

# Utilizing Forecasting Algorithms for Integrated Monitoring of Meteorological Patterns and Fisher Folks Locations

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## Abstract

Small-scale fisherfolk in the Philippines remain highly vulnerable to maritime hazards due to fragmented registration systems, limited vessel monitoring mechanisms, and the absence of localized predictive weather intelligence. This study proposes and evaluates an integrated monitoring framework implemented through the Fisherfolk Integrated System for Holistic Networking, Engagement, and Tracking (FISHNET). The system integrates automated fisherfolk registration, real-time Global Positioning System (GPS) vessel tracking, Short Message Service (SMS)-based alert dissemination, and a hybrid supervised machine learning and rule-based weather risk prediction model designed for low-resource coastal environments.

The forecasting component employs supervised linear regression trained on historical meteorological time-series data to generate hourly and weekly environmental trend estimates. These predictions are translated into operational safety categories (Safe, Caution, and Danger) and a quantitative hourly fishing suitability score ranging from 0 to 100 using a deterministic penalty-based scoring framework. The system further extracts optimal and high-risk sailing windows and generates automated, time-specific advisories to support proactive decision-making. Predictive outputs are synchronized with real-time spatial vessel data to enhance situational awareness and localized safety coordination.

The system was pilot-tested in Barangay Barra, Dipolog City, involving 30 purposively selected participants, including small-scale fisherfolk, local government personnel, and information technology experts. Evaluation results demonstrated high functional acceptance across usability, reliability, efficiency, and overall satisfaction dimensions (means ranging from 4.59 to 4.89 on a five-point scale). Spearman's rank correlation analysis revealed a strong positive relationship between system usability and user satisfaction ( $\rho = 0.7913$ ,  $p < 0.01$ ), indicating that intuitive system design significantly influences adoption.

Findings suggest that integrating supervised forecasting, structured risk classification, hourly suitability scoring, and automated advisory generation within a unified governance framework enhances maritime situational awareness and community-level disaster preparedness. The study contributes an explainable, resource-efficient predictive monitoring architecture tailored to vulnerable small-scale fisheries contexts.

**Keywords:** Small Scale Fisheries, Small Scale Fisherfolk, Maritime Safety, Forecasting Algorithms, Machine Learning, Machine Learning Forecasting, GPS Vessel Tracking, Early Warning Systems, Digital

Governance, Digital Fisheries Management, Coastal Resilience, Coastal Disaster Risk Reduction, Weather Risk Classification, Integrated Monitoring System

## 1. Introduction

The Philippines, an archipelagic nation composed of more than 7,600 islands, sustains one of the world's most productive marine ecosystems and supports millions of small-scale fisherfolk who contribute substantially to food security and coastal economies (FAO, 2020). Despite their economic importance, small-scale fishing communities remain highly vulnerable to maritime hazards, including sudden weather disturbances, typhoons, and increasingly unpredictable climate variability (Perez et al., 2019). These risks are intensified by limited access to localized predictive weather intelligence and insufficient vessel monitoring infrastructures.

