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# The Role of Sentiment and Toxicity in Digital Narratives Surrounding Sulawesi's Wildlife Tourism: A Content Analysis for Enhancing Conservation Strategies

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**Abstract**−This research explores the intersection of wildlife tourism and digital narratives, focusing on Sulawesi's endemic species. Utilizing the Digital Content Reviews and Analysis framework, the study combines content analysis, sentiment classification, and toxicity assessment to uncover critical insights. The findings highlight digital narratives' significant role in shaping public perceptions and behaviors toward conservation and ecotourism. Through systematic content analysis, themes such as biodiversity, conservation, and local community involvement emerged as effectively communicated, resonating with audiences and promoting sustainable tourism practices. The framework's structured approach enabled a thorough examination of digital content's impact on wildlife tourism narratives, identifying critical patterns and themes. The study also employed advanced machine learning techniques, specifically the SVM algorithm enhanced by SMOTE, which achieved a sentiment classification accuracy of 88.76% ± 3.11% and an AUC of 0.977, demonstrating its effectiveness. However, toxicity assessment revealed that while most interactions were civil, specific posts contained significant levels of toxicity, with a peak score of 0.64912, underscoring the need for better moderation and engagement strategies. The research emphasizes integrating conservation-focused elements into digital narratives to foster positive engagement and support for wildlife preservation. The study provides practical recommendations for enhancing the positive influence of digital narratives on conservation and sustainable tourism, offering a foundation for future initiatives to optimize digital communication strategies in ecotourism.

**Keywords**: Wildlife tourism; Digital narratives; Ecotourism development; Sentiment classification; Conservation communication

## 1. INTRODUCTION

The expansion of digital narratives across social media and online platforms has markedly influenced public perceptions and behaviors concerning wildlife tourism, particularly in ecologically diverse regions such as Sulawesi, Indonesia. This island, distinguished by its unique biodiversity, has become a significant destination for domestic and international tourists. While the surge in digital narratives has heightened awareness and interest in Sulawesi's wildlife, the sentiments embedded within these narratives, including varying toxicity, profoundly impact wildlife conservation discourse. Whether positive or negative, these narratives shape public engagement and influence conservation efforts. Therefore, an in-depth understanding of the dynamics of digital narratives is essential to formulating conservation strategies that resonate with public sentiment and effectively address the adverse effects of toxicity, ensuring the sustainability of wildlife tourism and the preservation of biodiversity.

Tourism and digital narratives are increasingly intertwined as the proliferation of online platforms amplifies the reach and impact of tourism-related content. These digital narratives, encompassing a wide range of sentiments and perspectives, play a crucial role in shaping public perceptions and behaviors toward destinations and their conservation [1], [2]. The influence of such narratives extends beyond mere information dissemination and actively constructs and reconstructs the image of destinations, often influencing the success of tourism initiatives and the sustainability of local environments [3], [4]. This interconnection necessitates a deeper analysis of how digital narratives contribute to or detract from conservation efforts, particularly in ecologically sensitive areas. Understanding these dynamics is essential for developing more effective tourism strategies that attract visitors and promote the long-term preservation of natural and cultural resources.

Addressing sentiment and toxicity within digital narratives surrounding Sulawesi's wildlife tourism is increasingly critical. As wildlife tourism expands, the likelihood of disseminating misinformation, harmful stereotypes, and toxic behaviors on online platforms escalates, posing a substantial threat to conservation efforts [5], [6]. Such negative digital influences have the potential to erode public support for conservation initiatives, which in turn could compromise the well-being of wildlife populations in Sulawesi. This situation necessitates an immediate and thorough analysis of digital narratives to uncover prevailing patterns of sentiment and toxicity, thereby enabling the development of more resilient and effective conservation strategies [7]–[9]. Proactively addressing these issues is essential to sustaining the integrity of wildlife populations and the efficacy of conservation efforts in Sulawesi.

This research endeavors to systematically analyze digital narratives about Sulawesi's wildlife tourism, with particular emphasis on sentiment and toxicity. The study uses content analysis methodologies to identify dominant sentiments in online discourse and pinpoint toxicity that may pose challenges to conservation efforts. The results of this investigation are anticipated to provide valuable insights into the mechanisms by which public perceptions are shaped and to inform strategies for managing these perceptions to promote sustainable wildlife tourism and

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conservation in Sulawesi. Such an approach is critical for aligning public engagement with conservation goals, ensuring the long-term preservation of the region's unique biodiversity.

The theoretical significance of this research is grounded in its contribution to digital media studies and conservation psychology, mainly through its exploration of the interplay between sentiment, toxicity, and conservation discourse. By delving into this intersection, the study enhances the current understanding of how digital narratives influence environmental behaviors and extends the academic discourse [10], [11]. Additionally, it establishes a framework for future inquiries into the role of online communication in shaping public attitudes toward conservation [12]–[14]. On a practical level, the research offers actionable insights for conservation practitioners and policymakers, equipping them with the tools to develop targeted communication strategies that encourage positive public engagement while curbing the proliferation of toxic content [15]–[18]. Such contributions are pivotal in advancing theoretical and practical approaches to environmental conservation in the digital age.

Previous research within the domain of digital narratives and conservation has primarily concentrated on overarching environmental discourse [19]–[22], frequently overlooking the intricate aspects specific to wildlife tourism [23]–[25]. While existing studies have examined the influence of online content on public perceptions of conservation efforts [26]–[29], a significant gap persists in understanding the particular roles of sentiment and toxicity within these narratives. By directing its focus toward Sulawesi's wildlife tourism, this research seeks to bridge this gap, offering a more nuanced and localized comprehension of the digital dynamics that shape conservation discourse in this unique context. This approach enhances the specificity of the analysis and contributes to a more targeted understanding of the factors influencing public engagement in conservation.

The limitations of this research warrant recognition to ensure a comprehensive understanding of the study's scope. The content analysis is confined to publicly accessible digital narratives, potentially resulting in a selection bias that may not accurately reflect the broader population's perspectives. Furthermore, the reliance on automated tools for analyzing sentiment and toxicity, despite their advanced capabilities, introduces challenges in capturing the intricate nuances of language, context, and cultural variations inherent in online discussions concerning Sulawesi's wildlife tourism. These constraints underscore the necessity for complementary qualitative research methods to validate and enrich the findings, thereby providing a more robust and holistic interpretation of the data.

This research addresses a pivotal gap in comprehending how digital narratives related to wildlife tourism in Sulawesi shape conservation strategies. By concentrating on sentiment and toxicity within these narratives, the study seeks to generate insights that will bolster the efficacy of conservation initiatives, thereby advancing the sustainable management of Sulawesi's distinctive wildlife. The findings are expected to inform local conservation practices and serve as a model for other regions grappling with similar challenges at the confluence of tourism, digital media, and wildlife conservation. Such contributions are instrumental in refining conservation efforts and ensuring the preservation of biodiversity in diverse ecological contexts.

## 2. RESEARCH METHODOLOGY

### 2.1 Gap Analysis

The novelty of this research lies in its focused exploration of the interplay between sentiment, toxicity, and conservation within the digital narratives surrounding wildlife tourism in Sulawesi. The study breaks new ground in understanding how digital discourse influences environmental stewardship by targeting the sentiments expressed online and analyzing their potential to support or undermine conservation efforts. This approach provides a fresh perspective on the dynamics of digital communication in conservation contexts and introduces a methodological framework that integrates content analysis with conservation psychology. The research, therefore, stands out as a pioneering effort to align digital media studies with practical conservation strategies, offering valuable insights that extend beyond conventional environmental discourse.

A significant research gap exists in exploring tourism and digital narratives, particularly in understanding how these narratives influence tourist behavior and conservation outcomes. While existing studies have predominantly focused on the promotional aspects of digital content in tourism marketing [30]–[33], there is a noticeable lack of research on the nuanced ways in which sentiment and toxicity within these narratives shape public perceptions and policy responses [34]–[36]. This oversight limits the ability to fully grasp the implications of digital discourse on sustainable tourism and environmental conservation. Addressing this gap is critical for developing a more comprehensive understanding of the digital landscape's role in tourism, thereby enabling the creation of strategies that effectively harness the power of digital narratives to promote responsible tourism and conservation efforts [37], [38]. This research aims to fill this void by offering insights into the intersection of digital communication and tourism sustainability.

