

Conceptual Paper: Analyzing Climate-Induced Financial Risks in the Langkawi Fishing Sector

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Abstract

This proposed research addresses the pressing concern of climate change's impact on Langkawi's fishing industry. While the research is yet to be conducted, it offers a blueprint for comprehending the complex relationship between climate change and the financial health of this vital sector. Its central aim is to conduct a comprehensive examination of the financial risks that climate change poses, providing valuable insights for decision-making and strategic planning. The research design employs a structured approach encompassing quantitative analysis, time series assessments, scenario modelling, and spatial analyses, all tailored to effectively address the research objectives. Anticipated outcomes include quantifying climate-induced financial risks, identifying influential climate variables, and proposing potential adaptation strategies for the industry. The findings, once realized, are poised to directly inform policy development, benefiting policymakers, industry stakeholders, and local communities. This knowledge will support the creation of adaptive strategies and policies that enhance the sector's resilience in the face of climate change. Recognizing potential limitations and challenges, including data availability and quality, the validity of assumptions, and the inherent uncertainty in modelling future climate scenarios, this research proposal will evolve into a comprehensive research endeavor. Its overarching goal is to empower informed decisions that mitigate risks and foster the sustainability of Langkawi's fishing sector in an era of climate change. The insights and recommendations emerging from this study offer the potential to positively impact Langkawi's community while contributing to broader discussions on environmental and economic sustainability.

Keywords: Climate change, Financial Risk Assessment, Langkawi Malaysia, Environmental Finance, Sustainability Evaluation

Introduction

Climate change is recognized as one of the most critical environmental challenges facing the world today, with potentially significant economic, social, and environmental impacts (IPCC, 2021). Malaysia, like other countries, is particularly vulnerable to the impacts of climate change, with rising temperatures, changing rainfall patterns, and sea-level rise expected to have adverse consequences for various sectors, including agriculture, forestry, and fisheries (MOE, 2018). Langkawi, located in the northern region of Malaysia, is one of the country's

most prominent tourism and fishing hubs, with the industry playing a crucial role in the local economy (Abdullah et al., 2019). However, the fishing industry in Langkawi is facing a range of challenges, including overfishing, habitat degradation, and climate change impacts (Azraai et al., 2020). There is a pressing need to understand the financial risks associated with climate change in the fishing industry in Langkawi and to identify strategies to mitigate these risks. This research proposal aims to assess the financial risks associated with climate change in the fishing industry in Langkawi, Malaysia. The research will focus on the economic impacts of climate change on the fishing industry, including changes in fish stocks, fishing revenues, and production costs. The research will also explore potential adaptation and mitigation strategies that can help to reduce the financial risks associated with climate change in the fishing industry in Langkawi, Malaysia.

Problem Statement

The fishing industry in Langkawi, Malaysia, is a critical component of the local economy, providing livelihoods for thousands of people (Abdullah et al., 2019). However, the industry is facing significant challenges, including overfishing, habitat degradation, and the impacts of climate change (Azraai et al., 2020). Climate change is expected to have a range of adverse effects on the fishing industry, including changes in water temperature, ocean acidification, and sea-level rise, which can result in a decline in fish populations and changes in fishing grounds (IPCC, 2021). These impacts could have significant financial implications for the fishing industry in Langkawi, with potential consequences for the local economy and livelihoods. Despite the potential financial risks associated with climate change in the fishing industry in Langkawi, there is a lack of research on this issue. While some studies have examined the impacts of climate change on fisheries in Malaysia, few have focused specifically on Langkawi (Azraai et al., 2020). The research that has been conducted has tended to focus on the ecological impacts of climate change, rather than the financial risks associated with these impacts. This research proposal aims to fill this gap by assessing the financial risks associated with climate change in the fishing industry in Langkawi, Malaysia.

The proposed research will address the following research questions:

1. What are the financial risks associated with climate change in the fishing industry in Langkawi?
2. How are these risks affecting the financial performance of fishing companies in Langkawi?
3. What strategies can the fishing companies adopt to mitigate these risks?