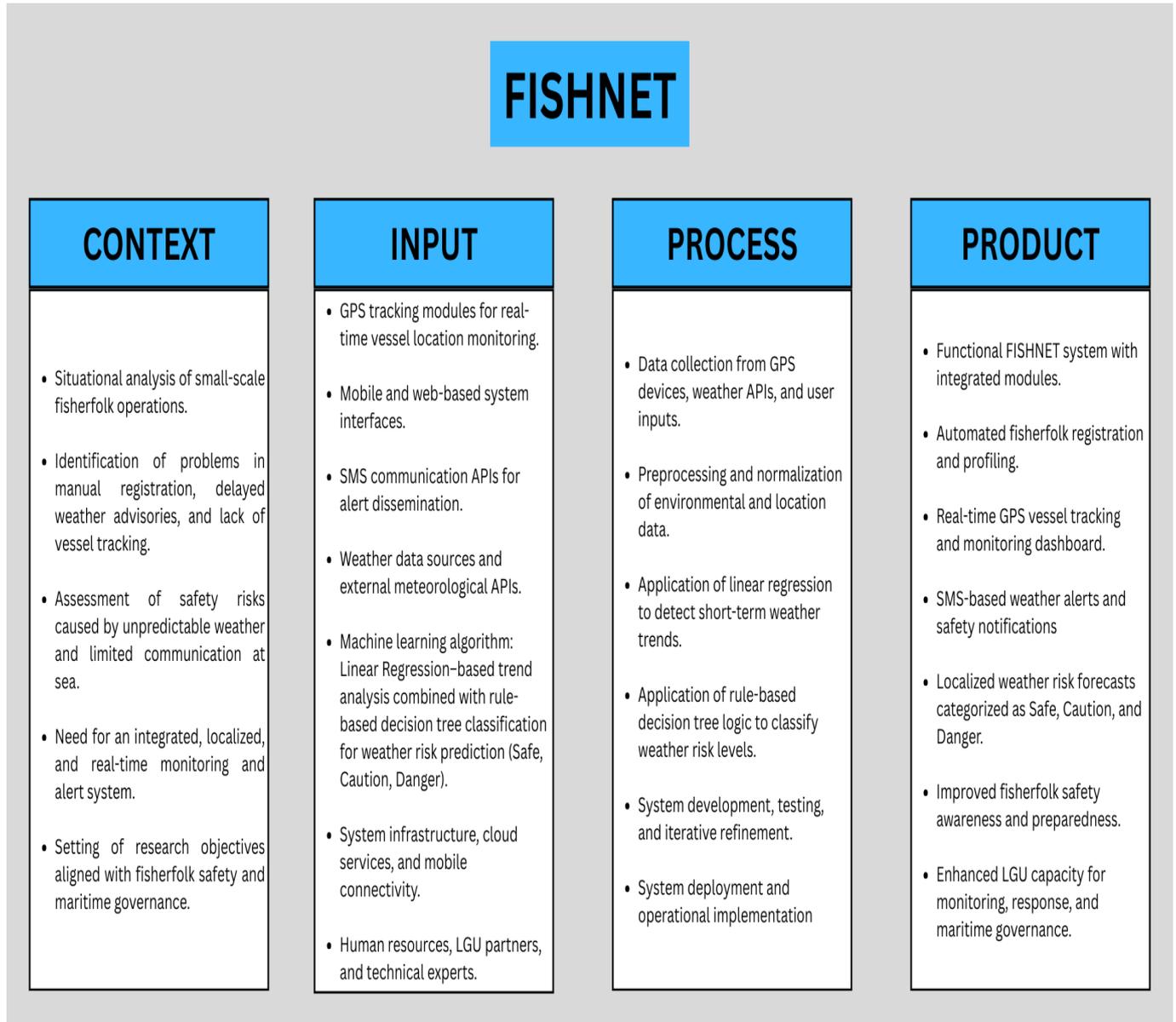
Existing governance mechanisms, including national fisherfolk registration systems and vessel monitoring programs, primarily serve administrative and regulatory functions and often operate independently of predictive environmental monitoring systems (BFAR, 2021). Weather advisories issued by national meteorological agencies are generally regional in scope and are not dynamically synchronized with the real-time spatial positions of fisherfolk at sea. Consequently, operational decisions are frequently reactive rather than predictive, limiting situational awareness and early intervention capabilities at the community level.

Recent developments in supervised learning–based forecasting demonstrate the potential to improve short-term environmental prediction. However, many forecasting architectures are computationally intensive, rely on opaque model structures, or are not designed for deployment in low-resource coastal environments. Moreover, limited research has examined the integration of explainable supervised forecasting models with real-time spatial vessel monitoring and time-specific decision support mechanisms within a unified governance framework tailored to small-scale fisheries.

There remains a gap in the development of resource-efficient, interpretable systems that not only forecast environmental conditions but also translate predictions into actionable hourly guidance for maritime activity. In particular, few studies have combined supervised meteorological trend modeling, structured safety classification, hourly suitability scoring, and automated recommendation generation within a single operational platform designed for community-level deployment.

To address this gap, this study proposes and evaluates the Fisherfolk Integrated System for Holistic Networking, Engagement, and Tracking (FISHNET), an integrated monitoring platform that combines automated fisherfolk registration, real-time GPS-based vessel tracking, SMS-based alert dissemination, and a hybrid supervised machine learning and rule-based weather risk prediction model. The forecasting component utilizes historical meteorological time-series data to estimate hourly and weekly environmental trends. These outputs are transformed into operational safety categories (Safe, Caution, and Danger) and quantitative hourly fishing suitability scores through deterministic decision logic. An automated recommendation module synthesizes trend direction, safety status, and environmental stability indicators to provide time-specific advisories regarding favorable and high-risk sailing windows.

By synchronizing predictive meteorological modeling with real-time spatial vessel monitoring and algorithm-driven advisory generation, the proposed framework enhances maritime situational awareness and supports proactive safety decision-making. This study contributes (1) an explainable hybrid supervised forecasting architecture optimized for low-resource coastal deployment, (2) an integrated suitability scoring and recommendation mechanism for time-specific maritime guidance, and (3) empirical evaluation of system usability and stakeholder acceptance within a pilot coastal community in Dipolog City, Philippines.



**Figure 3. The Schema of the Study using the CIPP model**

This study aims to develop and implement the FISHNET (Fisherfolk Integrated System for Holistic Networking, Engagement, and Tracking), a centralized digital platform designed to improve the safety, registration, monitoring, and weather risk forecasting of small-scale fisherfolk in Barangay Barra, Dipolog City, Zamboanga del Norte. The study addresses the persistent issues of low adoption of existing safety

technologies, unreliable access to localized weather alerts, and the absence of integrated tools suited for low-resource fishing communities. It was conducted during the academic year 2024–2025.

Specifically, this study sought to answer the following questions:

1. What is the current status of the fisherfolk registration and vessel profiling processes in Barangay Barra?
2. What are the functional requirements in developing a digital fisherfolk management system that integrates registration, GPS tracking, SMS alerts, and weather forecasting?
3. What machine learning model can be applied to generate localized weather risk forecasts categorized into Safe, Caution, and Danger zones?
4. What is the level of system efficiency, usability, functionality, and reliability of the FISHNET platform as evaluated by fisherfolk, LGU staff, and technical experts in Barangay Barra?
5. Is there a significant correlation between the system usability and user satisfaction scores across group of respondents?