This research employs VOSviewer as a tool for visualizing the development of studies on tourism and digital narratives, offering a comprehensive overview of the scholarly landscape in this domain. By mapping the relationships between key terms and themes, VOSviewer facilitates the identification of trends, gaps, and emerging areas of interest within the literature. The visualization produced through this method highlights the interconnectedness of various research topics and underscores the evolving focus of academic inquiry in tourism and digital narratives. The insights gained from this analysis are invaluable for guiding future research directions, enabling a more targeted and informed

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approach to exploring the impact of digital communication on tourism practices and outcomes. Ultimately, using VOSviewer in this context enhances the study's ability to contribute to the broader understanding of the dynamic interplay between digital narratives and tourism development.

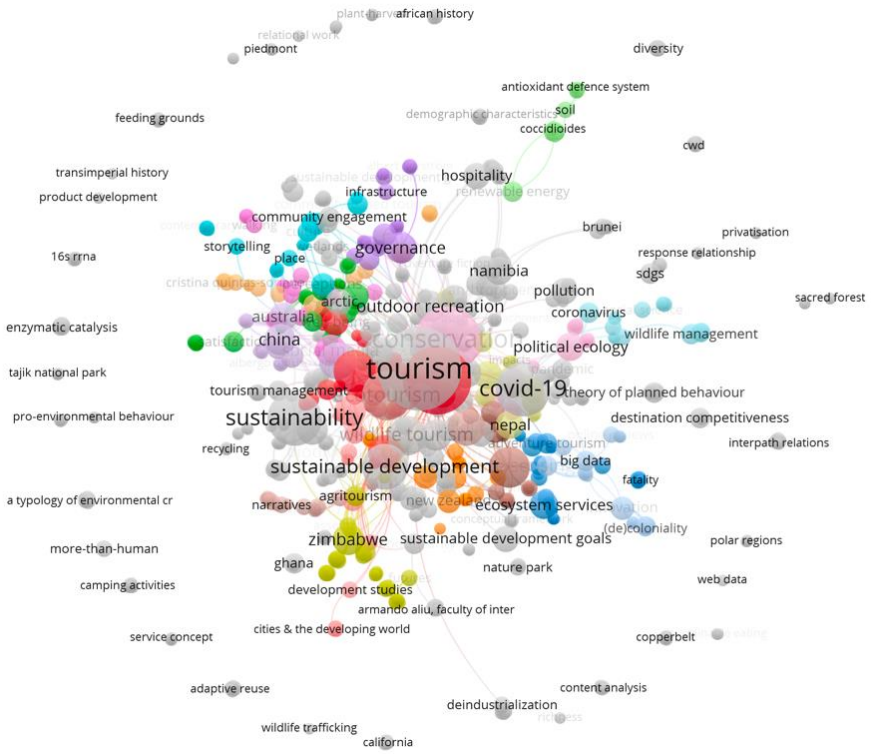


**Figure 1.** Network Visualization Wildlife and Digital Narratives

Figure 1 shows the network visualization of wildlife tourism and digital narratives. The study of wildlife tourism and digital narratives has emerged as a prominent area of inquiry, reflecting the increasing recognition of the interplay between tourism practices and digital communication. Popular research in this field often focuses on how online narratives shape public perceptions of wildlife conservation, tourism sustainability, and the socio-economic impacts on local communities [39]–[42]. These studies highlight the critical role of digital platforms in promoting and challenging conservation efforts, as narratives within these spaces can influence public sentiment and behavior on a global scale [43]–[45]. The visualization of critical themes within this research domain, as demonstrated in the VOSviewer analysis, underscores the concentration of scholarly attention on topics such as sustainability, governance, and community engagement. This convergence of interests suggests that understanding the dynamics of digital narratives is essential for developing effective strategies in wildlife tourism that align with conservation goals, thereby ensuring the long-term viability of both wildlife populations and tourism industries.

The importance of this research lies in its potential to bridge critical gaps in understanding the impact of digital narratives on wildlife tourism and conservation efforts. By systematically analyzing the sentiment and toxicity in online discussions, this study provides valuable insights into how public perceptions are shaped and how these perceptions influence tourism practices and conservation outcomes. Integrating digital communication analysis with conservation strategies is essential in an era where online platforms increasingly dictate the success or failure of environmental initiatives. The findings of this research are poised to contribute significantly to developing more effective, targeted strategies that enhance the sustainability of wildlife tourism and ensure the protection of biodiversity in ecologically sensitive regions. Thus, this study is a crucial endeavor to align digital media dynamics with the overarching goals of environmental preservation and sustainable tourism development.

### 2.2 Digital Content Reviews and Analysis Framework

This research employs the Digital Content Reviews and Analysis Framework, a methodological approach designed to evaluate and interpret digital narratives systematically. By leveraging this framework, the study meticulously dissects the content, sentiment, and toxicity of online discussions related to wildlife tourism, offering a comprehensive understanding of how these elements influence public perception and behavior. The framework's structured approach ensures that the analysis is rigorous and replicable, allowing for identifying patterns and trends that might otherwise remain obscured. Through this systematic analysis, the research illuminates the complexities of digital discourse and provides actionable insights critical for developing strategies to enhance conservation efforts. Ultimately, applying the Digital Content Reviews and Analysis Framework in this context is integral to advancing the understanding of digital media's role in shaping sustainable tourism practices.

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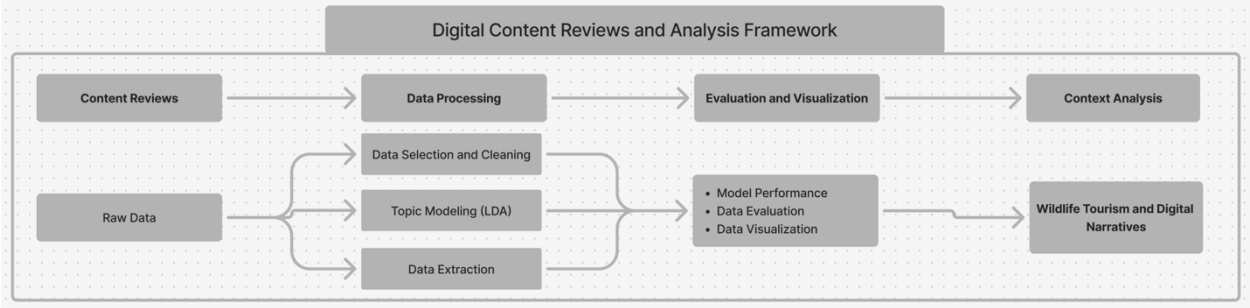


**Figure 2.** Digital Content Reviews and Analysis Framework

Figure 2 shows the digital content reviews and analysis framework. The Digital Content Reviews and Analysis Framework is a comprehensive methodological approach encompassing several critical stages: content reviews, data processing, evaluation and visualization, and context analysis. The content review stage systematically examines digital narratives to identify key themes, sentiments, and toxicity elements. Following this, the data processing stage transforms raw data into structured formats suitable for in-depth analysis. The evaluation and visualization stage utilizes advanced tools to interpret the processed data, generating visual representations that elucidate patterns and trends within the digital content. Finally, the context analysis stage situates these findings within broader socio-cultural and environmental contexts, providing a nuanced understanding of how digital narratives impact public perceptions and behaviors. This multifaceted framework not only enhances the rigor of the research but also offers a robust tool for uncovering the complex dynamics at play in digital discourse, making it indispensable for studies that seek to integrate digital media analysis with practical applications in fields such as conservation and tourism.

The Digital Content Reviews and Analysis Framework is inherently coherent with the objectives of this research, as it systematically aligns with the study's goal of exploring the intricate dynamics of digital narratives surrounding wildlife tourism. The framework's sequential stages—content reviews, data processing, evaluation and visualization, and context analysis—are meticulously designed to facilitate a comprehensive examination of digital content, ensuring that each phase contributes to a deeper understanding of the subject matter. By incorporating data cleaning, selection, extraction, and visualization, the framework ensures that the analysis is both rigorous and insightful, allowing for the identification of key trends and patterns that are crucial to the study's focus on wildlife tourism and digital narratives. This coherence between the framework and the research objectives not only enhances the methodological robustness of the study but also guarantees that the findings will be relevant and actionable, thereby contributing significantly to the digital media and tourism studies field.