The research will be conducted using a case study approach, focusing on a sample of fishing companies operating in Langkawi. The findings of this research will contribute to a better understanding of the financial risks associated with climate change in the fishing industry in Langkawi and will provide guidance for policymakers, industry stakeholders, and investors on developing strategies to mitigate these risks.

Expected Contribution

This proposed research is expected to make a significant contribution to the fishing industry in Langkawi, Malaysia in several ways: (1) Identifying Climate Change Risks: The research will provide an in-depth analysis of the specific climate change risks that the fishing industry in Langkawi faces. This can include threats such as changing sea temperatures, ocean acidification, extreme weather events, and shifts in marine ecosystems. By identifying these risks, the research can help stakeholders in the fishing industry better understand the

challenges they are likely to encounter in the future. (2) Quantifying Financial Impacts: By assessing the financial risks associated with climate change, the research can estimate the potential economic losses and costs that the fishing industry may incur. This information is crucial for decision-makers, including government agencies, local authorities, and fishing industry businesses, to develop strategies for risk mitigation and adaptation. (3) Sustainability Strategies: The research can offer insights into sustainable practices and strategies that the fishing industry in Langkawi can adopt to mitigate the adverse financial impacts of climate change. This may include recommendations for sustainable fishing practices, diversification of income sources, and investments in more resilient infrastructure. (4) Policy Recommendations: The research can provide a basis for policy recommendations aimed at safeguarding the fishing industry in Langkawi against climate change-related financial risks. This may involve proposing regulations, incentives, and support mechanisms to help the industry adapt to changing environmental conditions. (5) Community Resilience: Climate change impacts can have broader implications for local communities in Langkawi that rely on the fishing industry. The research can shed light on how these communities can build resilience and adapt to changing circumstances, potentially offering recommendations for community-based initiatives and support systems. (6) International Relevance: Given the global nature of climate change, the research in Langkawi can serve as a case study with implications beyond its specific location. It can contribute to a broader understanding of how climate change affects fishing industries in various regions and highlight commonalities and differences in the financial risks they face.

In summary, this research has the potential to be a valuable resource for the fishing industry in Langkawi, offering a comprehensive assessment of financial risks associated with climate change and providing guidance on how to adapt, mitigate losses, and promote sustainability in the face of these challenges.

Literature Review

Climate change is one of the most significant global challenges that the world is currently facing. It has the potential to cause widespread and severe impacts on various sectors of the economy, including the financial sector. This literature review section seeks to explore the relationship between financial risks and climate change by examining the existing literature on the subject.

The Intergovernmental Panel on Climate Change (IPCC) defines financial risks as "the potential for unanticipated financial losses arising from exposure to climate-related hazards" (IPCC, 2018). The IPCC further identifies two types of financial risks associated with climate change: physical risks and transition risks. Physical risks refer to the risks associated with the physical impacts of climate change, such as sea-level rise, extreme weather events, and other climate-related disasters. Transition risks, on the other hand, refer to the risks associated with the transition to a low-carbon economy, such as policy changes, technological advancements, and shifts in market preferences.

Climate change is a global phenomenon that has far-reaching consequences for the economy, environment, and society. In recent years, there has been an increasing recognition of the financial risks associated with climate change, particularly for vulnerable sectors such as fisheries (Dulal et al., 2019). Langkawi, a popular tourist destination located in northern Malaysia, is heavily reliant on its fishing industry, which contributes significantly to the local economy. However, the effects of climate change, including sea level rise, increased frequency of storms and typhoons, and ocean acidification, are threatening the sustainability

and profitability of the fishing industry in Langkawi. This research proposal seeks to assess the financial risks associated with climate change in Langkawi's fishing industry, to inform the development of effective adaptation and mitigation strategies.

The impacts of climate change on the fishing industry have been widely documented in the literature. The Food and Agriculture Organization (FAO, 2018) reports that fisheries and aquaculture are highly vulnerable to climate change, with potential consequences including changes in fish stock abundance and distribution, altered fish migration patterns, and reduced fish growth rates. These impacts can have significant economic implications, as the fishing industry supports millions of people globally, particularly in developing countries. For example, a study conducted in Ghana found that climate variability and change had a significant negative impact on the income and livelihoods of artisanal fishers (Kankam-Yeboah & Biney, 2020).