This study holds essential value for maritime safety and digital transformation and community resilience especially for small-scale fisherfolk in Zamboanga del Norte coastal municipalities. The study develops FISHNET (Fisherfolk Integrated System for Holistic Networking, Engagement, and Tracking) to address persistent technological and governance deficiencies which lead to repeated fisherfolk loss at sea incidents. The research outcomes will benefit various groups starting from individual fisherfolk and their families through to local government units (LGUs) and regulatory bodies and academic institutions.

## 2. Literature Review

Small-scale fisherfolk remain among the most vulnerable occupational groups due to unpredictable weather conditions, limited access to real-time advisories, and weak maritime monitoring infrastructures (Pomeroy et al., 2010; White et al., 2020). In the Philippines, fisherfolk play a crucial role in food security and local economies, yet governance systems often rely on fragmented administrative tools that lack integrated safety and forecasting capabilities (FAO, 2020, 2021).

Digital registration platforms such as the National Program for Fisherfolk Registration (FishR) have improved administrative data management but remain limited in real-time monitoring and predictive functionality (BFAR, 2020, 2021). Studies have shown that centralized digital systems enhance governance efficiency and disaster response by improving data accuracy and coordination (De la Cruz et al., 2021; Dizon & Medina, 2019). Similarly, GPS-based vessel monitoring systems have demonstrated effectiveness in improving compliance and situational awareness in coastal communities (Santos & Guillermo, 2020).

SMS-based early warning systems have also been found to significantly improve safety communication in developing coastal regions when properly contextualized and supported by local institutions (Berdegué et al., 2019; Yusran et al., 2021). However, weather advisories at national levels are often too generalized to support localized fishing decisions (Santos & Nolasco, 2020). Recent advancements in machine learning have enabled more accurate and localized weather forecasting models. Research by Chen et al. (2018), Jiang et al. (2022), Ramos et al. (2022), and Zhang et al. (2019) demonstrates that predictive

algorithms can effectively classify environmental risks into simplified categories that enhance user comprehension and decision-making. The World Meteorological Organization (2017) further emphasizes that early warning systems must translate forecasts into actionable and understandable risk information to be effective.

Despite the documented benefits of digital registration systems, GPS monitoring, SMS alerts, and Hybrid Supervised Machine Learning and Rule-Based Weather Risk Prediction Model, existing implementations remain fragmented and rarely integrated into a single operational platform tailored for small-scale fisherfolk in localized Philippine contexts. There is limited empirical research demonstrating the combined application of forecasting algorithms and real-time spatial monitoring within a community-centered governance framework.

In response to these gaps, the present study proposes and evaluates the FISHNET system as an integrated digital platform that consolidates automated registration, GPS-based tracking, SMS alerts, and machine learning-driven weather risk classification into a unified monitoring framework designed specifically for small-scale fisherfolk in Barangay Barra, Dipolog City.

### 3. Methodology

The method used in this study was carefully selected to align with the nature, objectives, and practical implementation goals of the Fisherfolk Integrated System for Holistic Networking, Engagement, and Tracking (FISHNET) project. The study adopted a developmental research method, also known as project research, which is commonly used for designing, creating, testing, and refining technology-based systems. This approach is particularly appropriate for the present research, which focuses on developing an integrated digital registration and safety tracking system for small-scale fisherfolk communities in Barangay Barra, Dipolog City, Zamboanga del Norte. The research was conducted in Barangay Barra, a coastal community located in Dipolog City, Zamboanga del Norte, Philippines. As one of the barangays directly facing the Sulu Sea, Barangay Barra is home to a significant number of small-scale fisherfolk who rely on traditional fishing practices for their primary livelihood. This coastal barangay represents a vulnerable population segment that regularly contends with maritime hazards such as rough sea conditions, typhoons, and sudden weather changes, particularly during the monsoon seasons. This study utilized purposive sampling to select individuals who possess relevant knowledge or experience related to the development, deployment, and assessment of the FISHNET (Fisherfolk Integrated System for Holistic Networking, Engagement, and Tracking) platform. The selected participants were grouped into three categories: information technology (IT) experts, small-scale fisherfolk, and local government unit (LGU) staff from Barangay Barra, Dipolog City, Zamboanga del Norte. These respondent groups were intentionally chosen to provide technical, functional, and contextual validation of the system's features and overall effectiveness.

**Table 1. Distribution of Respondents**

Respondent Group	Number of Participants	%
IT Experts	10	33.3

Small-scale Fisherfolk	15	50
LGU Staff	5	16.7
<b>Total</b>	<b>30</b>	<b>100</b>

The primary research instrument for this study is the researcher’s developed questionnaire specifically designed to collect data for the development and evaluation of the FISHNET platform in Barangay Barra, Dipolog City. The questionnaire, administered to purposely selected fisherfolk, local government unit (LGU) staff, and information technology (IT) experts, contained three integrated sections. The first section elicited respondent’s demographic profiles, capturing age, stakeholder role, years of professional experience, and level of technological literacy to contextualize subsequent responses. The second section presented a system-evaluation checklist that employed a five-point Likert scale to measure four constructs for functionality, usability, reliability, and relevance through statements such as “The GPS tracking module works accurately,” “The system is easy to use even for those unfamiliar with technology,” “The system performs consistently without frequent issues,” and “The weather alerts are timely and location-specific.” The third section offered open-ended prompts to solicit qualitative feedback, enabling respondents to elaborate on their experiences, suggest enhancements, and raise concerns.