### 2.2.1 Content Reviews

The video content selected for processing is titled *Surga Hewan Endemik: Sulawesi*, identified by the ID 94plxPmkKVg, and published by the channel Papaver Somnivera on June 29, 2024, with 491,740 views and 1,100 comments. This video is a significant source for analysis due to its substantial viewership and engagement, indicating its potential influence on public perceptions of Sulawesi's endemic wildlife. The comments section, reflecting diverse sentiments, offers valuable data for examining the intersection of digital narratives, sentiment, and public discourse on wildlife conservation. Analyzing this content provides an opportunity to understand how visual media forms digital narratives, thereby informing strategies that align conservation efforts with public engagement. This analysis is critical for developing more effective communication strategies that leverage digital platforms to support wildlife conservation initiatives.

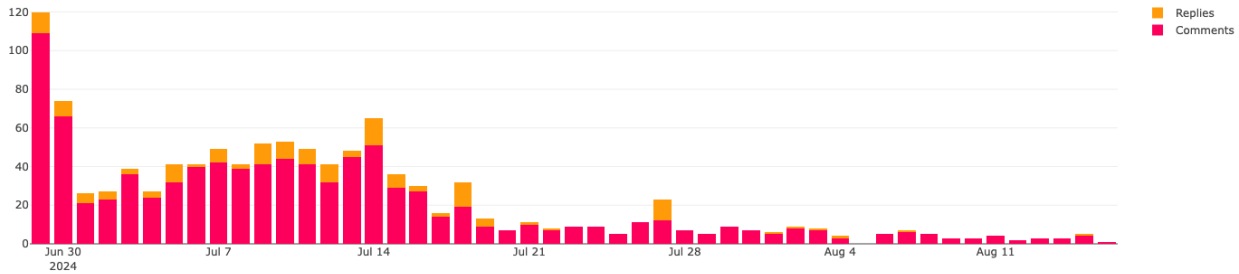


**Figure 3.** Post-per-day Statistic of the Video (Communalytic)

Figure 3 shows the content's post-per-day statistics. Based on the post-per-day statistics, a discernible pattern emerges in the frequency of digital content engagement following the June 29, 2024, publication date. The data reveals an initial surge in activity, with a peak of 109 posts on the release day and a gradual decline over the subsequent days. This trend suggests a concentrated burst of interest immediately after the content's release, which is typical in digital

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media consumption. However, the sustained, albeit reduced, engagement in the following weeks indicates a lingering interest, possibly driven by ongoing discussions and the relevance of the content. This pattern underscores the importance of timing and relevance in digital content strategy, particularly in maintaining audience engagement over time. The post-frequency fluctuations also highlight the need for continuous monitoring and adaptive strategies to sustain engagement in digital narratives. Ultimately, this analysis provides valuable insights into the dynamics of digital content dissemination and audience interaction over time.

The interpretation of the post-per-day data reveals significant insights into audience engagement trends over time. The data indicates an initial peak in activity immediately following the content's release, with the highest volume of posts occurring on June 30, 2024, suggesting a solid immediate response to the video. This initial spike is followed by a gradual decline, punctuated by occasional smaller peaks, likely driven by continued discussions and the content's sustained relevance. The data also highlights a shift like engagement, with a higher proportion of replies occurring as the overall volume of comments decreases, indicating a move toward more interactive, conversation-driven discourse as the initial wave of reactions subsides. This pattern suggests that while initial engagement is characterized by broad, spontaneous reactions, sustained engagement tends to be more interactive and community-focused. The gradual tapering off of posts toward mid-August underscores the temporal nature of digital engagement, where interest wanes as the content becomes less fresh in the public's mind. These findings emphasize the importance of timing, relevance, and interactive features in maintaining long-term audience engagement in digital narratives.


**Figure 4.** Top Ten Poster (Communalytic)

Figure 4 shows the top ten posters. The analysis of the top ten posters' data reveals vital contributors to the discussion, with users such as @yarmankalo3466 and @aurajustgame leading the engagement, each posting nine times. Following them, @ScarLion97 and @ibrohimhim2646 have each contributed six posts, while @MonarchMusic20, @BlissfulEchoNatureSounds, and @rumaheboh have each posted four times. The remaining contributors, including @DeviAdnyani-z7v, @user-iv6jb4br8t, and @riyandataswar8580, have each added three posts to the discussion. This distribution indicates that a small group of users significantly influences the discourse, suggesting a concentrated level of engagement among a few highly active participants. Such a pattern highlights the role of these key individuals in shaping the overall narrative within the digital space. Repeated posters may also indicate a substantial personal investment in the topic, which could drive more in-depth discussions and sustained interest over time. Understanding the dynamics of these top contributors is essential for comprehending the broader trends in user engagement and the propagation of digital narratives related to the content.

The interpretation of the top-ten poster data depicts user engagement distribution, with the leading contributors @yarmankalo3466 and @aurajustgame each accounting for 17.6% of the total posts. This high activity level suggests that these individuals play a pivotal role in driving the conversation within the digital narrative. Following closely, @ScarLion97 and @ibrohimhim2646 each contribute 11.8% to the discussion, indicating a significant, though slightly lesser, impact. The remaining participants, including @MonarchMusic20, @BlissfulEchoNatureSounds, @rumaheboh, @DeviAdnyani-z7v, @user-iv6jb4br8t, and @riyandataswar8580, each represent between 5.88% and 7.84% of the total engagement, suggesting a more moderate but still relevant influence on the discourse. This distribution indicates a concentration of influence among critical users, who significantly shape the digital narrative. Understanding the impact of these top contributors is essential for analyzing the dynamics of digital engagement and the role of individual voices in steering the conversation around the content in question.

Following the comprehensive identification of content and subsequent reviews, the research advances to the data processing phase. This progression is essential, as the data processing stage will transform the raw, identified content into a structured format suitable for in-depth analysis. This data's systematic organization and refinement are critical for ensuring that subsequent evaluations are accurate and meaningful. The transition to data processing marks a pivotal step in the research, enabling the extraction of valuable insights and facilitating the visualization and interpretation of trends within the dataset. This methodological progression is integral to achieving the research objectives, laying the groundwork for a robust analysis to inform the study's conclusions.

### 2.2.2 Data Processing

Critical procedures such as data cleaning, selection, topic modeling, and classification model performance evaluation are meticulously conducted during the data processing. The data cleaning process ensures that irrelevant or erroneous

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information is removed, thereby enhancing the quality and reliability of the dataset. Following this, the selection process identifies the most relevant data points that align with the research objectives. Topic modeling is then employed to uncover underlying patterns and themes within the data, providing a structured representation of the content. The final step involves the evaluation of the classification model's performance, which is essential for validating the accuracy and effectiveness of the model in categorizing the data. These processes collectively contribute to the robustness of the analysis, ensuring that the research outcomes are both precise and insightful, thereby advancing the study's contribution to the field.

The dataset comprising 1,099 posts will undergo a thorough cleaning process using the RapidMiner application, ensuring the accuracy and relevance of the data for subsequent analysis. This process involves several critical steps, including tokenization, case transformation, and removing stopwords, all of which contribute to refining the dataset by eliminating noise and enhancing the focus on meaningful content. RapidMiner's advanced text processing capabilities systematically filter the data to retain only the most pertinent information, facilitating more precise and insightful analysis. This meticulous data cleaning is an essential prerequisite for ensuring that the analysis yields valid and reliable results, ultimately contributing to the robustness of the research findings. The use of RapidMiner in this context underscores the importance of leveraging sophisticated tools in the data preparation phase to support high-quality research outcomes.