Numerous studies have examined the financial risks associated with climate change, particularly in the context of the financial sector. For example, a study by the Bank of England (2015) found that climate change posed significant risks to the stability of the financial system, including risks to insurance companies, banks, and pension funds. The study also highlighted the potential for stranded assets, as investments in high-carbon assets become stranded due to changes in policy and market preferences.

In addition to the risks posed to the financial sector, climate change also poses risks to individual businesses and industries. For example, a study by S&P Global Ratings (2019) found that climate change posed significant risks to the energy, transport, and agriculture sectors, as well as to coastal communities. The study highlighted the potential for physical risks, such as damage to infrastructure and property, as well as transition risks, such as changes in regulations and market demand.

The literature also suggests that the financial risks associated with climate change are not evenly distributed. Vulnerable populations, such as low-income communities and small businesses, are likely to be disproportionately impacted by climate change (IPCC, 2018). This is particularly true for developing countries, where limited resources and infrastructure can exacerbate the impacts of climate change. For example, a study by Kankam-Yeboah and Biney (2020) found that climate variability and change had a significant negative impact on the income and livelihoods of artisanal fishers in Ghana.

In the context of the financial risks associated with climate change, risk management has become increasingly important for the fishing industry. Dulal et al. (2019) conducted a review of the literature on financial risk management in the fishing industry and found that most studies focused on the use of insurance as a risk management tool. However, insurance may not be a viable option for small-scale fishers in developing countries, who often lack the financial resources to purchase insurance policies. Other risk management strategies, such as diversification of income sources and investment in more resilient fishing equipment, have been suggested as alternatives.

In terms of the specific case of Langkawi, there has been limited research on the financial risks associated with climate change in the fishing industry. However, the Government of Malaysia (2019) has acknowledged the vulnerability of the country's fisheries sector to climate change, particularly in the context of changing ocean currents and sea surface temperatures. A study conducted in the neighboring country of Indonesia found that small-scale fishers were experiencing negative impacts from climate change, including reduced fish catch and increased operating costs (Nurdin et al., 2021). It is likely that similar impacts are being felt in

Langkawi, given its geographical proximity to Indonesia and similar dependence on the fishing industry.

Overall, the literature suggests that the financial risks relationship with climate change in the fishing industry are significant and require urgent attention from policymakers and industry stakeholders. The case of Langkawi presents a particularly interesting and important case study, given its reliance on the fishing industry and exposure to climate change risks. By assessing the financial risks associated with climate change in Langkawi's fishing industry, this research proposal aims to contribute to the development of effective adaptation and mitigation strategies that can help protect the livelihoods of fishers and support the sustainability of the fishing industry in the face of a changing climate.

Methodology

To achieve a robust understanding of the financial risks stemming from climate change in the Langkawi fishing industry, a structured research design and data analysis process have been meticulously developed. This section provides a detailed account of the research design, data collection, preprocessing, analysis techniques, and the overall approach used to address the research objectives. The methodology's aim is to ensure the validity, reliability, and credibility of the research findings and to facilitate a comprehensive assessment of the financial implications of climate change in the context of Langkawi's fishing sector. Here is an explanation of the research design for this study:

Research Type

This research primarily employs quantitative methods to analyze and measure the financial risks associated with climate change. Quantitative research allows for the precise examination of relationships and statistical assessments of the data.

Research Approach

Cross-Sectional and Longitudinal Analysis: The research design includes both cross-sectional and longitudinal elements. It involves a cross-sectional analysis of current financial data and a longitudinal analysis of historical data to understand trends and patterns in the Langkawi fishing sector.

Sampling

Representative Sample: The study includes a representative sample of fishing industry stakeholders in Langkawi. This sample encompasses a variety of fishing activities, including small-scale and large-scale operations, to ensure a comprehensive assessment of the sector.