To establish content validity, the instrument was reviewed by a panel of IT and research specialists who evaluated the clarity, relevance, and comprehensiveness of each item. A pilot test was subsequently conducted among a small subset of intended respondents; insights from this trial informed minor wording adjustments that improved interpretability. Internal consistency reliability was examined using Cronbach’s alpha (Cronbach, 1951); all subscales registered coefficients of  $\alpha \geq .80$ , indicating satisfactory reliability and demonstrating that items within each construct measured a unified underlying dimension. Data derived from the finalized questionnaire served as the empirical basis for assessing the effectiveness, user acceptance, and perceived value of the FISHNET system during its pilot deployment.

To guide the interpretation of responses, the study used a weighted scoring framework, as presented in Table 2. This interpretative guide included five levels of satisfaction, each defined by a specific score range and corresponding qualitative description. A score within the range of 4.21 to 5.00 indicated that users were very satisfied, reflecting a perception that the system exceeded expectations in terms of usability, relevance, and impact. Scores between 3.41 and 4.20 were classified as satisfied, suggesting that the system adequately met user expectations and performed reliably. A score range of 2.61 to 3.40, labeled moderately satisfied, denoted acceptable but improvable performance. On the lower end, 1.81 to 2.60 indicated users were less satisfied, meaning the system required substantial enhancement. Finally, a score between 1.00 and 1.80, interpreted as not satisfied, suggested significant user dissatisfaction and likely the presence of major technical or usability issues.

**Table 2. Interpretative Guide for Overall Satisfaction with the FISHNET System**

Weight	Range	Description	Interpretation
5	4.21–5.00	Very Satisfied	Indicated that users were very satisfied, reflecting a perception that the system exceeded expectations in terms of usability, relevance, and impact.

4	3.41–4.20	Satisfied	Classified as satisfied, suggesting that the system adequately met user expectations and performed reliably.
3	2.61–3.40	Moderately Satisfied	Moderately satisfied, denoted acceptable but improvable performance.
2	1.81–2.60	Less Satisfied	Indicates users were less satisfied, meaning the system required substantial enhancement
1	1.00–1.80	Not Satisfied	Interpreted as not satisfied, suggested significant user dissatisfaction and likely the presence of major technical or usability issues.

**Table 3. Interpretative Guide for Efficiency of the FISHNET System**

Weight	Range	Description	Interpretation
5	4.21–5.00	Very Efficient	Indicated that users were very satisfied, reflecting a perception that the system exceeded expectations in terms of usability, relevance, and impact.
4	3.41–4.20	Efficient	Classified as satisfied, suggesting that the system adequately met user expectations and performed reliably.
3	2.61–3.40	Moderately Efficient	Moderately satisfied, denoted acceptable but improvable performance.
2	1.81–2.60	Less Efficient	Indicates users were less satisfied, meaning the system required substantial enhancement
1	1.00–1.80	Not Efficient	Interpreted as not satisfied, suggested significant user dissatisfaction and likely the presence of major technical or usability issues.

**Table 4. Interpretative Guide for Functionality of the FISHNET System**

Weight	Range	Description	Interpretation
5	4.21–5.00	Very Functional	Indicated that users were very satisfied, reflecting a perception that the system exceeded expectations in terms of usability, relevance, and impact.
4	3.41–4.20	Functional	Classified as satisfied, suggesting that the system adequately met user expectations and performed reliably.
3	2.61–3.40	Moderately Functional	Moderately satisfied, denoted acceptable but improvable performance.

2	1.81–2.60	Less Functional	Indicates users were less satisfied, meaning the system required substantial enhancement
1	1.00–1.80	Not Functional	Interpreted as not satisfied, suggested significant user dissatisfaction and likely the presence of major technical or usability issues.