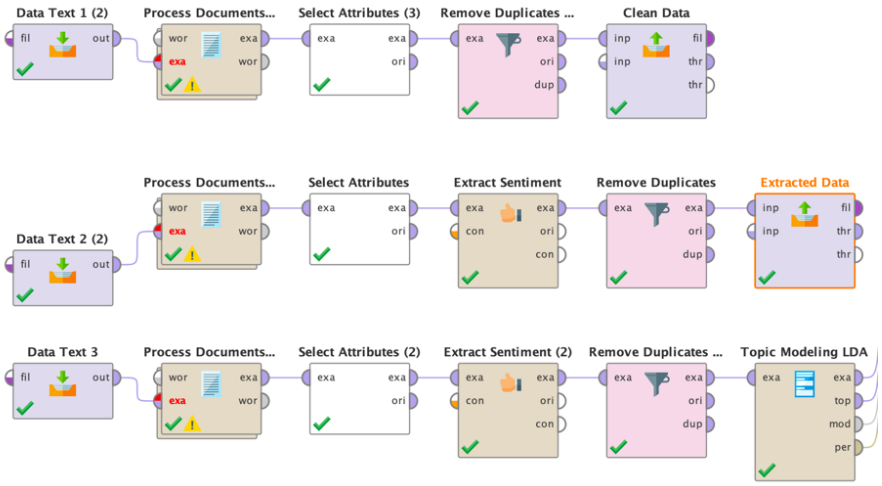


**Figure 5.** Data Cleaning, Extraction, and Topic Modeling

Figure 5 shows the data cleaning, extraction, and topic modeling process. The data processing within the RapidMiner application encompasses a series of sophisticated procedures, including data cleaning, data extraction using the VADER model, and topic modeling through Latent Dirichlet Allocation (LDA). Initially, data cleaning ensures that the dataset is accessible from irrelevant or erroneous information, thereby enhancing the integrity of the subsequent analysis. Following this, the VADER model is employed for sentiment analysis, extracting nuanced emotional tones from the text, which is crucial for understanding the underlying sentiment in the dataset. Lastly, topic modeling using LDA is conducted to identify and categorize the dominant themes within the data, providing a structured overview of the key topics discussed. This multi-stage processing approach not only refines the dataset but also enables comprehensive and in-depth analysis, ensuring that the research can uncover meaningful insights and contribute valuable knowledge to the field. Integrating these advanced techniques within RapidMiner underscores the importance of using robust analytical tools to achieve accurate and insightful research outcomes.

The topic modeling results, as reflected in the PerformanceVector metrics, offer a detailed quantitative assessment of the model's effectiveness. The LogLikelihood of -104565.901 and Perplexity of 928.337 suggest a moderate level of model fit, indicating the complexity of the data in capturing coherent topics. The average document entropy of 4.508 and an average coherence score of -21.923 highlight the diversity and potential overlap in topics, suggesting that while the model has identified distinct themes, there remains some degree of topic mixture. The Avg(eff_num_words) of 216.337 points to a substantial breadth of vocabulary utilized across the topics, while the Avg(exclusivity) of 0.678 indicates a relatively high level of uniqueness in topic word distribution. These results underscore the model's capacity to distill meaningful topics from a complex dataset, although the relatively low coherence score suggests opportunities for further refinement. The values of AlphaSum at 1.444 and BetaSum at 503.438, along with other metrics such as Avg(allocation_count) and Avg(rank_1_docs), provide a comprehensive overview of the model’s distribution parameters, offering insights into the allocation and exclusivity of topics across the documents analyzed. This analysis serves as a critical foundation for interpreting the thematic structure within the dataset and guiding subsequent analytical steps.

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**Figure 6.** Topic Modeling with LDA

Figure 6 shows the topic modeling result using LDA. The interpretation of the topic modeling results reveals critical insights into the thematic structure of the dataset. The LogLikelihood and Perplexity metrics suggest that the model effectively captured the underlying topics, though the complexity of the data is evident from the moderate fit indicators. The average document entropy and coherence scores highlight diverse topics, albeit with some overlap, indicating that while distinct themes have been identified, their boundaries may not be entirely clear-cut. The relatively high exclusivity score points to the uniqueness of the topics, suggesting that the model has successfully isolated specific thematic elements within the corpus. However, the coherence score suggests that further refinement may be necessary to enhance the clarity of the topics. Overall, the results underscore the model's ability to extract meaningful themes, providing a robust foundation for further analysis, but also indicate areas where additional adjustment could improve the interpretability and precision of the topic delineation. This interpretation enhances the understanding of the dataset's thematic content and guides the direction for subsequent analytical efforts.

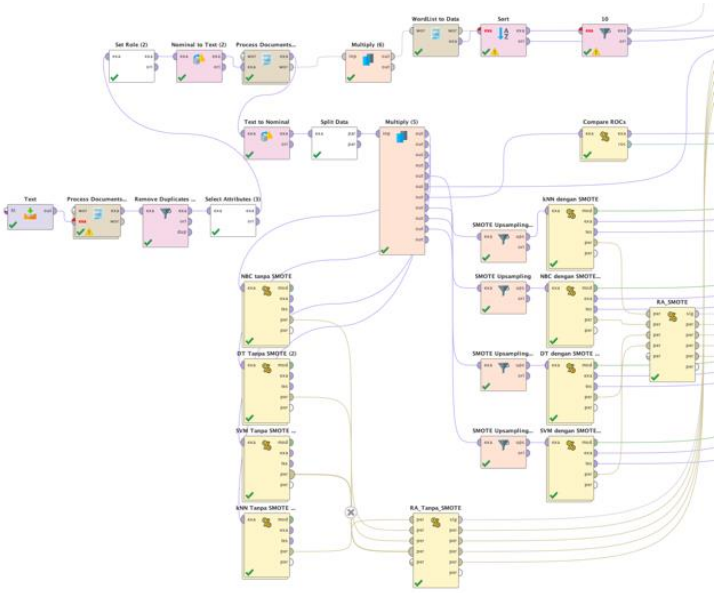

**Figure 7.** Performance Evaluation of Classification Model (Rapidminer)

Figure 7 shows the performance evaluation of the classification model using Rapidminer. Following the topic modeling process using Latent Dirichlet Allocation (LDA), the subsequent step involves evaluating the performance of the classification algorithms. This evaluation is crucial for determining the accuracy and reliability of the models in categorizing the identified topics within the dataset. The process includes testing various classification algorithms to assess their ability to correctly classify data points based on the topics generated by the LDA model. Performance metrics such as precision, recall, and F1-score are typically analyzed to measure the effectiveness of each algorithm. This step validates the quality of the topic modeling and ensures that the classification models are robust and capable of effectively handling the nuances of the data. The insights gained from this evaluation are essential for refining the model and improving its predictive accuracy, thereby enhancing the overall utility of the analysis in addressing the research objectives.

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Based on the data processing phase results, the dataset is now ready for evaluation and visualization in alignment with the research objectives. The processed data, having undergone rigorous cleaning, extraction, and modeling, provides a robust foundation for detailed analysis. It allows for the identification of key patterns and trends that are crucial to addressing the research questions. The subsequent evaluation will assess the models' effectiveness, ensuring the findings are accurate and relevant. Visualization will then serve to illustrate these findings in a clear and accessible manner, facilitating a deeper understanding of the data's implications. This systematic approach ensures that the research meets its objectives and contributes valuable insights.

### 2.2.3 Data Evaluation and Visualization

During the data evaluation and visualization stage, the performance of the Perspective model in calculating toxicity scores is systematically compared with the results of sentiment classification. This comparison is essential for understanding the relationship between sentiment and toxicity within the dataset, as it highlights how varying toxicity levels correlate with different sentiment categories. The evaluation provides critical insights into the model's overall effectiveness and reliability by analyzing its accuracy in identifying toxic content and its ability to classify sentiment. The visualization of these results further aids in identifying any patterns or discrepancies, enabling a nuanced interpretation of how sentiment and toxicity interact within digital narratives. This comparative analysis is pivotal in refining the models and ensuring the research outcomes are robust and aligned with the intended objectives.

