channels resulting from training directly into gainful employment concerns the jobs narrative directly. Second accessible demand and grievance channels provide channels to forestall the growth of grievance in the form of doubts regarding compensatory factors. Third cultural acculturation an attempt to bond traditional customs with the new system provides support for the view that the new means loss in culture. Fourth regular, comsumer friendly, sampling of sentiment, just like any feedback mechanism through interface of underling feelings closes the circle by signifying whether measures actually promote peace of mind for those chiefly affected. Methodologically these considerations rest upon firm ground. The RoBERTa model, which had been fine tuned and supported with levels of co-attention and BiLSTM duties experienced the ideal control and the most stable and accurate results with which to fine-tune output with F1 scores of .89 (positive), .85 (neutral) and .87 (negative). Inter rater reliabilities on the 500 texts manually labelled was high (Cohen's κ = .82). VADER and LSTM models were worked up and provided parameters from which to check and establish quality, so that conclusions did not overall working on a single model architecture, and edge cases intimately dealing with irony, code switching and local idioms were made, subject to revision, against the simplest base case structures. So in conclusion the statement made embraces real opportunity and real caution.

Confident hopefulness does result throughout if benefits are initial in the habitats immediately in households, when they were multifaceted taken a part in shaping the proactive steps and discussions with the process of implementation, and if the compensations felt fair and responsible. In such circumstances the present cautionary optimism can develop into consistent optimism.

Conclusion

Community views of HRM in North Sumatra's blue economy program are neither uniformly positive or uniformly negative they are balanced and dynamic. Positive opinions are mainly centered on three observable advantages job creation, protecting the environment and allowing communities to participate meaningfully in decision making while, conversely, concerns center around displacement from jobs, perceived low compensation and cultural changes that communities see as detrimental. The shift in time from being skeptical and then cautiously optimistic demonstrates a basic lesson trust develops when promises made at higher levels are fulfilled through observable and tangible improvements in the lives of households, and through credible dispute resolution processes that can resolve trade-offs and losses.

In terms of governance, the results indicate that HRM is most successful when used as the 'glue' that links the intentions of policies with the experiences of people in their daily lives. When there is clear and transparent communication about the rights and responsibilities of all parties involved in the process, along with the timeline of delivery and how success will be measured, costs associated with rumors decrease and expectations become aligned. The inclusion of local knowledge into the design process through collaborative planning enables generic policy objectives to be translated into viable and locally applicable practices. Fair and verifiable compensation financial acknowledges the risks taken on by households and allows resentment to develop into resistance to the extent that is possible. Where all of the above elements are functioning together in harmony, the sentiments of communities regarding HRM stabilize; however, if any of the above elements are absent, the good will generated during the initial stages of implementation can rapidly dissipate and create implementation shocks. As an actionable road map for HRM practice, the evidence indicates the following provide visible pathways from training to employment provide easy access to voice and grievance mechanisms; invest in cultural on boarding processes that bridge new ways of doing things with existing social norms; and establish a light and ongoing pulse of sentiment assessment to determine if interventions are reaching those most affected by change.

All of the above elements are not add-ons but are the operational embodiment of fairness and inclusion and are directly linked to the issues that cause sentiment to shift in either direction. Additionally, the research provides a contribution methodologically. The use of lexical based tools combined with a fine tuned version of RoBERTA, including Co-Attention and Bi-LSTM layers, and the establishment of an evaluation framework with high inter rater reliability, provide a reproducible model for assessing public moods throughout the phases of policy roll out. The ability to utilize sentiment analysis as an early warning system has the potential to identify emerging areas of concern before they escalate into conflict and guide timely course correction to the HRM programming. Similar to other NLP-based research, this research has typical limitations such as the representativeness of the text corpus, language and code-

switching specific to the domain and the inferential limitations of sentiment signals versus behavior.

While the limitations identified here do not negate the findings of the study, they suggest complementary mixed-method approaches (such as conducting focused interviews and utilizing participatory appraisal) and providing for careful data governance that protects the privacy of individuals and communities. In terms of future directions for the research, there are three that have promise. First, extending the scope of the current research to include multiple languages and adapting the application to various domains will increase the reach of the current research to local dialects and idioms. Second, creating near real-time dashboards that track changes in sentiment and connect them to specific HRM activities (such as training cohorts, compensation payments, co-management milestones) will allow for faster and more responsive actions to emerging trends. Third, replicating the current research in other districts and provinces will enable researchers to better understand differences in the effects of HRM across different locations and help policymakers develop more effective and efficient HRM policies.

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