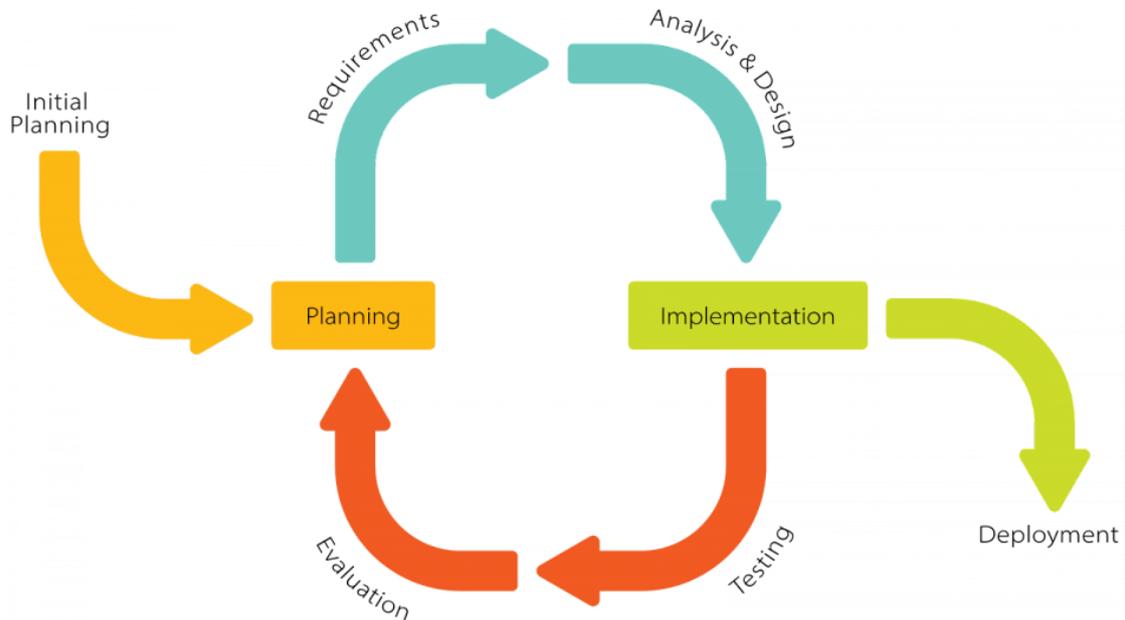
**Table 5. Interpretative Guide for Usability of the FISHNET System**

Weight	Range	Description	Interpretation
5	4.21–5.00	Very Usable	Indicated that users were very satisfied, reflecting a perception that the system exceeded expectations in terms of usability, relevance, and impact.
4	3.41–4.20	Usable	Classified as satisfied, suggesting that the system adequately met user expectations and performed reliably.
3	2.61–3.40	Moderately Usable	Moderately satisfied, denoted acceptable but improvable performance.
2	1.81–2.60	Less Usable	Indicates users were less satisfied, meaning the system required substantial enhancement
1	1.00–1.80	Not Usable	Interpreted as not satisfied, suggested significant user dissatisfaction and likely the presence of major technical or usability issues.

**Table 6. Interpretative Guide for Reliability of the FISHNET System**

Weight	Range	Description	Interpretation
5	4.21–5.00	Very Reliable	Indicated that users were very satisfied, reflecting a perception that the system exceeded expectations in terms of usability, relevance, and impact.
4	3.41–4.20	Reliable	Classified as satisfied, suggesting that the system adequately met user expectations and performed reliably.
3	2.61–3.40	Moderately Reliable	Moderately satisfied, denoted acceptable but improvable performance.
2	1.81–2.60	Less Reliable	Indicates users were less satisfied, meaning the system required substantial enhancement
1	1.00–1.80	Not Reliable	Interpreted as not satisfied, suggested significant user dissatisfaction and likely the presence of major technical or usability issues.

This study followed the Iterative System Development Life Cycle (SDLC) model which enabled systematic system development through multiple evaluation and improvement cycles. The iterative model progressed through each phase by adding new system capabilities which led to the development of the complete functional FISHNET platform. The system design adaptation process received emphasis through stakeholder feedback collection which ensured the system remained relevant and functional and user-friendly in coastal environments.



**Figure 5. Iterative System Development Life Cycle**

This study introduces a **Hybrid Supervised Machine Learning and Rule-Based Weather Risk Prediction Model** integrated within the FISHNET platform. The model employs a transparent and explainable forecasting framework specifically designed for low-resource coastal communities. By combining statistical trend analysis with deterministic rule-based classification, the system generates localized weather risk levels, fishing suitability scores, and structured safety status alerts without relying on complex black-box algorithms.

The model integrates real-time and historical meteorological data from the Open-Meteo API and evaluates short-term (hourly) and medium-term (daily) patterns relevant to fisherfolk safety.

### 1. Data Ingestion and Meteorological Variables

The model processes the following parameters:

- Temperature
- Wind speed and direction
- Precipitation probability
- Weather codes (WMO standard)
- Humidity
- Cloud cover
- Visibility
- Wave height, period, and direction

These variables serve as inputs for trend analysis, pattern detection, and rule-based classification.

## 2. Trend Detection Using Linear Regression

To identify short-term weather trends, the model calculates the slope of each parameter (temperature, wind speed, wave height) using linear regression:

$$\text{Slope (m)} = (n\sum xy - \sum x\sum y) / (n\sum x^2 - (\sum x)^2)$$

Trend interpretation follows:

- **Increasing:** slope > 0.1
- **Decreasing:** slope < -0.1
- **Stable:**  $-0.1 \leq \text{slope} \leq 0.1$

This enables the system to detect early signs of deteriorating or improving weather conditions.

## 3. Confidence Scoring

A confidence score is computed to reflect the reliability of each predicted trend:

$$\text{Confidence} = R^2 \times 100$$

Where  $R^2$  (coefficient of determination) is calculated as:

$$R^2 = 1 - (\text{SS}_{\text{residual}} / \text{SS}_{\text{total}})$$

$$\text{SS}_{\text{total}} = \sum (y - \bar{y})^2$$

$$\text{SS}_{\text{residual}} = \sum (y - \hat{y})^2$$

Interpretation:

- **High confidence (>70%)** – strong, consistent trend
- **Moderate confidence (50–70%)** – moderate variability
- **Low confidence (<50%)** – unstable or uncertain trend

The overall prediction confidence is the mean of temperature confidence, wind confidence, and weather stability.