Calculating toxicity scores facilitates a comparative analysis with the sentiment classification results. This comparison is essential for understanding the relationship between the prevalence of toxic language and the overall emotional tone within the dataset. By quantifying toxicity, the analysis provides a precise measure that can be directly contrasted with the sentiment categories identified through classification models. This approach enables a deeper exploration of how toxic language may correlate with or diverge from the general sentiment, offering insights into the potential impact of toxicity on public discourse. Ultimately, this comparative analysis enhances the research's comprehensiveness, providing a more nuanced understanding of the dynamics at play within the digital narrative.

| | Average for dataset | Highest value |
|---|---|---|
| Toxicity | 0.05982 | 0.64912 |
| Severe Toxicity | 0.00512 | 0.42874 |
| Identity Attack | 0.01760 | 0.48916 |
| Insult | 0.04105 | 0.63084 |
| Profanity | 0.03809 | 0.70865 |
| Threat | 0.01190 | 0.52547 |

**Figure 8.** Average for Dataset and Highest Value of Toxicity Classification (Communalytic)

Figure 8 shows the dataset's average and the highest toxicity classification value using Communalytic. Communalytic analyzed 970 posts from the total dataset of 1,099 using the Perspective API, yielding the following results. The average toxicity score across the dataset was 0.05982, with a peak toxicity value of 0.64912, indicating that while the overall discourse was relatively civil, specific posts exhibited high toxicity levels. Severe toxicity, which includes more harmful content, averaged at 0.00512, with the highest instance reaching 0.42874. Other critical indicators such as identity attack, insult, profanity, and threat showed varying levels of prevalence, with average scores of 0.01760, 0.04105, 0.03809, and 0.01190, respectively, and the highest values ranging from 0.48916 to 0.70865. These findings suggest that while most of the conversation remains moderate in tone, significant instances of severe language could influence the overall sentiment and perception within the community. This analysis is instrumental in understanding the nature of digital interactions and the potential impact of toxic language on online discourse.

The comparison between the calculated toxicity scores and the sentiment classification results derived from the VADER model provides a comprehensive analytical perspective. By juxtaposing these two metrics, the analysis reveals the relationship between the intensity of toxic language and the overall sentiment expressed within the dataset. The toxicity scores offer a quantifiable measure of harmful or damaging language. At the same time, the VADER model's sentiment classification provides a broader understanding of the emotional tone, whether positive, negative, or neutral. This comparative approach allows for a deeper insight into how sentiment correlates with or diverges from the presence of toxicity, enabling a more nuanced interpretation of the data. The findings from this comparison are critical for understanding the dynamics of online discourse, particularly in identifying how toxic elements may influence or distort the general sentiment within digital narratives. This integrated analysis, therefore, plays a pivotal role in informing strategies for managing and mitigating toxicity in online environments.

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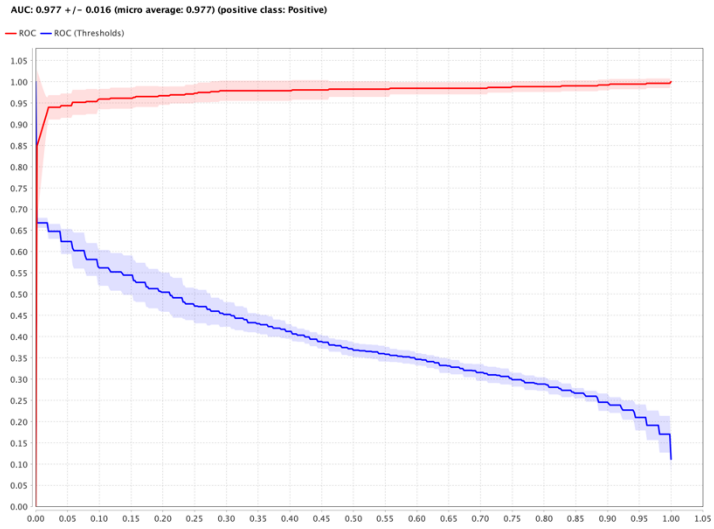


**Figure 9.** Area Under Curve of SVM enhanced by SMOTE

Figure 9 shows the Area Under the Curve of SVM enhanced by SMOTE. The Area Under the Curve (AUC) of the Support Vector Machine (SVM) model, enhanced by SMOTE, demonstrates the highest performance metrics, with an overall accuracy of 88.76% ± 3.11%. The AUC, a critical measure of the model's ability to distinguish between classes, exhibits values of 0.977 ± 0.016 (micro average), with optimistic and pessimistic estimates closely aligned at 0.978 and 0.976, respectively. This high AUC indicates that the model is highly effective at distinguishing between positive and negative classes. The confusion matrix further supports this, showing 418 true negatives, 18 false negatives, 98 false positives, and 498 true positives, reflecting a solid ability to correctly classify positive instances with a recall of 96.50% ± 2.90%. Additionally, the model's precision is 83.80% ± 4.45%, and the F-measure, which balances precision and recall, is reported at 89.62% ± 2.71%. These results collectively underscore the robustness of the SMOTE-enhanced SVM model, particularly in handling imbalanced datasets, and its efficacy in accurately predicting positive instances within the dataset. This level of performance indicates a high degree of reliability in the model's predictions, making it a powerful tool for classification tasks in this research context.

The evaluation and visualization of data derived from the video content will be systematically compared with the context of digital narratives that form the substance and flow of the video. This comparison is crucial for assessing how the thematic elements and messages conveyed in the video align with or diverge from the broader digital discourse surrounding the topic. By juxtaposing these findings, the analysis seeks to identify consistencies or discrepancies between the video's content and the prevailing online narratives, thereby offering a deeper understanding of how the video contributes to or shapes public perception. This approach not only enhances the interpretative value of the video content but also situates it within the larger context of digital communication, providing a comprehensive view of its impact and relevance. Such a comparison is instrumental in determining the effectiveness of the video as a tool for influencing digital narratives and, ultimately, public opinion.

### 2.2.4 Content Analysis

During the content analysis phase, an in-depth examination of wildlife tourism is conducted, drawing on the digital narratives in the video identified by ID 94plxPmkKVg. This analysis focuses on understanding how the video's content reflects and contributes to the broader discourse surrounding wildlife tourism, particularly concerning the themes and sentiments expressed. The narratives within the video are scrutinized to identify key messages, underlying themes, and their alignment with or divergence from existing digital conversations on the topic. This approach allows for a comprehensive evaluation of the video's role in shaping public perceptions of wildlife tourism, offering insights into its effectiveness as a communication tool. The findings from this analysis are critical in understanding the impact of digital media on tourism-related discourse and its potential influence on conservation efforts and public awareness.

The results of the content video coding have revealed several key topics within the narrative, including Ecotourism, Ecotourism Development, Predation and Ecological Significance, and Wildlife Tourism Impact. These topics collectively illustrate the video's focus on the intricate relationships between tourism and environmental conservation. The emphasis on Ecotourism and its development underscores the growing importance of sustainable tourism practices prioritizing biodiversity conservation and community engagement. The discussion on Predation and Ecological Significance highlights the role of keystone species in maintaining ecological balance. At the same time, the Wildlife Tourism Impact theme examines how tourism activities influence conservation efforts and local ecosystems. These interconnected topics demonstrate a comprehensive narrative that educates viewers on the ecological importance of wildlife and advocates for responsible tourism practices that support long-term

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environmental sustainability. This analysis provides a deeper understanding of the narrative's intent to promote conservation-minded tourism and the preservation of natural habitats.