Variables

To achieve the objective of this proposed research, this research will consider the inclusion of several key variables. These variables, to be obtained from the sources mentioned, will be essential for assessing the financial risks associated with climate change in the Langkawi fishing sector and conducting the data analysis outlined in the methodology. The following table shows the list of important variables to be included in the proposed study their expected sources.

Table 1:*List of Variables, Definition and Expected Sources*

Variable	Potential Sources of Data
<p>Financial Variables:</p> <ul style="list-style-type: none"> a. Revenue: The income generated by the Langkawi fishing industry. b. Profit: The net profit after accounting for expenses. c. Operating Costs: The costs associated with fishing operations, including fuel, maintenance, and labour. d. Catch Data: The quantity and value of the fish caught. e. Price of Fish: The market price of fish in Langkawi. f. Revenue: The income generated by the Langkawi fishing industry. 	<p>Financial records and reports from local fishing businesses, industry associations, and government agencies responsible for fisheries.</p>
<p>Climate Variables:</p> <ul style="list-style-type: none"> a. Sea Temperature: The average sea temperature in Langkawi over a specific period. b. Precipitation: The amount of rainfall or precipitation in the region. c. Ocean Acidification: Measures of changes in ocean pH levels. d. Extreme Weather Events: Data on events such as typhoons, cyclones, or storms. e. Sea Level: Data on sea level changes and tidal patterns. 	<p>Meteorological agencies, environmental organizations, and scientific research on climate conditions in Langkawi.</p>
<p>Socio-economic Variables:</p> <ul style="list-style-type: none"> a. Population: The population of Langkawi and nearby communities. b. Market Demand: Consumer demand for fish and seafood products. c. Government Policies: Policies related to fishing regulations and climate change adaptation measures. d. Tourism Data: If relevant, data on tourism trends, as tourism can impact demand for fish. 	<p>Local government records, census data, market surveys, and industry reports.</p>
<p>Geographic Variables:</p> <ul style="list-style-type: none"> a. Location: Geographic coordinates or zones where fishing activities occur. 	<p>Geographic Information Systems (GIS) data, local authorities, and environmental agencies.</p>

- b. Coastline Changes: Data on changes in the Langkawi coastline due to sea-level rise and erosion.

Risk Metrics:

- a. Value at Risk (VaR): A measure of the potential financial loss under specified risk levels.
- b. Standard Deviation: A measure of the variability in financial performance.
- c. Financial Risk Index: A composite index quantifying financial risk based on various factors.

These metrics are typically calculated based on the financial and climate data collected, using statistical and financial risk modelling techniques.

Policy and Adaptation Measures:

- a. Climate Change Policies: Government policies and regulations related to climate change mitigation and adaptation.
- b. Industry Adaptation Strategies: Strategies adopted by the fishing industry to adapt to changing climate conditions.

Government publications, industry reports, and interviews with stakeholders.

Historical Data:

Time Series Data: Historical data on all the variables mentioned above, allowing for trend analysis and the assessment of changes over time.

Government archives, industry records, scientific studies, and historical climate data.

Data Collection

Multi-Source Data. As mentioned in the above section, data will be collected from various sources, including government agencies, environmental organizations, fishing industry records, and meteorological databases. This multi-source approach ensures a comprehensive dataset to address the research objectives.

Data Analysis

Data Cleaning and Transformation: Raw data will be subjected to thorough data cleaning to address missing values, outliers, and inconsistencies. Any data that cannot be rectified will be documented. Variables are transformed as needed to meet the assumptions of statistical analysis. Transformation methods, such as log transformations or normalization, will be applied to ensure data reliability.

Analysis Techniques:

Descriptive Analysis: Descriptive statistics, such as measures of central tendency and variability, are used to summarize the data. Visualizations like histograms and time series plots are employed to explore data patterns.

Time Series Analysis: Time series analysis helps detect trends, seasonality, and cyclic patterns in climate variables and financial indicators.

Correlation and Regression Analysis: Correlation coefficients are calculated to examine relationships between climate variables and financial outcomes. Multiple regression models are used to model the impact of climate change variables on financial performance.