## 4. Weather Stability Analysis

The model analyzes fluctuations in weather codes to determine atmospheric stability:

$$\text{Stability Score} = 100 - (\text{Change Frequency} \times 100 / \text{Total Days})$$

Classification:

- **Stable:**  $\geq 70\%$
- **Moderate:** 40–69%
- **Unstable:** < 40%

This helps detect volatile conditions typical of tropical coastal regions.

## 5. Seasonal Pattern Recognition

The model identifies seasonal patterns using temperature and rainfall frequency:

**Table 7. Seasonal Pattern**

Season	Rainy Days %	Characteristics
Dry	<30%	Stable weather conditions, favorable for fishing activities
Wet	>50%	High rainfall expected, increased wave activity, reduced fishing opportunities
Transition	30-50%	Variable conditions, moderate rainfall, mixed fishing opportunities

This helps contextualize risk levels during monsoon shifts.

### 6. Fishing Suitability Score (Penalty-Based Model)

FISHNET uses a deterministic scoring method to translate weather and marine conditions into a 0–100 fishing suitability score.

**Base Score: 100**

**Weather penalties:** (Thunderstorm, heavy rain, moderate rain, light rain)

**Wind penalties:** (based on thresholds >40 km/h, 25–40, etc.)

**Wave penalties:** (based on thresholds >2.5m, 1.5–2.5m, etc.)

**Fishing Suitability Score** =  $\max(0, \min(100, \text{Base Score} - \text{Total Penalties}))$

Classification:

- **Excellent:** 80–100
- **Good:** 60–79
- **Fair:** 40–59
- **Poor:** 0–39

### 7. Safety Status Classification (Rule-Based System)

The model assigns one of three safety levels:

**SAFE**

- Wind < 25 km/h
- Waves < 1.5 m
- Light rains or clear weather
- Visibility > 1 km

**CAUTION**

- Wind 25 - 40 km/h
- Waves 1.5 – 2.5 m
- Heavy or moderate rains
- Visibility 500 m - 1 km

**DANGER**

- Wind > 40 km/h
- Waves > 2.5 m
- Thunderstorms

- Visibility < 500 m

Final status is determined using a structured decision algorithm evaluating wind, waves, weather codes, and visibility.

## 8. Risk Assessment (Daily & Hourly)

The model produces:

- **Daily Risk Levels** (High, Medium, Low)
- **Hourly Risk Levels** (0–23 hours)

Risk = function of Fishing Suitability Score + trend direction + stability + seasonal context.

## 9. Peak Fishing Hours Extraction

The system identifies:

- **Best hours:** score  $\geq$  80
- **Good hours:** 60–79

These are displayed on the dashboard and used for SMS recommendations.

## 10. Extreme Weather Probability

Based on the frequency of hazardous conditions (thunderstorms, high winds, high waves), the model computes:

$$\text{Extreme Weather Probability} = (\text{Extreme Days} / \text{Total Days}) \times 100$$

Classified into:

- Low
- Medium
- High
- 

## 11. Recommendation Generation

Recommendations are automatically generated based on:

- Overall risk
- Best fishing hours
- Weather instability
- Safety status

Recommendations include warnings, advisories, and optimal fishing windows.

## 4. Results and Discussion

Survey results show that current fisherfolk registration and vessel monitoring practices in Barangay Barra are slow, fragmented, and prone to inaccuracies, with all indicators rated Strongly Agree and an overall mean of 4.65. Respondents emphasized the need for automated tracking, timely weather communication, and a centralized digital system, which received the highest level of agreement. The functional requirements assessment confirmed strong community support for the core modules of FISHNET, including automated registration, GPS tracking, SMS alerts, and weather risk assessment, with an overall mean of 4.78. The weather risk assessment feature received the highest rating, highlighting its importance in promoting safer fishing decisions. The Hybrid Supervised Machine Learning and Rule-Based Weather Risk Prediction Model was evaluated positively, with respondents affirming its clarity, accuracy, and

usefulness in supporting pre sailing decisions. The overall mean of 4.77 indicates strong trust in the Safe, Caution, and Danger risk categories and their relevance to local fishing conditions. Across all software quality dimensions’ functionality, reliability, efficiency, usability, and overall performance the system received consistently high Strongly Agree ratings, with overall means ranging from 4.59 to 4.89. Users expressed very high satisfaction, confirming that FISHNET effectively supports registration, monitoring, safety communication, and decision making processes. The correlation analysis revealed a strong positive relationship between system usability and user satisfaction with a Spearman coefficient of 0.7913. This indicates that improved usability significantly increases user satisfaction and reinforces the importance of intuitive design for long term adoption. These findings suggest that FISHNET demonstrates strong perceived usability and operational relevance that enhances fisherfolk safety, operational efficiency, and local maritime governance, with strong potential for wider implementation.