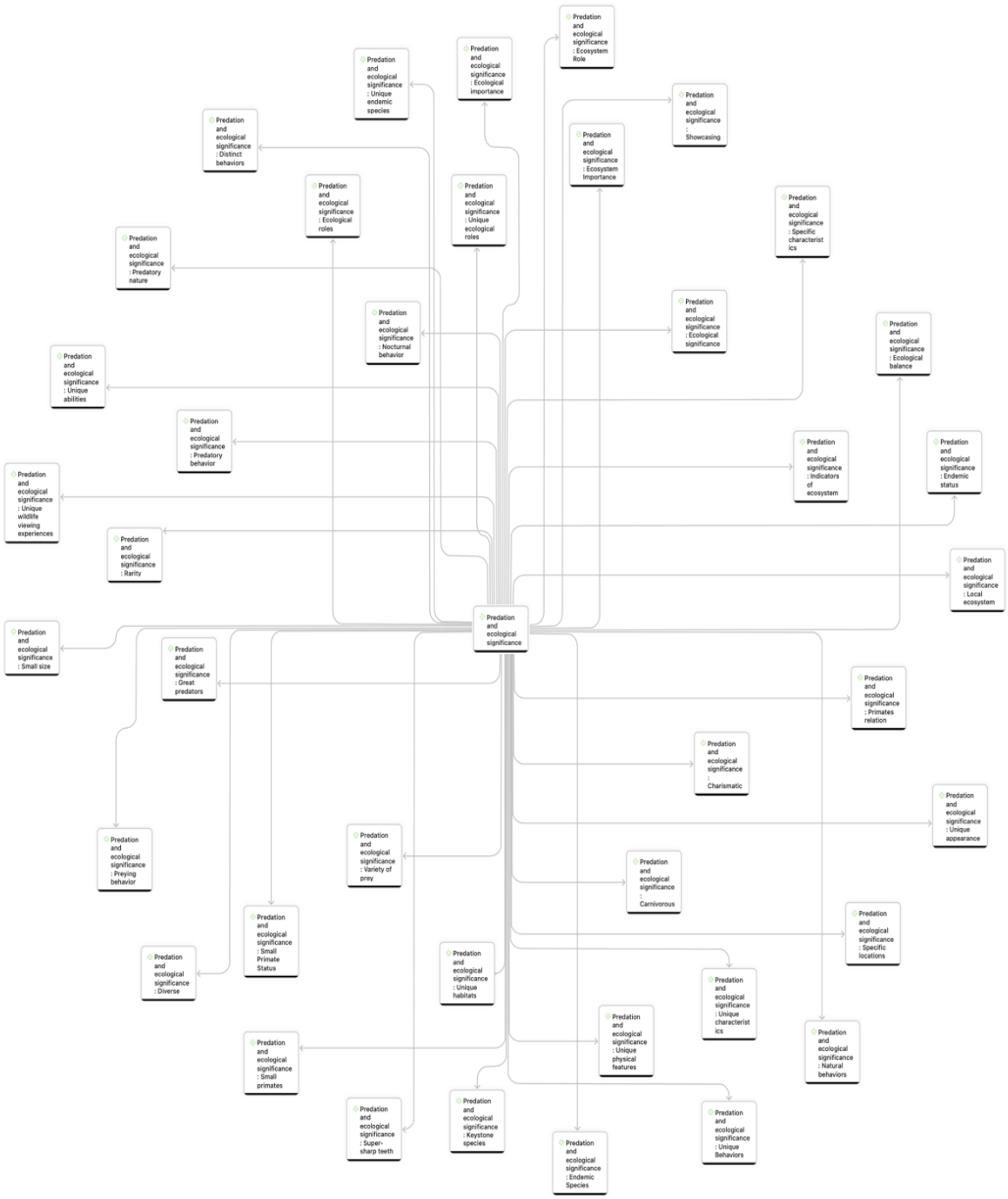


**Figure 10.** Coding of Digital Narratives (Content ID: 94plxPmkKVg)

Figure 10 shows the coding results based on the content ID 94plxPmkKVg. It indicates that the code "Predation and Ecological Significance" is closely associated with various aspects of certain species' predatory nature and ecological roles. Includes references to their charismatic appearance, distinct behaviors, and diverse prey, which collectively contribute to maintaining ecological balance and health. The analysis highlights the importance of these species as keystone species and indicators of ecosystem health, emphasizing their unique ecological roles and the significance of their predatory behavior. Furthermore, the content underscores tiny primates' rarity and endemic status with specific physical and behavioral characteristics critical to their local ecosystems. These predators' unique abilities and appearances play a vital role in their habitats and offer distinctive wildlife viewing experiences that contribute to the ecological and conservation narrative. This comprehensive coding reveals the intricate connections between predation, ecological significance, and the broader themes of biodiversity and conservation.

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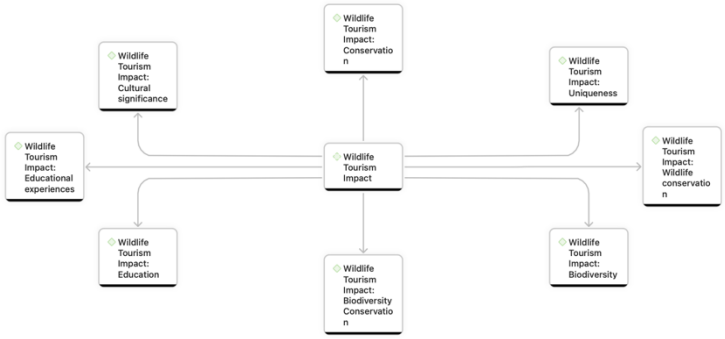


**Figure 11.** Wildlife Tourism Impact Network

Figure 11 shows the network visualization of the coding result related to wildlife tourism impact. The code "Wildlife Tourism Impact" is intricately linked to several critical themes, including biodiversity, biodiversity conservation, and broader conservation efforts. These themes underscore the dual role of wildlife tourism in promoting awareness of and contributing to preserving unique ecosystems. The content emphasizes the cultural significance of wildlife tourism, particularly its ability to provide educational experiences highlighting the uniqueness of local fauna. Additionally, the code reflects the impact of wildlife tourism on fostering a deeper understanding of the need for conservation, thus reinforcing its role as a powerful tool for environmental education and advocacy. The analysis suggests that wildlife tourism supports biodiversity conservation and plays a vital role in shaping public perceptions and actions toward preserving natural habitats and species. This interconnectedness highlights the importance of carefully managing wildlife tourism to maximize its positive impact on conservation efforts.

The code "Ecotourism" is intricately connected with several key concepts, including tourist appeal, conservation awareness, and sustainable tourism practices. This association reflects the dual focus of ecotourism on attracting visitors while simultaneously promoting conservation efforts. The appeal for tourists, mainly those interested in wildlife and conservation, is central to ecotourism's success, as it combines the natural allure of wildlife with educational experiences that raise awareness about conservation issues. The suitability of specific areas for ecotourism is also emphasized, highlighting the importance of selecting locations supporting sustainable tourism without compromising ecological integrity. Additionally, the involvement of local communities in ecotourism initiatives is crucial, as it ensures that the benefits of tourism are shared locally, fostering a conservation-minded approach among residents and visitors alike. This interconnectedness underscores ecotourism's role in bridging tourism and conservation, offering a model for sustainable development that benefits both the environment and local communities.

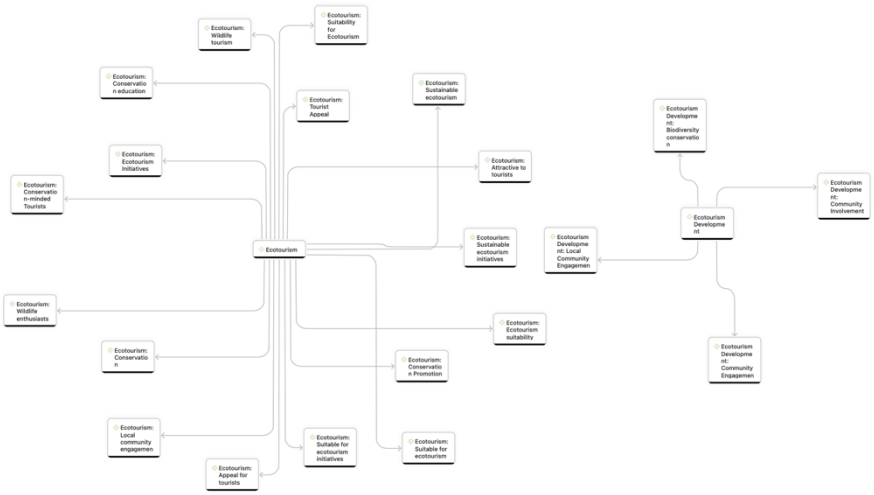


**Figure 12.** Ecotourism and Ecotourism Development Network

Figure 12 shows the ecotourism development network. The code "Ecotourism Development" is strongly associated with themes such as biodiversity conservation, community engagement, and local community involvement, highlighting the multifaceted impact of ecotourism initiatives. These connections underscore the critical role of ecotourism in preserving biodiversity and fostering active participation from local communities in conservation efforts. The involvement of local populations is pivotal, as it ensures that ecotourism projects are sustainable and culturally appropriate, enhancing their effectiveness. Furthermore, community engagement in ecotourism

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development creates opportunities for education and empowerment, leading to a more profound commitment to environmental stewardship among local stakeholders. This holistic approach to ecotourism development integrates conservation goals with community interests, ultimately contributing to ecological preservation and socio-economic benefits for the regions involved. Such an approach is essential for ensuring ecotourism initiatives' long-term success and sustainability.