Risk Assessment Models: Quantitative financial risk assessment models, such as Value at Risk (VaR) and other models, will be used to estimate potential financial losses under different climate change scenarios.

Scenario Analysis: Different climate change scenarios are considered, simulating various environmental conditions and their potential impact on the Langkawi fishing industry. These scenarios are based on established climate change projections.

Spatial Analysis: Geographic Information Systems (GIS) tools may be used to assess spatial variations in climate-induced financial risks within Langkawi, allowing for a spatial dimension to the research.

This research design incorporates a structured and systematic approach to examining climate-induced financial risks in the Langkawi fishing sector. By combining cross-sectional and longitudinal data, various analysis techniques, and multi-source data collection, the design aims to provide a comprehensive understanding of the challenges and opportunities facing the fishing industry in the context of climate change.

Potential Limitations

As we propose the research endeavor titled "Analyzing Climate-Induced Financial Risks in the Langkawi Fishing Sector," it's essential to anticipate potential limitations that may arise during the research process:

Data Availability and Quality: One of the primary challenges we may face is the availability and quality of historical and current data. Access to comprehensive and reliable climate and financial data, specific to the Langkawi fishing sector, could present limitations. It's essential to identify potential data sources and assess their data completeness and accuracy.

Assumption Validity: The proposed research will involve various assumptions, such as the stability of historical relationships between climate variables and financial indicators. The validity of these assumptions, especially in the context of changing climate patterns, is a potential limitation that requires careful consideration.

Modeling Uncertainty: We anticipate that the quantitative models used in the analysis might introduce uncertainty. These models are based on historical data and projected scenarios, and they may not perfectly reflect the actual future climate change impacts in Langkawi.

Generalizability: While the study aims to provide valuable insights for the Langkawi fishing sector, the extent to which these findings can be generalized to other regions with different ecological and economic contexts is a limitation. Each location has its unique set of circumstances that necessitates tailored assessments.

Behavioral and Socio-Economic Factors: Understanding the behavioral and socio-economic dimensions of the fishing industry is crucial for a comprehensive analysis of climate-induced

financial risks. Limitations may arise in capturing and analyzing these factors, as the proposed research primarily focuses on quantitative aspects.

Complexity of Climate Interactions: Climate-induced financial risks result from intricate interactions among a multitude of factors, and simplifications are necessary for analysis. These complexities may lead to the omission of nuanced factors, representing a potential limitation.

Future Climate Scenarios: The research relies on climate change projections for future scenarios. Uncertainty associated with these projections could affect the accuracy of the results. The study should acknowledge the potential variation in actual future climate change impacts.

While these potential limitations are recognized at the proposal stage, they will be addressed, and mitigating strategies will be put in place as part of the research design and methodology. Acknowledging these potential constraints helps in shaping the research approach to enhance the validity and reliability of the study's findings.

Conclusion

This proposed research seeks to investigate the impact of climate change on the financial well-being of the fishing industry in Langkawi. Although the research is yet to be conducted, the proposal outlines a critical avenue of study that holds immense promise. The motivation behind this research proposal stems from recognizing the profound influence of climate change on the Langkawi fishing sector. We believe that examining climate-induced financial risks can provide valuable insights for better decision-making and strategic planning. Our proposed research design entails a comprehensive and structured approach. It combines quantitative analysis, time series evaluation, scenario modeling, and spatial assessments to effectively address our research objectives. Although the research has not yet taken place, we expect to gain significant insights, including the quantification of financial risks associated with climate change, the identification of climate factors with the most substantial impact, and potential adaptation strategies for the fishing industry. The findings, once realized, are poised to have direct policy implications. Policymakers, industry stakeholders, and local communities can benefit from this knowledge to formulate adaptive strategies and policies that enhance the sector's resilience. As we transition from the proposal to the research phase, our objective remains clear: to contribute to the understanding of how climate change affects financial risk in Langkawi's fishing sector. We aim to create a foundation for well-informed decisions, enabling proactive measures to mitigate risks and foster the sector's sustainability amidst climate change.

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