**Table 8. Evaluation of the Current Fisherfolk Registration, Monitoring, and Safety Practices (n = 30)**

Statement	Mean	Interpretation
1. The current fisherfolk registration process is slow and time consuming	4.57	Strongly Agree
2. Manual vessel monitoring is difficult and often inaccurate	4.57	Strongly Agree
3. Weather updates received by fisherfolk are often delayed or unclear	4.63	Strongly Agree
4. Safety protocols for fisherfolk are not consistently followed or communicated	4.70	Strongly Agree
5. There is a need for a centralized digital system to manage fisherfolk data and safety information	4.80	Strongly Agree
<b>Overall Mean</b>	<b>4.65</b>	<b>Strongly Agree</b>

**Table 9. Functional Requirements of the FISHNET System (n = 30)**

Statement	Mean	Interpretation
1. The fisherfolk registration module meets the community’s needs.	<b>4.63</b>	Strongly Agree
2. The GPS tracking module provides essential information for monitoring vessels.	<b>4.77</b>	Strongly Agree
3. The SMS alert system fulfills the need for timely safety communication.	<b>4.77</b>	Strongly Agree
4. The weather risk assessment feature is needed for safer fishing decisions.	<b>4.93</b>	Strongly Agree
5. The system aligns with the operational needs of fisherfolk and LGUs.	<b>4.80</b>	Strongly Agree
<b>Overall Mean</b>	<b>4.78</b>	<b>Strongly Agree</b>

**Table 10. Evaluation of the Hybrid Supervised Machine Learning and Rule-Based Weather Risk Prediction Model**

Statement	Mean	Interpretation
1. The weather risk predictions Safe, Caution, and Danger are understandable.	4.73	Strongly Agree
2. The system provides weather information that is relevant to local fishing conditions.	4.70	Strongly Agree
3. The weather predictions help reduce risk during fishing activities.	4.80	Strongly Agree
4. The system analyzes weather conditions accurately based on actual experiences.	4.83	Strongly Agree
5. The weather risk categories support better decision making before sailing.	4.77	Strongly Agree
<b>Overall Mean</b>	<b>4.77</b>	<b>Strongly Agree</b>

**Table 11. System Functionality Evaluation**

Statement	Mean	Interpretation
1. The system performs all intended functions effectively	<b>4.67</b>	Strongly Agree
2. The system ensures accurate data processing for registration, GPS tracking, and weather analysis	<b>4.63</b>	Strongly Agree
3. The system integrates all modules in a coordinated and efficient	<b>4.67</b>	Strongly Agree
4. The system supports the operational needs of fisherfolk and LGU staff	<b>4.63</b>	Strongly Agree
<b>Overall Mean</b>	<b>4.65</b>	<b>Strongly Agree</b>

**Table 12. System Reliability Evaluation**

Statement	Mean	Interpretation
1. The system operates consistently without unexpected errors	<b>4.70</b>	Strongly Agree
2. The system maintains stable performance even during repeated use	<b>4.63</b>	Strongly Agree
3. The system provides reliable outputs for registration, tracking, and alerts	<b>4.63</b>	Strongly Agree
4. The system performs as expected under normal fishing community conditions	<b>4.63</b>	Strongly Agree
<b>Overall Mean</b>	<b>4.65</b>	<b>Strongly Agree</b>

**Table 13. System Efficiency Evaluation**

Statement	Mean	Interpretation
1. The system responds quickly and processes tasks without delay	<b>4.67</b>	Strongly Agree
2. The system uses computing resources effectively	<b>4.63</b>	Strongly Agree
3. The system reduces time spent on manual tasks related to registration, monitoring, and communication	<b>4.63</b>	Strongly Agree
<b>Overall Mean</b>	<b>4.64</b>	<b>Strongly Agree</b>

**Table 14. System Usability Evaluation**

Statement	Mean	Interpretation
1. The interface is easy to understand and navigate	<b>4.70</b>	Strongly Agree
2. The system layout is organized and user friendly	<b>4.60</b>	Strongly Agree
3. Users can operate the system with minimal difficulty	<b>4.50</b>	Strongly Agree
4. Information is easy to retrieve and interpret	<b>4.57</b>	Strongly Agree
<b>Overall Mean</b>	<b>4.59</b>	<b>Strongly Agree</b>

**Table 17. System User Satisfaction Evaluation**

Statement	Mean	Interpretation
1. The system is easy to use regardless of digital literacy level.	4.80	Strongly Agree
2. Users can navigate the menus and features without difficulty.	4.77	Strongly Agree
3. Users can learn how to use the system quickly.	4.87	Strongly Agree
4. The system helps users accomplish tasks effectively.	4.87	Strongly Agree
5. Overall, I am satisfied with the FISHNET system.	4.90	Strongly Agree
<b>Overall Mean</b>	<b>4.89</b>	<b>Strongly Agree</b>

**Table 18. Overall System Performance Evaluation**

Statement	Mean	Interpretation
1. The system meets its intended purpose	<b>4.63</b>	Strongly Agree
2. The system enhances safety communication and monitoring	<b>4.63</b>	Strongly Agree
3. The system improves operational workflows for fisherfolk and LGUs	<b>4.67</b>	Strongly Agree
<b>Overall Mean</b>	<b>4.64</b>	<b>Strongly Agree</b>