Based on the narrative content coding results, a connection can be drawn with the toxicity score calculations and sentiment classification to identify and analyze viewer preferences related to content on wildlife tourism and digital narratives. The integration of these data points allows for a comprehensive analysis of how viewers respond to various themes within the content, particularly those concerning conservation and ecotourism. Examining the correlation between narrative elements, toxicity levels, and sentiment makes it possible to discern patterns in viewer engagement and preferences. This analysis is critical for understanding how the tone and substance of digital content influence audience perception and interaction, offering valuable insights into the effectiveness of wildlife tourism narratives in fostering positive engagement. The findings can guide the development of content strategies that align with viewer preferences while promoting conservation goals, ensuring that digital narratives serve educational and ecological purposes effectively.

# 3. RESULT AND DISCUSSION

The discussion of the research findings is divided into two main sections: the analysis of toxicity scores and sentiment classification of the content reviews and the content analysis from the perspective of wildlife tourism and digital narratives. The initial section quantifies and categorizes the content's emotional tone and harmful language, providing a nuanced understanding of how viewers react to specific themes. This analysis is crucial for identifying the impact of negative sentiments and toxic language on audience engagement and the overall discourse. The second section delves into the thematic elements of the content, exploring how the narratives related to wildlife tourism are constructed and perceived in the digital space. By examining these narratives, the research offers insights into the effectiveness of content in promoting conservation awareness and ecotourism. Together, these two sections provide a comprehensive overview of how digital narratives influence public perceptions and behaviors concerning wildlife tourism, offering guidance for developing more effective communication strategies in this field.

## 3.1 Toxicity Score and Sentiment Classification of the Video Content Reviews

Based on the toxicity score analysis, it is evident that Communalytic evaluated 970 posts out of 1,099 using the Perspective API, resulting in daily average toxicity metrics that offer critical insights into the nature of the discourse. The average toxicity score across the dataset was calculated at 0.05982, with the highest recorded value reaching 0.64912. Severe toxicity, which indicates more harmful and aggressive content, averaged at 0.00512, with a peak value of 0.42874. The analysis also revealed the presence of specific negative interactions, including identity attacks and insults, with average scores of 0.01760 and 0.04105, respectively, and maximum values of 0.48916 and 0.63084. Profanity and threats were also detected, showing average scores of 0.03809 and 0.01190, with the highest instances reaching 0.70865 and 0.52547, respectively. These findings highlight the prevalence of toxic language within the digital narratives analyzed, underscoring the need for strategies to mitigate such negativity to foster a more constructive and respectful online environment, especially in discussions related to sensitive topics like wildlife tourism.

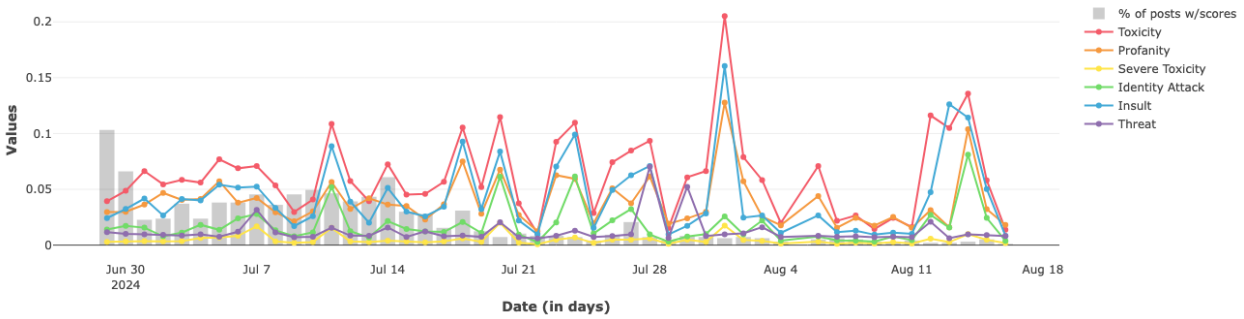


**Figure 13.** Average Toxicity Score Calculated by Perspective Model

Figure 13 shows the average toxicity score calculated by the perspective model. The toxicity score results provide a nuanced understanding of the linguistic environment within the analyzed dataset, revealing both the prevalence and intensity of negative discourse. The average toxicity score of 0.05982, with a peak value of 0.64912, indicates that while the overall tone of the content is moderately civil, there are significant instances where the discourse becomes highly toxic. Severe toxicity, though less frequent, is present with an average score of 0.00512 and a maximum of 0.42874, suggesting occasional occurrences of extreme negativity. Identity attacks and insults, with

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average scores of 0.01760 and 0.04105, respectively, further highlight the presence of targeted negative behavior, with some posts reaching alarmingly high levels, particularly in profanity and threats, which peaked at 0.70865 and 0.52547. These findings suggest that while most interactions remain within acceptable limits, there are notable pockets of harmful language that could influence the overall tone and safety of the discourse. Addressing these high toxicity levels is crucial for fostering a healthier, more inclusive online environment that encourages constructive engagement and respectful communication.

The calculated toxicity scores provide significant insights into user perception and engagement dynamics within the online discourse environment. Higher toxicity levels, as observed in specific posts, suggest a potential for adverse interactions, which can influence user engagement by either deterring participation or provoking more aggressive responses. The presence of severe toxicity, identity attacks, and profanity indicates an environment where harmful language may overshadow constructive dialogue, potentially leading to a polarized or hostile atmosphere. This toxicity affects the overall tone of the discourse and shapes user perceptions, potentially diminishing the perceived credibility and inclusivity of the conversation. Consequently, the elevated toxicity levels identified in the analysis underscore the importance of implementing moderation strategies and promoting positive engagement to foster a healthier, more productive online community, especially in discussions surrounding critical topics such as wildlife conservation and ecotourism. Addressing these toxic elements makes it possible to enhance the quality of discourse and ensure that user engagement contributes positively to the broader narrative.

The SVM algorithm enhanced by SMOTE has demonstrated impressive performance metrics, achieving an accuracy of 88.76% ± 3.11%, with a micro-average reflecting consistent accuracy. The confusion matrix reveals a strong classification ability, correctly identifying 418 negative and 498 positive instances, with only 18 false negatives and 98 false positives. The model's Area Under the Curve (AUC) scores further highlight its efficacy, with optimistic, average, and pessimistic AUC values of 0.978, 0.977, and 0.976, respectively, indicating high-class discrimination. Precision stands at 83.80% ± 4.45%, with a micro-average of 83.56%, showcasing the model's accuracy in identifying true positives. The recall rate of 96.50% ± 2.90% underscores the model's robustness in capturing nearly all positive instances, while the F-measure, a balanced metric of precision and recall, is reported at 89.62% ± 2.71%. These results collectively affirm the effectiveness of the SVM algorithm, particularly when enhanced by SMOTE, in handling imbalanced datasets and delivering reliable sentiment classification in complex digital narratives.

The sentiment classification results, achieved through the SVM algorithm enhanced by SMOTE, reveal a notably high level of performance across several key metrics. The model's accuracy of 88.76% ± 3.11%, supported by a consistent micro-average, demonstrates its reliability in correctly classifying sentiments within the dataset. The confusion matrix further underscores this capability, with the model accurately distinguishing between 418 negative and 498 positive instances and only a minimal number of false negatives (18) and false positives (98). The AUC scores, which include optimistic, average, and pessimistic values of 0.978, 0.977, and 0.976, respectively, highlight the model’s exceptional discrimination ability between sentiment classes. Precision at 83.80% ± 4.45% and a high recall rate of 96.50% ± 2.90% indicate that the model accurately identifies true positives and robustly captures nearly all relevant instances. The F-measure of 89.62% ± 2.71% reflects a well-balanced performance, combining precision and recall, further validating the model’s effectiveness in managing imbalanced data. Collectively, these results illustrate the SVM algorithm’s strong capability to deliver accurate and reliable sentiment classification within complex digital narratives, making it a valuable tool for sentiment analysis in varied contexts.