**Table 19. Correlation Between Usability and Satisfaction Scores**

Variable Pair	Spearman's p	Interpretation
Usability Composite Mean and Satisfaction Mean	<b>0.7913</b>	Strong Positive Correlation

This study successfully developed and evaluated the FISHNET system, an integrated digital platform designed to enhance fisherfolk registration, vessel monitoring, safety communication, and localized weather risk forecasting in Barangay Barra, Dipolog City. The system was created to address inefficiencies in manual processes, delayed weather updates, and the absence of real time monitoring tools. The results revealed strong support for the system core features, including automated registration, GPS tracking, SMS alerts, and machine learning based weather risk classification. The platform received very high ratings for functionality, reliability, efficiency, and usability. A strong positive relationship between usability and user satisfaction was also identified, confirming that intuitive system design increases user acceptance.

Overall, the study demonstrates that FISHNET is a relevant, effective, and community centered technological solution with strong potential for long term implementation and wider adoption in coastal communities.

## 4.1 Findings

The study findings are systematically presented below and are organized to directly address the research questions and test the stated hypotheses.

1. The assessment of current practices revealed that existing fisherfolk registration and vessel monitoring processes are slow, fragmented, and prone to inaccuracies, highlighting the need for a centralized digital system.
2. Respondents strongly agreed that the core modules of FISHNET such as automated registration, GPS vessel tracking, SMS alerts, and weather risk assessment are essential for improving operations, preparedness, and safety oriented decision making.
3. The Hybrid Supervised Machine Learning and Rule-Based Weather Risk Prediction Model was perceived as clear, accurate, and helpful, with easy to understand risk categories that provide practical guidance for daily sailing decisions.
4. The system received very positive evaluations across software quality dimensions, being rated as highly functional, reliable, efficient, and easy to use by both fisherfolk and local government personnel.
5. A strong positive relationship was identified between system usability and user satisfaction, indicating that intuitive design significantly enhances overall user acceptance.
6. Overall, the findings confirm that FISHNET is a relevant, effective, and user centered digital solution with strong potential for wider adoption in coastal communities.

## 5. Conclusions and Recommendations

Based on the findings presented in the preceding sections, the study concludes that the FISHNET system is a highly functional, reliable, and user centered digital platform that effectively responds to the operational and safety needs of small scale fisherfolk in Barangay Barra, Dipolog City. The results confirmed that existing manual registration and vessel monitoring practices are inefficient and prone to inaccuracies, reinforcing the necessity of a centralized digital solution. The evaluation demonstrated strong support for the system core modules, including automated registration, GPS based vessel tracking, SMS safety communication, and localized weather risk forecasting. The integrated machine learning model was validated as clear, accurate, and useful in guiding pre sailing decisions. Across all software quality dimensions, the system received very high ratings, indicating strong user acceptance and readiness for sustained implementation. Furthermore, the strong positive correlation between usability and user satisfaction highlights the importance of intuitive interface design in promoting long term engagement and adoption. Overall, the study affirms that FISHNET is an effective technological intervention that enhances fisherfolk safety, improves operational efficiency, and strengthens local maritime governance, with strong potential for expansion to other coastal communities.

Based on the conclusions of the study, several recommendations are proposed to strengthen the effectiveness, sustainability, and long-term adoption of the FISHNET system while also identifying areas that require further exploration for future research:

1. The system interface should undergo continuous refinement by simplifying language options, incorporating more intuitive visual cues, and improving offline capabilities to support fisherfolk operating in low signal coastal environments. The responsiveness and accuracy of GPS tracking and SMS alerts should also be enhanced to ensure reliable performance during actual fishing operations.
2. The local government of Barangay Barra should consider expanding the implementation of FISHNET to neighboring coastal barangays to establish unified safety practices, strengthen regional monitoring, and improve coordinated emergency response. Collaboration with the Bureau of Fisheries and Aquatic Resources, the Philippine Coast Guard, and disaster risk reduction offices is also recommended to support data integration, regulatory enforcement, and broader institutional adoption.
3. Regular capacity building programs should be organized to improve the digital literacy of fisherfolk and enhance the technical capabilities of LGU staff, ensuring confident system use and minimizing barriers to technology adoption.
4. Future system upgrades should strengthen the machine learning component by incorporating additional environmental indicators such as rainfall intensity, sea surface temperature, wind direction shifts, and tidal behavior. Retraining the predictive model with more diverse and seasonal datasets will help maintain accuracy and relevance under changing climate conditions, and alternative predictive approaches may also be explored.
5. The system should include a digital zoning or boundary feature that clearly identifies designated fishing areas for small scale and large scale fishers to support regulation enforcement, promote equitable resource distribution, and prevent conflict in shared fishing zones.
6. The FISHNET system should integrate additional application programming interfaces to enhance real time data access and overall system accuracy. Incorporating reliable weather and maritime data sources will improve forecast timeliness and strengthen decision support for fisherfolk and local authorities.
7. The institutionalization of FISHNET through local ordinances, policies, and standard operating procedures is strongly encouraged to secure its long-term sustainability and integration into community governance. Regular system evaluations, user feedback collection, and periodic technical reviews should be conducted to support continuous improvement and assess its broader social and safety impact.

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