### 3.2 Content Analysis Based on Wildlife Tourism and Digital Narratives Perspective

The content analysis reveals that the model for ecotourism development in Indonesia, particularly in Sulawesi, is intricately connected to several vital aspects. These include the appeal and attractiveness of ecotourism for tourists, which are crucial for drawing attention to conservation efforts. Conservation awareness and education are central to promoting ecotourism and fostering a conservation-minded approach among tourists. The success of ecotourism initiatives in this context is also heavily dependent on their suitability to the local environment and their ability to effectively engage local communities. Sustainable ecotourism, which ensures the long-term viability of tourism activities without compromising the environment, is emphasized through initiatives that align with the region's biodiversity conservation goals. The involvement of local communities in ecotourism not only enhances the sustainability of these efforts but ensures that the benefits are equitably distributed, further promoting community engagement and involvement. Overall, the findings highlight the multifaceted nature of ecotourism development in Sulawesi, where environmental, educational, and community-focused aspects converge to create a model that supports conservation and sustainable tourism.

The primary challenges in developing ecotourism in Sulawesi are multifaceted, encompassing environmental, socio-economic, and infrastructural issues. One significant challenge is balancing conservation efforts with the growing demand for tourism, ensuring that increased tourist activity does not compromise the region's unique biodiversity. Additionally, the engagement and involvement of local communities are crucial yet complex and require adequate education, resources, and incentives to participate actively in conservation-focused tourism. The lack of well-developed infrastructure, including transportation and accommodation, further complicates the promotion of ecotourism in remote areas, limiting access for tourists and, thus, the potential economic benefits for local populations. Moreover, maintaining the authenticity of cultural and natural heritage while integrating modern tourism demands presents a delicate balance that must be managed to preserve the integrity of Sulawesi's ecotourism offerings.

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Addressing these challenges requires a comprehensive and sustainable approach integrating environmental protection, community involvement, and infrastructural development to create a resilient ecotourism model in Sulawesi.

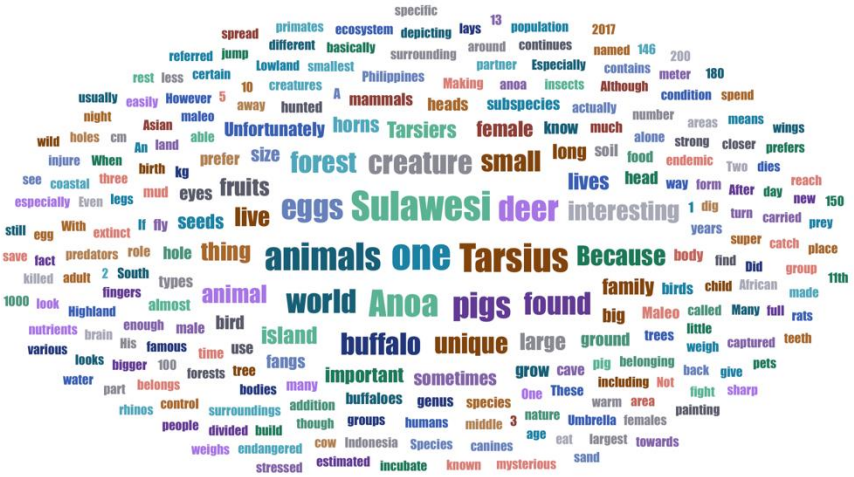


**Figure 14.** Word Cloud of The Content

Figure 14 shows the word cloud of the content. The word cloud visualization effectively highlights the prominence of key terms associated with Sulawesi's unique endemic wildlife, with words like "Tarsius," "Anoa," "Sulawesi," and "animals" standing out as central themes. These terms reflect the focus on specific species and Sulawesi's broader context of biodiversity. The frequent appearance of words such as "forest," "eggs," "buffalo," and "creature" suggests a strong emphasis on the ecological roles and reproductive behaviors of these animals. Additionally, words like "unique," "important," and "small" indicate a narrative that underscores the distinctiveness and ecological significance of these species. This visualization is a powerful tool for identifying the dominant themes within the content, revealing the narrative's focus on conservation, the distinct characteristics of the wildlife, and the importance of preserving these animals and their habitats. Such insights are crucial for understanding how the digital narrative is constructed and how it might influence public perception and awareness of Sulawesi's biodiversity.

Crafting content that appeals to viewers who are enthusiasts of wildlife tourism requires a strategic approach that combines compelling digital narratives with visually engaging elements. The primary objective is to captivate the audience by highlighting wildlife tourism's unique experiences and conservation aspects while fostering a connection to the natural world. Content must be designed to emphasize the rare and fascinating behaviors of wildlife, the ecological significance of preserving their habitats, and the opportunities for sustainable tourism that benefit both the environment and local communities. By weaving these elements into a cohesive narrative, the content can evoke emotional responses and inspire viewers to engage more deeply with conservation efforts. Additionally, leveraging digital platforms to present these narratives in an interactive and accessible manner enhances the reach and impact of the content, ensuring that it resonates with a broad audience of potential tourists who value sustainability and wildlife preservation. Ultimately, such a strategy attracts tourists and contributes to the long-term goals of conservation and sustainable tourism development.

Content analysis from the perspective of wildlife tourism and digital narratives provides critical insights into how online content shapes public perceptions and behaviors related to conservation and tourism. Examining digital narratives reveals that viewing wildlife and natural habitats influences viewers' attitudes toward conservation efforts and their willingness to engage in sustainable tourism practices. Digital content can effectively communicate the importance of preserving biodiversity while promoting tourism that benefits local economies by focusing on conservation, ecological significance, and community involvement. Moreover, compelling storytelling techniques within these narratives enhance their emotional impact, making the content more relatable and persuasive. This approach raises awareness about the challenges and opportunities within wildlife tourism and encourages a broader audience to participate in conservation initiatives. Therefore, strategically designed content with these elements in mind is pivotal in advancing tourism and conservation goals in the digital age.

## 4. CONCLUSION

In conclusion, this research has comprehensively analyzed wildlife tourism and digital narratives, explicitly focusing on Sulawesi's unique endemic species. Utilizing the Digital Content Reviews and Analysis framework, the study incorporated content analysis, sentiment classification, and toxicity assessment to uncover critical insights. The research demonstrated that digital narratives significantly influence public perceptions and behaviors toward conservation and ecotourism. By systematically reviewing and analyzing content, the study identified that themes

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such as biodiversity, conservation, and local community involvement were effectively communicated and resonated well with audiences, promoting sustainable tourism practices. The framework employed in this study facilitated a structured approach to content analysis, enabling the identification of key themes and patterns within the digital narratives. The framework comprehensively examined how digital content influences wildlife tourism narratives through content reviews, data processing, evaluation, and visualization. Advanced machine learning techniques, specifically the SVM algorithm enhanced by SMOTE, achieved a high sentiment classification accuracy of 88.76% ± 3.11%. The model's micro-average AUC of 0.977 demonstrated its effectiveness in distinguishing between positive and negative sentiments within digital narratives. The toxicity assessment revealed that while most interactions were civil, specific posts exhibited significant toxicity levels, with a peak score of 0.64912, highlighting the need for better moderation and engagement strategies. The content analysis revealed that compelling digital narratives incorporate elements that appeal to tourists while emphasizing the importance of conservation. Key themes included the ecological significance of wildlife, the role of community engagement, and the promotion of sustainable ecotourism practices, all crucial for successful conservation efforts. The study recommends that efforts to reduce toxicity in online discourse and enhance the positive influence of digital narratives are essential for the success of conservation initiatives. The findings provide a blueprint for developing digital communication strategies supporting environmental preservation and responsible tourism, ensuring that digital narratives contribute constructively to wildlife conservation efforts. Overall, this research contributes valuable insights into the intersection of tourism, conservation, and digital communication, underscored by the systematic application of the Digital Content Reviews and Analysis framework, providing a solid foundation for future initiatives aimed at improving the effectiveness of digital narratives in promoting sustainable ecotourism.

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